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Region**

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Final Environmental Impact Statement

Land and Resource Management Plan

Olympic National Forest

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE LAND AND RESOURCE MANAGEMENT PLAN

Olympic National Forest

Clallam, Grays Harbor, Jefferson and Mason Counties in Washington

July 1990

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ABSTRACT

This Final Environmental Impact Statement discloses the environmental consequences of six alternatives for managing the 632,324 acres of land administered by the Olympic National Forest. Each alternative responds differently to the issues and concerns identified.

- Alternative NC (No Change) continues management under the existing Timber Resource Plans, but without adjustment for requirements of the National Forest Management Act (NFMA) of 1976.

- Alternative A-Current Direction ("No Action") continues management of the Forest according to current plans and policies, with levels of outputs and activities updated to reflect current knowledge and compliance with Management Requirements of NFMA.

- Alternative B-Departure (Modified) responds to public input to the Draft EIS requesting a "community stability" alternative which provides 250 million board feet of timber outside of the Shelton Cooperative Sustained Yield Unit. This goal is met by departing from a nondeclining flow harvest schedule.

- Alternative C-Preferred (Modified) is the Preferred Alternative which emphasizes fish habitat protection, recreational opportunities, and production of wood. This alternative was modified from the Draft EIS, Alternative C, to respond to public comment on the Proposed Forest Plan.

- Alternative H (Modified) emphasizes protection of amenity values such as water quality, game, fish and wildlife habitats, dispersed recreation, and scenery.

- Alternative I emphasizes preservation of natural systems, fish and nongame habitats, old-growth stands, and watersheds.

OLYMPIC NATIONAL FOREST PLAN

FINAL ENVIRONMENTAL IMPACT STATEMENT

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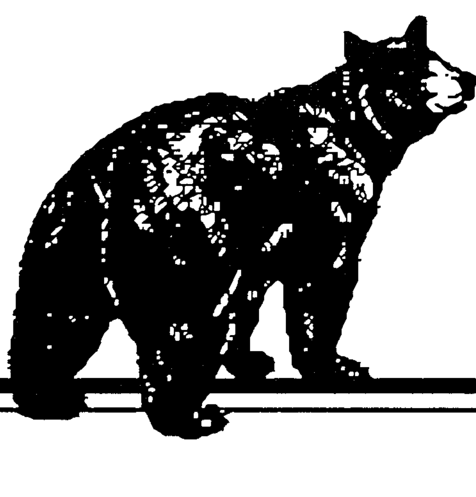


Olympic National Forest

Chapter I

PURPOSE AND NEED FOR ACTION

INTRODUCTION

The Olympic National Forest has proposed and analyzed several alternatives for managing the Forest's land and resources. This chapter presents the purpose of, and the need for, proposing these alternatives.

There is widespread public interest in the resources of the Olympic National Forest and diverse viewpoints on how these should be managed. The purpose of this analysis and disclosure is to examine the Forest resources and, in full awareness of these viewpoints, recommend a sound course of action to guide the future management of these resources, as well as display the associated environmental impacts. This Final Environmental Impact Statement (FEIS) describes a range of alternatives for future management of the Olympic National Forest and discloses the environmental consequences, including significant impacts of implementation. The management alternatives considered include a Preferred Alternative, i.e., the Proposed Action.

The alternatives describe various means of: (1) addressing local, Regional, and national public issues and management concerns; (2) providing for the use and protection of Forest resources; and (3) fulfilling national legislative requirements.

Each alternative was evaluated to determine its potential to provide a sustained yield of goods and services in a way that would meet multiple use objectives while best maximizing long-term net public benefits and being responsive to the Planning Problems. The "net public benefits" represents the cumulative net value of all Forest outputs and activities, whether assigned a dollar value or not. This is an overall goal, and its determination is dependent on the degree of resolution for each of the Planning Problems identified later in this chapter. For a full explanation of the analytic methods used in addressing this concept (net public benefits, present net value, and net subject value), see Appendix B. The Preferred Alternative is that alternative which, in the considered opinion of the Forest Service, would best meet these multiple-use objectives.

The Preferred Alternative is the basis for the accompanying Land and Resource Management Plan (LRMP, also called the Forest Plan), which is a separate document. The purpose of the Forest Plan is to guide future natural resource management activities on the Forest.

The preparation of this Environmental Impact Statement (EIS) that discloses the proposed action and accompanying alternatives is required by the National Environmental Policy Act of 1969 (NEPA), the Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1500 et. seq.), and the implementing regulations of the National Forest Management Act of 1976 (NFMA) (36 CFR 219). Preparation of the Forest Plan is required by the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA), as amended by NFMA and the associated National Forest System Land and Resource Management Planning Regulations (36 CFR 219). For purposes of disclosure under NEPA, this FEIS and accompanying Forest Plan are treated as combined documents.

This FEIS is also required since the approval of the Forest Plan is a major Federal action significantly affecting the quality of the human environment. The dual role of the FEIS is to provide decisionmakers with an environmental disclosure sufficiently detailed to aid in the selection of management direction for the Forest. It is equally important to display information on the alternative environmental impacts available to the interested public, and to encourage public participation in the development and refinement of that information.

The Record of Decision (ROD) accompanies this FEIS and Forest Plan. The ROD identifies the selected alternative that will be implemented and provides the rationale for the decision.

Due to the length and complexity of this FEIS, Appendices, and accompanying Forest Plan, reader aids are provided to help locate given subjects. The TABLE OF CONTENTS at the beginning of the FEIS lists the documents and their general content. The ACRONYMS and ABBREVIATIONS and GLOSSARY which define terms, units and abbreviations, and an INDEX to key subjects is located after the last chapter. A list of references cited in the FEIS is also provided (REFERENCES). For additional assistance, please contact the Forest Supervisor's Office. (Telephone numbers and addresses are on the ABSTRACT located inside the cover of this FEIS and Preface of the Forest Plan.)

CHANGES BETWEEN DRAFT AND FINAL

The Draft Environmental Impact Statement (DEIS) and proposed Land and Resource Management Plan for the Olympic National Forest were released to the public on November 28, 1986. On September 30, 1988, the Forest published a Supplement to the DEIS which contained a new alternative (Alternative NC - No Change) and an analysis of alternative ways of meeting the Management Requirements (MRs) found in the National Forest Management Act implementing regulations (36 CFR 219.27). Among the many changes that have occurred since the DEIS and Supplement were published are land exchanges, boundary changes with the Olympic National Park, and Forest lands transferred to the Quinault Indian Nation. Changes such as these which resulted in an adjusted Forest land base area obviously have great bearing on this FEIS. These changes have varying degrees of impact on alternative outputs and effects and are detailed at the beginning of each chapter and are also listed in the Summary of the FEIS.

For this chapter, it is important to note that three issues have been added for detailed consideration in the FEIS. These are: (1) American Indian concerns, values and treaty rights; (2) management of native plant species and communities; and (3) impacts on local communities.

The Final Supplement to the EIS for the Amendment to the Pacific Northwest Regional Guide (USDA FS 1988) that addresses spotted owl guidelines has been completed since the publication of the Olympic DEIS. The changes in direction have been incorporated in this FEIS resulting in changes in the Standards and Guidelines and the habitat network. Changes in the alternatives for this analysis are also displayed.

The FEIS for Managing Competing and Unwanted Vegetation (USDA FS 1988) was also released since the DEIS for the Olympic was released. The EIS assumes that all methods of managing vegetation are available and is consistent with the analysis in this FEIS and Forest Plan for the Olympic National Forest.

NATIONAL, REGIONAL, AND FOREST PLANNING

As required by RPA, NFMA, and the related implementing regulations cited above, the Forest Service uses a three-level, integrated planning process. At the national level, the RPA Program establishes long-range resource objectives that are based on the present and anticipated supply of, and demand for, various resources. Portions of each of the national resource objectives included in the RPA Program are distributed to each of the nine Forest Service Regions.

At the Regional level, a Regional Guide is developed. This guide distributes the Region's portion of RPA national objectives to each National Forest within the Region. The Regional Guide also establishes Regional management standards and guidelines. The Pacific Northwest Regional Guide (USDA FS 1984) provides this direction for the Olympic National Forest. Standards and guidelines for management of spotted owl habitat are established in the Final Supplement to the EIS for an Amendment to the Pacific Northwest Regional Guide (USDA FS 1988). The FEIS for Managing Competing and Unwanted Vegetation (USDA FS 1988) provides direction for vegetation management for the Pacific Northwest Region.

At the Forest level, a proposed Forest Plan is prepared. Ranges of different resource objectives form the basis for alternatives considered in the EIS for the Plan; one of these alternatives incorporates the tentative RPA Program resource objectives displayed in the Regional Guide. The Forest Plan includes direction provided by RPA, NFMA (including the implementing regulations) and the Regional Guide.

The planning process is a continuously repeating process. Information from the Forest level flows up to the national level, is incorporated into the RPA Program, and then flows back to the Forest level. The RPA Program and Regional Guide are updated every five years. The Forest Plan analysis considers a 150-year planning horizon to ensure that management plans can be implemented over the long term, and to disclose and evaluate long-term environmental consequences.

The Forest Plan is reviewed every five years and is ordinarily revised on a 10-year cycle or when changes in the RPA Program significantly affect forest programs. It must be revised at least every 15 years. It may also be revised whenever conditions or demands in the area covered by the Forest Plan change significantly. This process ensures that the Forest Plan is responsive to changing conditions. Revisions are not effective until considered in accordance with the requirements for the development and approval of a Forest Plan.

Management actions, outputs, and environmental effects for several decades beyond the Plan period are also discussed for the alternatives. The purpose of these discussions is two-fold: (1) to present to decisionmakers and the public a long-term analysis of the management necessary for each alternative to achieve and maintain in perpetuity, a high level of regular periodic outputs of various resources without impairment to the productivity of the land. This analysis also provides an estimate of the level of long-term outputs for each alternative, and (2) program development for RPA requires information for four decades beyond the Plan period. In order for the analysis of alternatives for an RPA program to link with actual conditions and local issues at the Forest level, a complete estimate of outputs, costs, and effects for the RPA time horizon is imperative.

The Planning steps leading to the development of the FEIS and Land and Resource Management Plan are:

1. Identification of issues, concerns, and opportunities.
2. Development of planning criteria.
3. Inventory data and information collection.
4. Analysis of the management situation.
5. Formulation of alternatives.
6. Estimated effects of alternatives.
7. Evaluation of alternatives.

8. Recommendation of the Preferred Alternative.
9. Plan implementation.
10. Monitoring and evaluation.

(Refer to Appendices A and B for a detailed description of the process used in Planning Steps 1 through 6.) "Planning Records," the documents and files which chronicle the first seven planning actions, are available for review at the Forest Supervisor's Office in Olympia, Washington. The planning records are referenced in the text and appendices of this FEIS and Forest Plan.

Government agencies and the public were consulted for comments on the DEIS, Supplement, and the proposed Forest Plan. Comments received have been used to evaluate the results of the first seven planning steps and modify, where necessary, the Preferred Alternative and Forest Plan. Appendix K describes the public involvement process between the DEIS, Supplement, and FEIS. It also displays the comments received and the Forest's response to those comments.

This FEIS will be used by the Regional Forester as the information base for a Record of Decision. The ROD will be made available to the public. Issuance of the ROD will complete Planning Step 8 and initiate the last two Planning Steps.

Upon implementation, the FEIS and Forest Plan will be used for "tiering" in accordance with the Council on Environmental Quality regulations. Tiering means that the environmental analyses conducted for site-specific projects and implemented under the direction of the Forest Plan will incorporate discussions by reference to the FEIS, Forest Plan, and associated documents. Information will be used from them to help narrow discussions and concentrate on issues pertinent to the project. This will help minimize repetition of information contained in documents having broader authority or coverage. Project scoping, public and other agency involvement, and the ensuing environmental analyses will then focus on issues unique to those projects and site conditions.

The Forest Plan supersedes all previous land and resource management plans prepared for the Olympic National Forest. Some implementation or action plans which currently are in effect will be revised to be consistent with the Plan; others may be consistent in their current form and will be maintained as they are. Refer to Table I-1 for a listing of the disposition of existing plans. Upon implementation, Forest management activities will comply with the Forest Plan. Appropriated budgets may alter the schedule of activities. In addition, all permits, contracts, and other instruments for the use and occupancy of National Forest System Lands and resource uses must be in conformance with the Forest Plan. Such documents shall be revised, where needed, as soon as practicable, subject to valid, existing rights. This updating will generally be done within three years.

Congressionally designated areas, such as the Forest Wilderness Areas, will be incorporated without change in the Forest Plan. The Forest planning process will be used to provide management direction for the five Wildernesses which will have separate implementation schedules.

Additional plans and/or management direction may be needed in the future to guide implementation of this Forest Plan. Should the need for these arise, they will be incorporated through revision or amendment as previously discussed. The Forest Supervisor may change implementation schedules to reflect differences between proposed annual budgets and appropriated funds by amendment (36 CFR 219.10(e)).

In addition to the glossary (defining terms and units), the list of acronyms, and the index, the reader will find it useful to consult the land management allocation maps for each alternative when reviewing this FEIS. The maps are in a separate envelope accompanying this FEIS.

Table I-1. Disposition of Existing Olympic National Forest Plans*

Plan Name	Maintain/Revise	Supercede
Soleduck Planning Unit		X
Quinault Planning Unit		X
Canal Front Planning Unit		X
Satsop Block Planning Unit		X
Timber Management Plan, Peninsula Working Circle		X
Timber Management Plan, Quinault Working Circle		X
Timber Resource Management Plan, Shelton CSYU		X
Plan Designating Types of Travel Permitted on Trails (1976)		X
Olympic Peninsula Off-Road Vehicle Comprehensive Study (1990)	X	
Lake Quinault South Shore Composite Plan	X	
Dead and Defective Tree Management Plan	X	
Olympic National Forest Road Management Plan	X	
1972 Fire Management Plan		X
Olympic National Forest Trail Plan	X	
Memoranda of Understanding - Fire	X	
Wishkah Watershed Memorandum of Understanding	X	
Quilcene Municipal Watershed Letter of Intent	X	
Landownership Adjustment Plan	X	
Grays Harbor Federal Sustained Yield Unit Policy	X	
Shelton Cooperative Sustained Yield Unit Agreement	X	
Memoranda of Understanding with Washington State Departments of Fisheries and Wildlife	X	
Olympic National Forest Tree Improvement Plan	X	
Statewide Comprehensive Wildlife and Fisheries Management Plan	X	
Approved Forest Species Management Guides	X	
High Lake and Stream Survey Report, Parts 1 and 2	X	
Columbia Basin Anadromous Fish Policy and Implementation Guide	X	

These plans are available for review at the Forest Supervisor's Headquarters, Olympia, WA.

OVERVIEW OF FOREST

THE PENINSULA

The Forest is located on the Olympic Peninsula in the northwest portion of Washington State. The Peninsula is a separate and unique geographical area surrounded on three sides by saltwater. U.S. Highway 101 is the main travel route paralleling the Pacific Coast on the west, Strait of Juan de Fuca on the north, and Hood Canal and the inland waters of Puget Sound on the east. This 6,500 square mile area is an association of complex winding ridges, rugged and steep mountains, deep canyons and tree-covered slopes. Because of the extremely rugged topography, there are no through routes crossing the center of the Peninsula. (Refer to Figure I-1 for a general vicinity map).

The first people who lived on the Olympic Peninsula were American Indians whose ancestors are believed to have migrated from Asia by way of Alaska. No one knows how long these Native Americans were present before European settlers arrived. Archaeological evidence suggests that occupation occurred with the retreat of continental glaciers some 12,000 to 13,000 years ago.

Explorers made contact with the coastal region about one century before the interior Olympic Mountains were investigated. The Press Expedition explored the mountainous core in the 1890's. After early explorations, the inland Peninsula saw little development. Almost all settlement on the Olympic Peninsula is peripheral to the Olympic Mountains and adjacent to saltwater. A major portion of the Peninsula's population is in the communities of Aberdeen, Hoquiam, Forks, Port Angeles, Sequim, Port Townsend and Shelton.

An incredible variety of environments occur within short distances on the Peninsula. Within less than fifty miles between the Pacific Ocean and Mt. Olympus, the vegetation changes from the lush, temperate rain forests of the Hoh, Queets, and Quinault River valleys, to an arctic environment of lichens and mosses. More than one hundred species of wildflowers have been identified on the National Forest alone; eight native only to the Olympic Mountains occur in the arctic Alpine Zone. The major commercial, wood-producing trees are Douglas-fir, western hemlock, western redcedar, and Pacific silver fir.

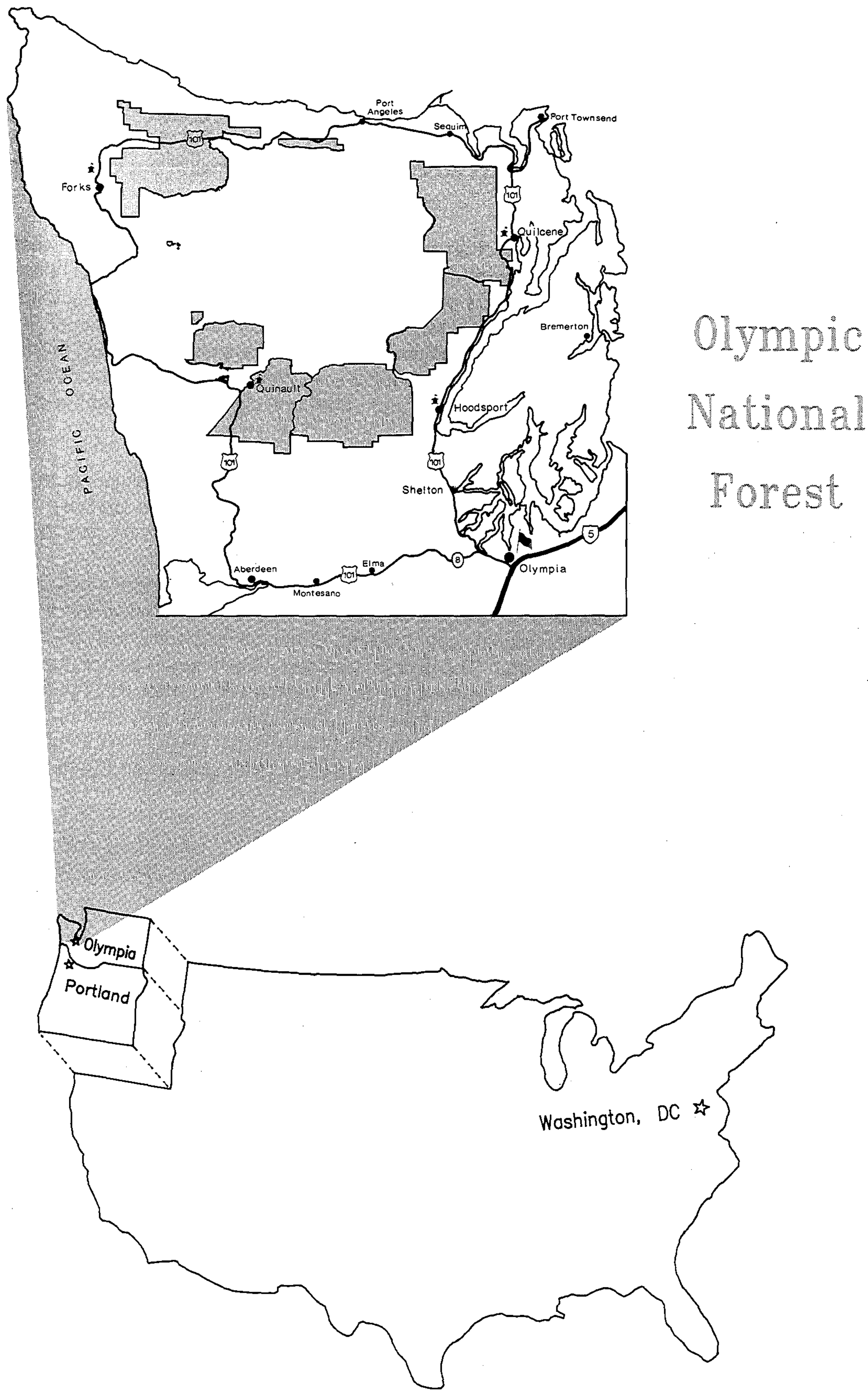


Figure I-1. VICINITY MAP

Precipitation is heavy in the fall and winter, reaching a peak in December and decreasing in spring. The driest area is the northeastern corner which receives less than 25 inches of precipitation a year. The wettest areas, with more than 220 inches annually, are on the windward side of Mount Olympus and in the upper Clearwater River drainage. Winter snowfall ranges from less than 10 inches in the lower valleys to greater than 250 inches in the higher mountains. Summers are relatively dry and mild with the warmest temperatures averaging near 75 degrees F. Winters are wet and mild with temperatures in the lowlands seldom dropping below 20 degrees F.

The Peninsula is generally thought of as an area characterized by steep, mountainous terrain dissected by large rivers that radiate from the center. Although this is an accurate description for much of the area, the south and west sides also have extensive areas of flat, gentle topography with rolling foothills. Soils have formed from a variety of geologic materials. In general, soils developed from marine basalt predominate in the south and east, while those derived from sedimentary deposits are most common in the south and west. Metamorphosed sediments and volcanics are found at higher elevations toward the interior. Soils derived from continental glacial drift are located at lower elevations along the northern and eastern flanks of the Olympic Mountains.

Many recreational opportunities exist throughout the year. Visitors and residents enjoy auto touring, camping, picnicking and backpacking, which are most popular during spring and summer. Fishing, hunting, berry picking and Christmas tree cutting are enjoyed during the fall and winter months.

The Peninsula's Roosevelt elk population is the largest of its kind. It is estimated there are between 5,000 and 7,000 elk in the herds on Federal land. With some individual animals often weighing more than 600 pounds, they are a major attraction for both viewing and hunting. Other common animals are the black-tailed deer, black bear, marmot and mountain goat. The goat is not a native Peninsula species, having been introduced in the 1920's. Less commonly seen animals are the mountain lion, bobcat, coyote, beaver, marten, otter, mink, raccoon and skunk.

There are over 250 species of birds common to the Olympic Peninsula. Both golden and bald eagles are frequently sighted, however, few nests have been located.

The many lakes, rivers and streams, including surrounding bodies of saltwater, offer outstanding fisheries. Anadromous fish include steelhead trout, Pacific salmon, and sea-run cutthroat trout. Resident fish include cutthroat, eastern brook, and rainbow trout, as well as Dolly Varden char.

THE FOREST

The Olympic National Forest was designated a Forest Reserve in February 1897. President Cleveland signed the proclamation which included 1,500,000 acres of public land on the Olympic Peninsula. On three separate occasions between 1897 and 1909, proclamations added to or eliminated land from the Reserve. In 1905, the name Olympic Forest Reserve was changed to Olympic National Forest. The core of the Olympic National Forest was proclaimed Mount Olympus National Monument by President Theodore Roosevelt in 1909. The Monument was transferred from the jurisdiction of the Forest Service, Department of Agriculture, to the Park Service, Department of the Interior in 1933 and became Olympic National Park in 1938. Since 1909, there have been several land transfers between the Forest and Park.

Lands administered by the Olympic National Forest now occupy approximately 632,300 acres in Clallam, Jefferson, Grays Harbor and Mason Counties. There are approximately 67,200 acres of private and other government-administered lands within the boundary of the Forest, mostly on the west side.

National Forest lands are administered under the direction of a Forest Supervisor headquartered in Olympia, Washington. The Supervisor is supported by a headquarters staff and personnel on four Ranger

Districts located in the Peninsula communities of Hoodsport, Quilcene, Forks, and on the south shore of Quinault Lake (see Figure I-2).

Principal forest resources include the vegetation (especially trees), water, wildlife, fish, recreation, and wilderness. These, as well as other resources and attributes, are described in much greater detail in Chapter III.

There are also about 250,000 acres of land owned by Simpson Timber Company that are directly affected by this Plan. Simpson's lands, and approximately 111,000 acres of National Forest land in the Hood Canal District, are managed as the Shelton Cooperative Sustained Yield Unit (Shelton CSYU). This relationship, and that of the Grays Harbor Federal Sustained Yield Unit (Grays Harbor FSYU), is explained in greater detail in Chapter III under the heading of "Sustained Yield Units."

OTHER LANDS

Other major landownerships on the Olympic Peninsula that have a bearing on the environment and the Forest include the Olympic National Park, the State of Washington Department of Natural Resources (DNR), several Indian Reservations, and private land (much of which is managed by large timber companies). Refer to Figure I-3 for the relationship of major ownerships.

Olympic National Park is the largest land manager with over 916,100 acres in the center of the Peninsula and in a narrow strip along the Pacific Ocean. Most of the major rivers on the Peninsula originate within the Park. No roads go through the Park, although there are several within the boundary. In November 1988, Congress created an 876,669-acre Olympic Wilderness in Olympic National Park. Within the Park's Wilderness, recreation opportunities are limited to those that are associated with the Primitive end of the Recreation Opportunity Spectrum ROS) (see Chapter III), such as hiking, backpacking, fishing, horseback riding and mountain climbing. Approximately 80 percent or over 701,000 acres of this Wilderness provides Primitive recreation opportunities, and the remaining 20 percent or over 173,000 acres provide Semi-Primitive Non-Motorized opportunities. Approximately three percent of the Park is outside wilderness and provides mostly Semi-Primitive Motorized and Roaded recreation opportunities. This portion of the Park provides opportunities that are common to the Roaded end of the Spectrum, such as auto camping, picnicking, boating, hiking nature trails, staying and eating at lodges, and viewing nature exhibits at visitor centers. The Olympic National Park recreation facilities consist of 600 miles of trail (mostly in Wilderness), 19 campgrounds, 9 picnic sites, 6 boating sites, 7 visitor centers or museums and 4 lodges or resorts.

The State of Washington DNR manages over 364,700 acres, mostly on the west side of the Peninsula. Timber production is the primary use and current plans call for extensive harvesting of overmature forest stands. Recreation opportunities provided by DNR are primarily at the Roaded end of the Spectrum. They include 9 campgrounds, 2 picnic sites, and 17 boating sites.

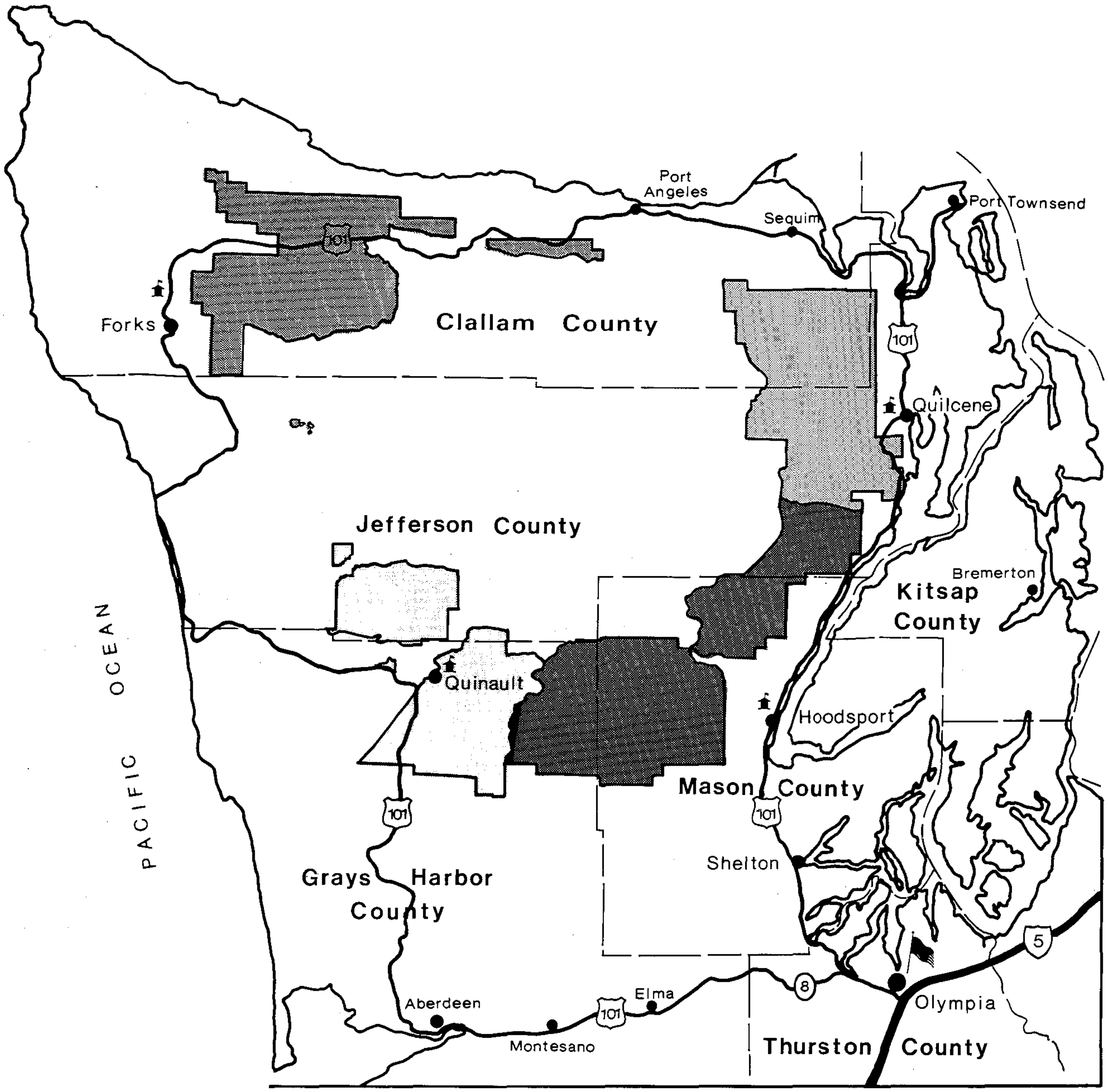
Washington State Parks provide opportunities primarily for developed recreation. There are a total of 18 State Parks on the Olympic Peninsula that provide for a combination of camping, picnicking and boating.

The various Indian Reservations include over 235,000 acres, with the Quinault, Makah and Skokomish being the largest. The major activity has been timber harvesting, but management emphasis is changing as the acreage of overmature forest declines and more of the management and planning responsibility is assumed by tribal agencies. Newer management plans call for less emphasis on the timber resource and more emphasis on traditional values. Special consideration will be given to multiple-use management, especially fish and wildlife, in association with timber commodity.

Various forest industry corporations manage approximately 915,000 acres (excluding Simpson's Shelton CSYU land) in the four-county Peninsula area. Again, the predominant use is timber production. Past activities have converted the area to young forests. Expectations are that these lands will continue to be managed primarily for the production of timber commodities.

There are also numerous landowners with smaller acreage within and adjacent to the Forest boundary. The trend over the last decade has been toward more subdivision of these and other holdings, and the subsequent construction of residences or other facilities, thereby reducing the acres being managed for forest products. This is particularly true on the east side of the Forest.

There are also several private recreation developments, primarily along State Highway 101, that provide a few additional facilities for developed camping, picnicking, and boating.



LEGEND

Hood Canal Ranger District

Quilcene Ranger District

Quinault Ranger District

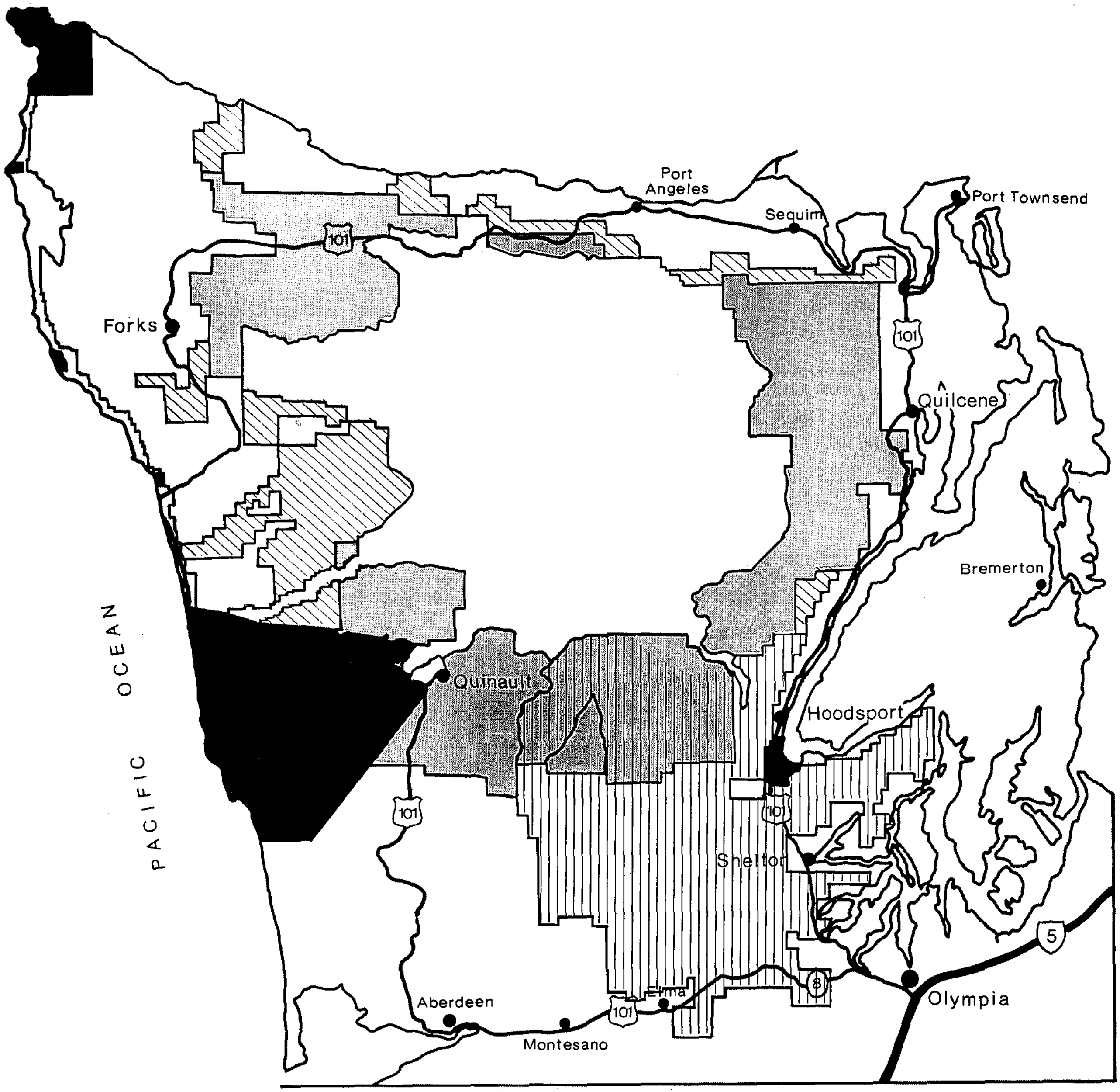
Soleduck Ranger District

Ranger Station

Supervisor's Office

County Line Boundaries

Figure I-2. RANGER DISTRICTS



LEGEND

Olympic National Forest	State of Washington
Shelton CSYU	Indian Reservation
Olympic National Park	Private Ownership

Figure I-3. LANDOWNERSHIP

ISSUES, CONCERNS, AND OPPORTUNITIES

The Olympic National Forest consists of complex natural systems that can be managed for different mixes of resource outputs, land uses, and environmental conditions. The public has differing views on how the Forest should be managed. Each viewpoint emphasizes a different combination of outputs, uses, and conditions. Because all the resources, uses, and conditions of a forest are ecologically and economically interrelated, a management emphasis for certain resource outputs will result in changes in other forest resources. These tradeoffs occur as a direct result of the implementation of management schemes which emphasize selected resource outputs, land uses, and environmental conditions at the expense of others. There are practical and natural limits to what a forest can provide.

The Issues, Concerns, and Opportunities (ICOs) are identified to provide the context for analyzing the Forest's potential to provide the various mixes of outputs, uses, and conditions that are encompassed by differing public views. A public "Issue" is a subject or question of widespread public interest relating to management of the National Forest resources. A management "Concern" is an issue, problem, or condition which constrains the range of management practices identified by the Forest Service in the planning process.

A third component influencing alternatives comes from the various resource use and development "Opportunities" suggested by both the public and Forest Service. These opportunities give rise to many of the issues and concerns identified here. The opportunities to preserve or develop and use the resources of the National Forest are the focus of many of the Agency's programs, and are the principal focus of the management alternatives developed here. Because there are both public issues and management concerns about these opportunities, most of them are incorporated within the discussion of issues and concerns.

The ICOs have changed somewhat with time. As new events occurred and local, regional, and national goals and policies changed, the ICOs were modified accordingly. This confirmation was essential in order to keep the lengthy planning process updated and the analysis tracking with current conditions and views. Additional information on how the ICOs were collected, evaluated, and selected for inclusion in the planning analysis is presented in Appendix A.

Identification of the ICOs has been a critical step in the planning process. This information has been collected and refined throughout the entire planning effort. The process was initiated in the fall of 1978 with preparation of a public involvement plan. Work began in earnest in December 1978 when the Citizens' Work Group convened to start the ICO process. This was followed by a news release announcing public meetings (workshops) relative to the planning process and identification of ICOs. Meetings were held in Aberdeen, Port Angeles, Shelton and Tacoma. Other meetings with landowners, county planners, and American Indian tribal organizations were also held.

A preliminary list of ICOs was developed from oral comments received at these meetings, as well as a review of comments received through the mail. Responses were further examined using a scoping procedure involving the Citizens' Work Group, Forest Planners and the District Rangers and Staff of the Olympic National Forest. Scoping is a procedure used by the Forest Service to determine the extent of analysis necessary to arrive at an informed decision on a proposed action. A series of Forest Plan Reports was then used to inform interested groups and individuals of the scoping process being used and the results of efforts being made. The Citizens' Work Group provided valuable assistance during that time.

On April 20, 1979, the major issues to be used in the planning process were published as Forest Plan Report No. 3 and sent to over 400 interested citizens, groups, organizations, county, State and Federal agencies, and Olympic Peninsula American Indian tribes.

Since that initial listing, the planning team has continued to keep the issues current. Through periodic meetings with groups and individuals, and as a result of changes in policy and procedures, some of the issues and concerns have been modified. The planning questions presented in this chapter are the latest version of the original issues and concerns identified. It is around these questions that the alternatives contained in the FEIS are designed and analyzed, and on this foundation that the preferred alternative is identified.

In March 1987 the ICOs for Forest Planning were ratified again through extensive public comment received after publication of the DEIS and proposed Forest Plan. The same process was repeated following publication of the Supplement to the DEIS in September 1988. The Forest received nearly 4,000 responses during these two public review periods. In addition, numerous meetings with interested agency officials, groups, and individuals have subsequently been held to clarify the ICOs.

As a result of public participation and comment, several issues or aspects of ICOs received fresh emphasis and three issues have been added to the list of thirteen key issues. Appendix K describes the public involvement process between the DEIS and FEIS. It also displays public comments received and Forest responses to the comments. In addition, Appendix K lists the names of those who commented; photocopies of letters received from elected officials, local, State, Federal agencies, and American Indian groups from around the Olympic Peninsula are also included.

PLANNING PROBLEMS

The central tasks in Forest planning are the development of alternative ways of managing the National Forest and the determination of the implications of these management alternatives for the Forest environment and its potential for supplying human needs. The differing emphases on goods, services, uses, and environmental conditions that various concerned communities, groups, and individuals desire, as well as the physical, biological, and legal limits of Forest management, are reflected in the ICOs that thread through the entire planning process. The ICOs have been analyzed and grouped or restated in the following Planning Problems (Planning Questions) and posed as questions that can be used to guide the development of alternatives. The alternatives are then evaluated to determine how well they respond to these Planning Problems in an attempt to resolve the conflicts and identify the best course for land and resource management.

Appendix A documents the development of the following Planning Problems from the ICOs. The resources that these questions address are more fully described in Chapter III.

This listing is not intended to indicate any priority for the Planning Problems.

1. ***How should the scenic resource of the Forest be managed?***

   The scenic quality of the Forest is important to both Forest visitors and the numerous residents of the greater Puget Sound area who view parts of the Forest from their homes. Both groups prefer to see natural-appearing landscapes when viewing the Forest, and are often dissatisfied when management activities are highly visible. In order to retain a landscape's scenic quality, it is necessary to place limitations on those management activities having the potential to detract from the natural appearance of the landscape. The principal activities are timber harvest and road construction. While the limitations on these activities needed to maintain scenic quality generally do not preclude the activity entirely, they can result in increased management costs and reductions in timber output.

   The major areas of concern are the views of the Forest from Highway 101, Quinault Lake, Lake Cushman, Hood Canal and other Puget Sound waterways, and several recreation routes accessing the Olympic National Forest and Park. It is within these view areas that tradeoffs between scenic quality and the costs and outputs of timber management must be considered.

All of the land on the Forest is assigned to one of five categories of Visual Quality Objectives: Preservation, Retention, Partial Retention, Modification, and Maximum Modification. These categories reflect the relative visual sensitivity of a given area, and are listed in decreasing order of the degree to which management activities may be evident to the viewer. The Wildernesses and Quinault Research Natural Area have the Preservation objective that allows for ecological changes only; this is met in all alternatives. Of the remaining four categories, Retention and Partial Retention are of the most concern. Meeting these objectives entails modifications in the location, timing, and scale of management activities that would not be necessary if scenic quality were not a concern. The Retention and Partial Retention objectives apply to lands which are visually sensitive.

The responsiveness of the alternatives to this problem can be quantitatively evaluated by considering the acreage to be managed to meet Preservation, Retention, and Partial Retention Visual Quality Objectives in each alternative.

Comments from the DEIS dealt essentially with aesthetic and economic concerns. Some responses supported protection of the Forest's scenic resources including a general disdain for clearcutting and road building that is visible from popular vistas and scenic trailways. This view was expressed primarily by urban residents in cities such as Bremerton, metropolitan Seattle, and other south Puget Sound cities between Seattle and Olympia. Other responses and concerns by many from the smaller communities around the Peninsula stressed the need to be more "realistic," and suggested urban residents must expect to view harvested areas as well as scenic corridors. There is a concern about the effect management for scenic qualities may have on timber harvest levels.

2. ***How should the outdoor recreation resource be managed?***

In 1986, the Forest provided 1,469,600 Recreation Visitor Days (RVDs) of recreation use to Forest visitors. Demand for Forest recreation opportunities is expected to grow in the future. The Forest has sufficient capacity to meet future demands for recreation in relatively developed settings (developed and undeveloped roaded recreation). Therefore, the main facet of the outdoor recreation issue is the availability of opportunities to recreate in an environment that is not noticeably altered by the sights and sounds of human activity. The recreation opportunities of most concern in this planning question are those associated with the Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized classes of the Recreation Opportunity Spectrum.

Many members of the public specifically desire these forms of recreation. In order to provide such opportunities in a given area, it is necessary to limit management activities to those which will not compromise the undeveloped nature of the area. Therefore, road construction and timber harvest are generally incompatible with Primitive and Semi-Primitive recreation. To the extent that areas are allocated to this use, the area available for timber harvest decreases.

The projected demand for Primitive and Semi-Primitive recreation exceeds the Forest's current ability to supply these experiences. In fact, the current use of these areas exceeds their theoretical capacity to provide "standard" quality Primitive and Semi-Primitive recreation experiences. This determination is based on the maximum number of encounters with other people considered to be consistent with the desired experience within the different Recreation Opportunity Spectrum classes.

The steep topography, dense vegetation, and difficult route finding usually associated with undeveloped unroaded areas limit the amount of use they can accommodate. This, in combination with the low number of human encounters consistent with the desired quality of experience, means that a relatively large acreage per RVD is needed to supply Primitive and Semi-Primitive opportunities.

Therefore, although there are substantial areas within Olympic National Park and in the Forest's five Wildernesses which provide these opportunities, the remaining undeveloped areas of the Forest are an important component in the overall supply of undeveloped unroaded recreation opportunity.

Two primary messages emerged from public responses. One being the desire to protect existing areas and/or expand the opportunities for recreation in the Primitive and Semi-Primitive setting on the Forest. The other viewpoint is that lands presently dedicated to this use on the Peninsula are already out of balance, and further allocations to Primitive and Semi-Primitive recreation would only add to this imbalance.

The responsiveness of the alternatives to this problem can be quantitatively evaluated by considering the acreage outside wilderness to be managed to retain Primitive and Semi-Primitive recreation opportunities in each alternative.

The management of the Forest's unroaded areas, closely related to this planning question, is discussed separately later in this section (refer to Planning Question #8).

3. ***How should the old-growth resource of the Forest be managed?***

Considerable interest was expressed regarding management of old-growth stands on the Forest. Old-growth forest has unique characteristics and frequently provides habitat for specific animal and plant communities. Management activities on timber-producing lands are generally designed to convert old-growth forest to managed forest over rotations shorter than required to restore old-growth characteristics. The issue is primarily concerned with the reduction of old-growth acreage; that is, how much and which existing old-growth will be harvested, and what amount will be retained over the next 10 to 15 years.

Interests cover a wide spectrum of concerns from both commodity and noncommodity forest users. To some, old-growth stands contain a large percentage of high quality, high volume raw material that should be harvested and replaced with new stands. Others stated they were opposed to harvesting old-growth and desired to maintain the forest in a near natural state. Several responses dealt with the relationship of old-growth to wildlife habitat and plant communities. Some individuals stressed the need to harvest old-growth to create more diverse habitat. Others indicated that harvesting was detrimental to plant communities and wildlife such as habitat for the northern spotted owl. Some comments focused on reducing the size of clearcut areas and still providing for natural plant communities and animal habitats.

A related interest is focused primarily on the west and north sides of the Forest, and concerns the Forest's ability to provide old-growth cedar and other specific wood products. This includes cedar shakes, shingles, clear veneer and planking for wooden boats. Concern was expressed that the availability of cedar products would decrease if these stands were harvested soon after maturity, thus affecting cedar mills and employment on the Peninsula that are dependent on old-growth.

Other facets of the issue include the need for gene pool and ecosystem diversity and the cultural and religious significance of old-growth (especially cedar) to American Indians. Traditionally, the cedar tree has many uses and is of importance culturally and spiritually to the tribes (also, refer to Planning Question No. 13).

Interest in this issue appeared to be Forest-wide, but most concerns dealt with the Eastside, including the Shelton CSYU. It was clearly stated by those responding that how much, what kind, and where old-growth is harvested may affect the economic well-being of some and environmental concerns of others.

The Forest inventory (updated to 1989) identifies 267,000 acres of old-growth currently existing on the Forest; approximately 109,000 acres are in areas dedicated to management that will preserve the old-growth condition (i.e., Wilderness, Research Natural Areas, and Spotted Owl Habitat Areas). The alternatives vary by the amount of additional old-growth included in land allocations that would retain the old-growth character, and by the rate of harvest of those acres that would be available for timber management.

4. ***Where should timber be harvested and what is the appropriate harvest level?***

Timber harvest provides a wide range of goods and benefits which are realized in the broader economy rather than within the Forest itself. Logs removed from the Forest provide the raw material for production of lumber, paper products, and other consumer goods. Associated with the harvest of timber and the processing of logs are social and economic benefits: employment and income for those involved in the timber industry (either directly or indirectly), and revenues for county governments and the National Treasury. The higher the harvest level, the greater the output of consumer goods and the level of associated social and economic benefits. Many members of the public, particularly those whose employment and/or income are closely tied to timber harvest, feel that the Forest's timber resource should be managed to provide these goods and benefits. Others feel that the costs of timber harvest, in terms of the tradeoff of other resource outputs it entails, are too great.

Perhaps more than any other issue, the timber issue affects and is affected by the resolution of other resource issues. Sometimes this relationship is complementary, and sometimes competitive. For example, timber harvesting may enhance deer habitat (through forage production in clearcuts), but reduces the amount of wildlife habitat available for species dependent on mature conifer forest. The most significant effect of other resources on timber is the allocation of land to uses that preclude or limit timber management. Managing for fish habitat, older forest wildlife habitat, soil protection, water quality, wilderness, unroaded recreation, undeveloped areas, and Research Natural Areas all reduce the number of acres available for harvest and/or the intensity of timber management which may be applied.

On the other hand, timber harvesting reduces the amount of habitat available for wildlife dependent on older forest conditions, eliminates unroaded undeveloped recreation opportunities and undeveloped areas, increases sedimentation, and can affect scenic quality. It is these tradeoffs in other resource outputs that make the timber harvest level an important planning issue.

An important aspect of the overall timber harvest question is the management to be applied in areas in which timber production is likely to contribute less to overall present net value than emphasis on other resource outputs.

The Forest has identified four different kinds of areas in which management of the timber resource may involve management costs in excess of returns and/or a smaller contribution to present net value than would production of outputs dependent on the exclusion of harvest. These include:

- Excessively overstocked, stagnated stands (doghair) on the east side of the Forest.

- Areas in which road construction would be physically impossible, environmentally unacceptable, or more costly overall than use of aerial yarding systems. Such areas require a helicopter or similar system for removing logs.

- Areas in which access by roads is more cost-effective than harvest by helicopter, but where road construction costs exceed the value of the timber accessed.

- Areas in which the collective value of resources other than timber exceeds the stumpage value of the timber that would be produced if the area were harvested.

The principal question with regard to these areas is whether they should be included in the timber harvest base. Doing so increases employment opportunity and provides an additional flow of raw material into the Peninsula timber economy. However, it also results in reduced present net value, a lower net flow of revenue to the U.S. Treasury, and lower outputs of some nontimber resources.

Many individuals and groups feel that the Forest should help sustain regional and local economies by maintaining or increasing annual timber harvests. Along with this they feel that the land base available for commercial timber production should be conserved and not allocated to competing uses, and that intensive timber management practices should be applied on these lands to maximize timber yields. On the other hand, there is concern about the effects of timber management on other resources, such as plant, animal, fisheries, and water quality. Concerns are also expressed by those who commented on the DEIS about our ability to provide for biological diversity and maintain species richness and distribution over time and space. Some focus is on reforestation success, growth and yield potential, and sustaining harvest levels in the future. Many feel that the amount of timber harvest should be reduced to benefit wildlife and recreation resources, and to preserve natural ecosystems.

The expectations of timber interests nationally, regionally, and locally are that the Forest should continue to supply a significant volume of timber. Historically, the Forest has had an allowable sale quantity as high as 370.9 million board feet (MMBF) of timber annually from National Forest land. The current allowable sale quantity, based on existing timber management plans, is 330.5 MMBF from National Forest land. These plans include an additional 111.3 MMBF from Simpson Timber Company land within the Shelton CSYU, for a total annual harvest of 441.8 MMBF from the combined ownerships. Recent analysis of resource potentials, including habitat needed for spotted owls, indicates a maximum annual harvest level of 380.3 MMBF (76.5 million cubic feet) from the combined ownerships. This is the maximum first-decade harvest that is compatible with maintaining a nondeclining flow harvest schedule. It includes substantial reduction in National Forest harvest (down to 223.2 MMBF) and increased emphasis on harvest from Simpson land (157.1 MMBF). These determinations indicate that the timber supply potential of the Forest is lower than past projections (i.e., timber management plans) have indicated.

Some of those who commented on the DEIS believe that the Forest should utilize a variety of technical applications to increase yield. These include technical applications such as adjustments to the yield tables, changes in the board-foot/cubic-foot conversion ratio, utilizing shorter rotations, applying fertilizer to plantations, and selecting other programs or models to predict yields.

This problem also encompasses the question of whether the Forest should harvest timber on a nondeclining flow schedule, or harvest at a higher level in the near future and plan for a decline in harvest volume in future decades. Departing from nondeclining flow could help sustain local economies by supplying a higher level of National Forest timber during a period when harvests from private lands are expected to be at low levels. Opponents to departure claim that this only shifts the burden of an inevitable decline to the future and increases the risk of adverse environmental impacts by harvesting at the higher level.

Another element in this Planning Problem includes the cost, hazards, utilization factors, and environmental impacts of treating residues created by timber harvest or stand conversion. Limits are needed for acceptable risks associated with residue treatments. Better utilization, for firewood and other forms of energy, could aid in reducing the amount requiring disposal. Disposal activities often involve the application of prescribed fire which can affect air, water quality and soil productivity.

This Planning Problem involves allocation of Forest land to timber production and the selection of management intensities, including harvest schedules and treatments such as commercial thinning and site preparation. Potential timber production of lands allocated to other purposes must also be considered. Factors that vary by alternative include the number of acres selected for timber harvest (selected suitable), long-term sustained yield capacity (LTSYC), allowable sale quantity (ASQ), and the number of acres on extended rotation lengths or reduced yields.

The responsiveness of the alternatives to this problem can be quantitatively evaluated by considering the harvest level of each alternative and the changes in employment and income associated with each alternative (roughly 90 percent of these changes result from variations in timber harvest level).

5. ***How should the existing transportation system be managed and where should new roads and trails be constructed?***

The development and management of the Forest's transportation system is a concern to those who responded to the DEIS. There is a wide range of opinion as to how this system should be managed to best serve recreational needs and resource management objectives. Many people feel that roads should be developed and maintained to provide a high level of access to the entire Forest. Others feel that the road system is already overdeveloped, and that road closures and road obliteration should be used to reduce or eliminate some of the environmental effects associated with roads and road use.

Facets of the issue that contribute to its importance include conflicts associated with various recreation uses (roaded vs. unroaded, motorized vs. nonmotorized), wildlife disturbance (particularly in winter range, where roads may contribute to poaching and general harassment of animals), the effect of road cutslopes on scenic quality, and water quality. It is estimated that 85 percent of activity-generated sediment on the Forest is associated with existing roads and their use.

The Forest has over 200 miles of trail providing access to a variety of undeveloped recreation areas. About half of these trails are outside of the Wildernesses. The Forest has currently identified another 331 miles for possible trail construction. Many of the trails traverse areas being managed for timber. A focus on this issue is the environment through which existing and planned future trails will pass.

Roads and trails serve a vital function in the management and use of the Forest. They provide access to major recreation destinations, such as campgrounds, and offer the opportunity for sight-seeing trips. They also provide a means of ready access for fire suppression, search and rescue operations, and Forest management activities.

Respondents to the DEIS expressed a concern about the effects roads in steep areas have on soil stability and siltation of streams and rivers. Some comments indicated opposition to substantial increases in the road system on the Forest, especially into the existing unroaded areas. Most supported closure of roads no longer needed to manage the Forest; an example being closures for the protection of wildlife. Respondents identifying themselves as hikers, horsemen, and nonmotorized users of trails were strongly against the off-road use of motorized vehicles on the Forest.

The responsiveness of the alternatives to this problem (the road management aspect, in particular) can be quantitatively evaluated by considering the road mileage projected to be open to public use in the fifth decade in each alternative.

6. ***How should the soil and water resources (including riparian areas, hydropower potential, and municipal watersheds) be managed?***

Maintaining water quality at a level suitable for domestic use is an important concern to the many residents and municipalities dependent upon water from the Forest's watersheds. Water quality is also critical to the maintenance of fish habitat, both in Forest streams and in downstream drainages and estuaries. Water quality on the Forest is influenced primarily by sediment entering the streams. The principal source of nonnatural sediment on the Forest is the road construction and use associated with timber harvest. Therefore, there is a close correlation between timber harvest level and degree of sedimentation. Managing for reduced sediment levels could necessitate reductions in timber harvest.

Management of vegetation within riparian zones has become a concern to many people. Riparian vegetation, particularly large trees, is now recognized as an important component of fish habitat. It provides a continued source of large woody debris which, when it falls into streams, creates rearing habitat. Riparian areas also play an important role in providing wildlife habitat. Conflicts in resource management frequently arise because maintenance of riparian area vegetation contributes to the quality of fish and wildlife habitat, while riparian areas are also among the Forest's most productive timberlands.

The hydropower facet of this issue is relatively new compared to the others, surfacing during the energy "crisis" in the early 1980's. It is primarily associated with new technology that resulted in lower development costs and new legislation that provided incentives to develop hydropower resources. The major concerns are associated with construction of dams and other instream obstructions that preclude or restrict movement of fish, especially anadromous species.

Responses to the DEIS concerning the Forest water resource principally addressed the effects of soil erosion resulting from timber harvesting and roads and the effects on water quality. Respondents expressed the view that clean, high-quality water was a primary value of the Forest and sedimentation should be kept at minimum levels. Protection of the soil from the effects of erosion was also strongly advocated. Concern for soil protection was mentioned because of its potentially degrading effects on water quality and fisheries habitat. Finally, concern was expressed over the "cumulative effects" of management activities on the Forest soil and water resources.

The responsiveness of the alternatives to the water quality aspects of this problem can be quantitatively evaluated by considering the sediment output level associated with each alternative. Also, the application of site-specific practices or Best Management Practices, including feedback monitoring, provides the mechanism for ensuring the Forest meets State water quality standards.

The management of fish habitat, closely related to this planning problem, is discussed as an aspect of a different issue (refer to Planning Question #7).

7. ***How should fish and wildlife habitat be managed?***

Public resource management agencies, the commercial fishing industry, American Indian tribes, and the general public have a strong interest in maintenance of productive fish habitat in rivers and streams, both on and off the Forest. Demand for both commercial and sport fishing continues to increase. American Indian tribal members and organizations and several coastal communities are dependent on commercial and sport fisheries for economic stability.

The controversy in the wildlife question is not found in the desirability of maintaining diverse and healthy populations, but in the management actions needed to accomplish this objective. Many people responding to the DEIS are concerned about vegetation-altering activities, such as timber harvest, which change the character of the habitat and its ability to provide for various species. Activities are often beneficial for some species and detrimental for others. Populations, such as big game, benefit from increased forage produced in harvest units, while populations of species dependent on mature or old-growth forest may decline. Cavity-nesting species are also impacted by removal of snags and hollow trees. There is a divergence of opinion as to the appropriate balance of habitats that should be maintained, and the acceptable level of effect on timber production resulting from wildlife management prescriptions.

Poor timber harvest practices can adversely affect fish habitat. The productivity of fish habitat can be reduced by excessive amounts of sediment entering the stream system and filling pools or silting spawning beds. The road construction, reconstruction, and use associated with timber harvest are the primary sources of sediment above natural levels in Forest streams. Sediment output levels can be limited through the application of appropriate standards governing road development and timber harvest activities. Use of such standards is called for in all alternatives.

Many segments of the public are also interested in the maintenance of habitat for wildlife. Concerns range from growing demands to maintain or increase game populations for hunting to the desire that no additional wildlife species become threatened or endangered. Many members of the public gain satisfaction from wildlife by "just knowing it's there." The habitat needs of wildlife vary greatly. Species such as spotted owls require habitat provided by old-growth forests. Species such as deer require open areas (timber clearcut units and natural meadows) to obtain needed forage. There is no one habitat condition that can be said to be "ideal" for wildlife.

While the habitat needs of individual wildlife species differ, it is generally true that the older forest habitat component (old-growth in particular) is the most likely to be in short supply in the future, given the present mix of age classes on the Forest and assuming continuation of timber harvest. This age group contains most of the Forest's harvestable timber. Therefore, to the extent that this habitat component is retained, the volume of timber available for harvest will be reduced.

Resolution of this fish and wildlife problem involves a mix of land allocation, capital investments, and application of Standards and Guidelines. Allocations to different Riparian Management prescriptions, and the allocation of higher risk lands to Management Areas where no timber harvest is programmed, are complementary to fish and wildlife resources. Scheduling capital investments can be utilized for both mitigation and enhancement. Resource protection can be met through applying Standards and Guidelines in project phases of planning, location, design, implementation, and monitoring.

The responsiveness of the alternatives to the fish habitat aspect of this problem can be quantitatively evaluated by considering the fishery production potential (number of adult anadromous fish) associated with each of the alternatives. Responsiveness to some wildlife habitat aspects of the issue can be evaluated by considering the acreage of old-growth remaining at the end of the fifth decade of the planning horizon in each alternative.

The management of riparian areas and the maintenance of water quality, closely related to the fish habitat aspect of this planning question, are discussed separately as aspects of a different problem (refer to Planning Question #6).

The management of old-growth, closely related to the wildlife habitat aspect of this planning question, is discussed separately earlier in this section (refer to Planning Question #3).

8. ***How should the unroaded areas of the Forest be managed?***

This Planning Problem involves the management direction for those areas not yet developed by roads. The Forest has 88,265 acres of Wilderness. The inventory of unroaded areas outside of Wilderness in the 1984 data base was 87,629. Since 1984, under current management direction, some road development has occurred in former unroaded areas. The 1986 Forest/Park boundary adjustment altered the size of three unroaded areas and eliminated one. Currently, there are approximately 85,800 acres of unroaded areas outside of Wilderness; adjusted boundaries and current acreages are displayed in Appendix C. In 1988 approximately 862,000 acres within Olympic National Park were added to the National Wilderness Preservation System. This brings the total Wilderness on the Olympic Peninsula to over 950,000 acres. This planning problem deals with the allocation and management of remaining unroaded areas.

Respondents on both sides of the unroaded issue feel they are continually losing ground. Timber and commodity interests see the land base eroding as areas are periodically allocated for uses that preclude development for commodity production. Many feel allocation of any additional land to uses that do not allow development would be unwarranted and unacceptable. On the other side, those who would prefer that land and forest areas remain in their natural state see options dwindle as new roads are constructed in previously undeveloped areas. In recent years, development has been deferred in these areas while various reviews have been conducted, but it seems that major portions of these areas may be roaded in the next few years if the lands are allocated to uses that include timber management. Many feel that all or part of these lands should remain undeveloped and be managed to provide benefits not available in areas where timber harvest and roading are permitted.

Wilderness and unroaded areas provide the majority of Primitive and Semi-Primitive Non-Motorized recreation experiences on the Forest. Under current management direction, a large amount of the currently unroaded area is expected to be developed within the next two decades, leaving existing Wildernesses to supply Primitive and Semi-Primitive Non-Motorized recreation. Based on projected increases in use, by the year 2020 demand is expected to exceed the capacity of the Wildernesses to provide these forms of recreational experience.

Management options in the unroaded areas range from closure of existing trails and campsites to actions that increase capacity and disperse users. Trail development, maintenance, or improvement, and the use of fire as a management tool are the principal mechanisms for changing the use and capacity while maintaining opportunities for quality experiences.

The alternatives vary by the management direction and capital investment schedules for the Wildernesses. Alternatives also vary by, and are evaluated by, the location and number of acres of unroaded areas allocated to management that would maintain their undeveloped status. Another key indicator is the area remaining in Primitive and Semi-Primitive status. The analysis of individual unroaded areas is documented in Appendix C.

The availability of undeveloped unroaded recreation opportunity, closely related to this planning question, is discussed in detail earlier in this section (refer to Planning Question #2).

9. ***How should the corridors adjacent to eligible Wild, Scenic, or Recreational Rivers be managed?***

This subject became an issue on the Olympic Peninsula during the energy crisis of the early 1980's. Many hydropower projects were being proposed, and people became more concerned about potential loss of anadromous fish habitat. Some people feel that any river with an anadromous fishery possesses an "outstandingly remarkable" feature and is, therefore, eligible for designation as a Wild, Scenic, or Recreational River. Others would like to see such designations made to preserve the free-flowing nature of the Peninsula's rivers. In contrast, some segments of the public would prefer that rivers not be designated Wild and Scenic, both to preserve options for hydropower development and to avoid limitations on timber harvest activity.

There are diverse opinions on the appropriate levels of use for these rivers along with management of the surrounding lands. The level of use affects the amount of contact between users and has the potential to detract from the quality of the recreation experience. Activities such as timber harvest could affect the recreational setting if allowed within sight and sound of the rivers. Some feel strongly that such activities would seriously degrade the quality of the river environments, while others feel that these practices could be accomplished in ways that would be compatible with all values in the river corridors.

Response to this planning question includes both a determination of the eligibility of Forest rivers for classification and a recommendation regarding classification for those rivers for which the Forest Service is the logical lead classification study agency. In all, 17 rivers have been evaluated. Three

(Big Quilcene, Skokomish, and the Calawah and its tributaries) were identified as ineligible; four (Quinault, Hoh, Bogachiel, and Elwha) are proposed for suitability analysis and recommendation by other agencies because the Forest Service manages an insignificant percentage of the river corridor; and ten (Dungeness, Gray Wolf, Dosewallips, Duckabush, Hamma Hamma, Main Stem and West Fork of the Humptulips, Soleduck, Wynoochee, East Fork Humptulips, and South Fork Skokomish) were identified as eligible for classification.

Several resources are potentially affected by the resolution of this issue. Recommendation of rivers for inclusion in the Wild and Scenic River System will result in reduced or delayed timber harvest within the affected river corridors. Wildlife species dependent upon the present habitat conditions along recommended rivers will benefit. Others, such as elk and deer, will lose foraging opportunities if harvest is foregone. Hydropower development will be prohibited along classified river courses. Landownership patterns may be affected, as the Federal Government usually tries to acquire all land within the corridor of a designated Wild, Scenic, or Recreational River.

Since the area usually included within a designated river corridor involves all lands within one-quarter mile of the riverbank, management of a corridor to retain its qualifying attributes often complements fish habitat and water quality objectives. This type of management also provides for the older forest plant communities favored by many wildlife species (especially since the land is usually within big game winter range), and provides for aesthetically pleasing views compatible with recreation and attainment of Visual Quality Objectives.

The responsiveness of the alternatives to this issue can be quantitatively evaluated by considering the number and miles of river corridors to be recommended for inclusion in the Wild and Scenic River System and the number and miles of river which are allocated to the River Corridor management area prescription in each alternative.

10. ***How should sensitive or unusual plant species and communities be managed?***

The Forest provides habitat for numerous rare plants and unusual or sensitive plant communities. A considerable amount of interest in studying as well as protecting these sites (from disturbance that might result from activities such as road construction, timber harvest, and mining) developed during the response period to the draft planning documents. Those responding felt that these unique areas contribute to overall Forest diversity and that concentrations of rare plants or unique ecosystems should be designated as Botanical Areas (BAs) or Research Natural Areas (RNAs). Activities that could disturb plants would be precluded in these areas, including, where appropriate, protection from plant collectors. Others commented that the plant populations should be managed through "on-the-ground" project location and design, without removing or greatly restricting lands for timber management or mineral development.

The management of sensitive or unusual plant habitats is addressed through the alternatives by the allocation of various sites (acres) to BA or RNA designations. Currently there are no designated Botanical Areas on the Forest. The Forest has one established Research Natural Area of 1,500 acres on the Quinault Ranger District.

Key indicators for the development and evaluation of alternatives are the acres allocated to these Management Areas. Protection of sensitive or unusual plants and their habitat will also be addressed through standards to guide project design.

11. ***How will management of forest resources affect local communities?***

Forest management activities and resulting outputs influence job opportunities, incomes, and the quality of life of residents in local communities. There is concern that changes in Forest outputs and activities may adversely affect local economies and community stability.

Olympic National Forest resources support several local industries including lumber and wood products, commercial fishing and tourism. The current (1985) levels of timber harvest, wildlife and fish populations, and recreational use provide an estimated 6,540 jobs in the four counties where the Forest is located. These jobs include 2,180 in lumber and wood products industries and 4,360 in trade and service industries (see FEIS, Appendix B, "Social and Economic Impact Analysis").

In addition to providing resources for local industries, 25 percent of receipts from the sale of Forest resources is paid to counties to finance schools and roads. From fiscal years 1985 to 1989, an average of $5.4 million was paid annually to the four counties. In addition, a portion of the annual Forest operating budget, averaging $15 million in fiscal years 1985 to 1989, was spent annually in the local area on supplies, services, and salaries.

People employed by the timber and wood products industries and those who benefit from that source of income feel the Forest should maintain or increase the emphasis on commodity production to ensure community stability. In recent years, the timber industry has experienced a comeback from the recession of the early 1980's, and those who have benefited would like to see timber-related incomes remain high. There is strong local concern that revenues from timber are needed to finance roads and schools or property taxes would rise.

The Forest also has other resources that are important to many local residents, though the resources do not provide direct income to the counties. Several individuals expressed their concerns through comments on the DEIS that the Forest should place a high emphasis on maintaining the amenity resources, such as clean water, wildlife and fish habitats, visual quality and recreation. These people feel that the provision of jobs should not be more important than protection of the Forest environment. Many local residents value the opportunity to use the Forest for firewood cutting, hunting, fishing and recreation.

Production of resources valued by some groups may conflict with management of resources valued by others. For example, providing timber for the lumber and wood products industry could remove some land from undeveloped recreation opportunities and damage some fish and wildlife habitats. In other cases, management of resources is complementary. For example, timber management provides access roads for hunting and undeveloped recreation, and can benefit some species of wildlife that use created openings to forage.

The alternatives explore the effects of variations of Forest Service activities on local communities. Some alternatives would provide high levels of timber, which may support jobs in the lumber and wood products industries and increase payments to counties. Some alternatives would provide high levels of recreation, visual quality, and wildlife and fish habitat, which support jobs and lifestyles dependent on tourism and fishing, as well as preserve amenity values.

Responsiveness of the alternatives to this issue can be evaluated by considering the changes in employment and community income, and amount of payments to counties.

12. ***How should the Shelton Cooperative Sustained Yield Unit (SCSYU) be managed?***

The Shelton CSYU, created under authority of the Sustained Yield Forest Management Act of 1944, was established in 1946 and is the only one of its kind in the United States. Management is guided by the terms of a 100-year Cooperative Agreement between Simpson Timber Company and the Forest Service. Included within the Shelton CSYU are about 111,000 acres of Olympic National Forest land and approximately 250,000 acres owned by Simpson. More background information is provided in Chapter III.

The focus of management activity within the CSYU is shifting from National Forest land to Simpson Timber Company land. With this shift, the need to change management direction on National

Forest land within the CSYU to incorporate requirements of the NFMA has been questioned by Simpson Timber Company. Simpson Timber Company feels the Preferred Alternative is heavily constrained in order to promote nontimber values. They argue that this does not fit the intent of the CSYU Agreement (Section 16). Simpson believes that conflicts exist between requirements of the National Forest Management Act and the CSYU Agreement (e.g., diversity, unit size limitations, and riparian management). They point out that conflicts should be resolved in favor of the CSYU Agreement. They suggest modification of the Agreement would be needed if NFMA requirements are imposed on the National Forest portion of the Unit. They contend that NFMA requirements are not applicable on either Simpson Timber Company or National Forest lands within the Unit.

During the response period, the Squaxin Island Tribe stated the Draft EIS and the Draft Plan (Proposed Forest Plan) did not consider that the Forest Service has the responsibility to cooperatively manage all resources on Simpson Company lands, not just timber production. They cite the Sustained Yield Forest Management Act of 1944. They contend that the requirements of NFMA should be imposed on all land within the SCSYU, including Simpson land. The Tribe feels that the planning documents did not give adequate consideration to cumulative effects from harvesting on National Forest lands and Simpson Timber Company lands.

Several public responses indicated a perception that resources have been seriously damaged because of concentrated harvest on National Forest lands within the CSYU. They suggest discontinuing the CSYU altogether. Finally, a substantial number of respondents felt that the CSYU should be retained and the NFMA requirements applied since Simpson has had the benefit of harvesting on Forest land during the past forty years at appraised prices.

13. ***How will American Indian concerns, values, and treaty rights be addressed by this Plan?***

Peninsula Indian Tribes' concerns focus primarily on: (1) the identification and protection of areas of religious significance, and (2) the management of fish and wildlife resources. Specifically, they want to assure the planning process adequately evaluates the fishery resource in relation to their economy and culture. Several tribes would like to see management activities (primarily timber harvest and related road development) displayed for each drainage so specific impacts could be assessed for each (tribal) area. Also, some tribal comments indicated the Draft planning documents did not adequately recognize tribal archaeological and cultural resources, and that protection measures for these resources would be inadequate. Old-growth, especially cedar, has cultural and religious significance to Indians. Use of this resource by the tribes include the need to both remove some trees (as in the case of canoe construction) and preserve trees (as in the case of some religious beliefs). Finally, the Squaxin Island Tribe is concerned about adequate resource protection for their treaty rights. Specifically, they maintain that Simpson Timber Company lands, which are part of the Shelton Cooperative Sustained Yield Unit, should be managed under the requirements of the National Forest Management Act (NFMA).

Forest Service policy requires that the setting and location of sites once important for religious purposes are protected from disturbance and are available for use by American Indians. Forest personnel will continue to cooperate with the tribes in identifying and maintaining such traditional uses of the Forest. The output of these resources for each alternative will be an indicator of responsiveness to this issue. Further information on this issue may be found in Chapter III, Appendix A and Appendix K of the FEIS.

INDICATORS OF RESPONSIVENESS

The quantitative measure of the Forest's ability to respond to each ICO is referred to as an indicator. Indicators include the outputs, uses, or conditions that can be measured and described to judge how well the various alternatives resolve issues. Table I-2 provides a summary of the indicators for each of the ICOs that had alternatives designed to specifically resolve the issues. Indicators are also useful when comparing alternatives in Chapter II with respect to the Planning Questions in Chapter I. Also, refer to Table II-1 in Chapter II for additional information.

Table I-2. Indicators of Responsiveness to ICOs

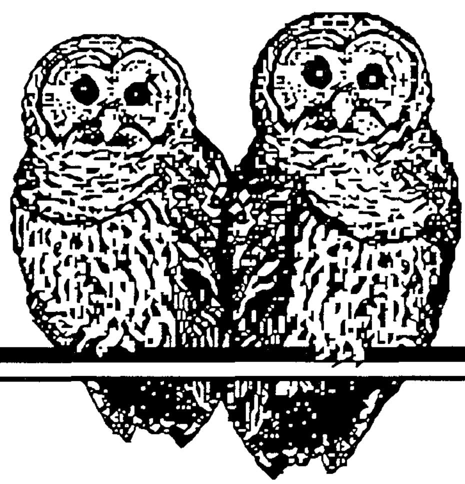
ICOs/Indicator	Unit of Measure
1. Management of the Scenic Resource -Visual Quality Objectives -Viewshed Condition	 M acres Degree of alteration
2. Mangement of Outdoor Recreation -ROS classes provided -Percent of demand for Primitive & Scenic Primitive ROS classes met	 M acres Percent
3. Old-Growth Forest Management -Retained acres, decade 1,2, and 5	 M acres
4. Timber Harvest Schedule and Location -Land suitable for timber production -Allowable sale quantity, average annual for 1st decade -Long-term sustained yield (LTSYC)	 M acres MMCF and MMBF MMCF
5. Transportation System Management -Average annual miles road constructed, 1st decade -Miles of road constructed in unroaded areas, 1st decade	 Miles Miles
6. Management of Soil and Water -Average annual sediment (index) output for the first 10 years -Timber harvest in riparian areas for the first 20 years	 M tons/year M acres
7. Fish & Wildlife Habitat Management -Average annual fishery production potential -Commercial anadromous production -Habitat for spotted owls -Habitat for marten, pileated woodpecker -Bald eagle sites -Big game recreation use	 1000s of anadromous smolts 1000 lbs. Number of owl pairs Number of marten, pairs of woodpeckers Number and acres WFUDs
8. Management of Unroaded Areas -Portion of unroaded areas to be retained in undeveloped condition -Specific unroaded areas maintained	 M acres Number
9. Management of Potential Wild and Scenic Rivers -Amount of river corridors to be recommended for inclusion in the Wild and Scenic River System (A4A) -Number and miles allocated to River Corridor Prescription (A4B)	 Number of miles Number and miles
10. Management of Native Plant Species and Communities -Sites established as Botanical Areas or Research Natural Areas	 Number and acres
11. Local Communities -Employment opportunity -Local income -Payments to counties	 Number of jobs MM$ MM$
12. Shelton CSYU -National Forest; 1st decade ASQ -Simpson River Company, 1st decade ASQ	 MMCF MMCF

PLANNING RECORDS

The documents and files that chronicle the planning process (including the Environmental Analysis) of the Olympic National Forest are available for review at the Forest Supervisor's Office, Federal Building, 801 S. Capitol Way, Olympia, Washington 98501. These documents and files, or "planning records," contain the detailed information and technical analysis used in developing the FEIS and Forest Plan. The planning records are referenced at appropriate points in the text, in the Appendices of this FEIS, and in the Forest Plan.

Chapter II

Alternatives, Including the Proposed Action



Olympic National Forest

Chapter II

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

INTRODUCTION

This chapter is the heart of the Environmental Impact Statement. In this chapter, alternate ways of managing the Olympic National Forest (the alternatives) are presented, and their resource outputs and major environmental effects are displayed. There are also discussions of how these alternatives were developed, as well as how they compare to each other and to the way the Forest is currently being managed. This chapter draws on material from later chapters. Chapter III describes the affected environment. Chapter IV presents the environmental consequences.

There are three main parts to this chapter. First, there is a summary of the analysis that was conducted in the alternative development process. A more detailed presentation of this analysis is provided in Appendix B, "Description of the Analysis Process." Second, the alternatives are described in terms of the purpose and management emphasis of each. Third, the alternatives are compared to each other and to other information. This comparison shows the response to the planning questions from Chapter I, the emphasized land uses, the resource outputs, the environmental effects, and the costs and benefits which are most likely to occur with each alternative. Following the tables that extensively display this information, there are tables and a narrative which describe differences among alternatives.

Many of the discussions throughout this document refer to "zones" within the Forest. These were developed by the planning team for analysis purposes because of significant differences in one or more of the environmental components. The "Eastside" zone includes the Quilcene Ranger District as well as the portion of the Hood Canal Ranger District outside both the Shelton Cooperative Sustained Yield Unit (SCSYU) and the "Satsop Block." The "Westside" zone includes the Quinault and Soleduck Ranger Districts plus the "Satsop Block" within the Hood Canal District. The National Forest land within the Shelton CSYU is considered a separate zone. Refer to Figure III-2 for the relationship of each District within the zones and their relationship to the Olympic Peninsula.

In discussions covering the two distinct management entities included in this planning process (the Shelton CSYU and remaining National Forest land), several terms are used to distinguish "remaining National Forest land" from the Shelton CSYU. The reader can expect to encounter the following terms: "East-West," "Eastside and Westside zones," "National Forest land outside the Shelton CSYU," and some variations on these. All of these terms refer to the combination of the Eastside and Westside zones, which between them include all National Forest land that is not within the Shelton CSYU. This terminology was developed because it is often necessary to separate the conditions, outputs, and effects associated with management of the East-West portion of the Forest from those associated with the Shelton CSYU. Refer to "Sustained Yield Units," Chapter III, for a full description of the Shelton CSYU.

CHANGES BETWEEN DRAFT AND FINAL EIS COMMON TO ALL ALTERNATIVES

After the documentation of the alternative analysis in the DEIS, and the identification of the Forest Service preferred alternative, the DEIS and Proposed Forest Plan documents were released for public review. (The public review process and the comments received during the review period are described in FEIS, Chapter I and Appendix A.) Once the public comment period had closed and analysis of the responses was complete, the Forest IDT explored alternative ways to respond to the concerns of the public.

Next IDT members agreed to propose several changes in land allocations, management prescriptions, and standards and guidelines they felt would best address the public's concerns and management of the Forest. The IDT then revised the alternatives, in particular DEIS Alternative C and the Forest Plan, to incorporate these proposals, and evaluated the effects of the revisions. The revised Plan and FEIS were submitted to the Regional Forester for review.

Following is a summary of the revisions made between the draft and final EIS to respond to concerns expressed during the public comment period. These revisions included fine-tuning the objectives, design, and analysis used to develop the original alternatives.

GENERAL CHANGES

- Alternative NC, the "No Change" alternative suggested by the Northwest Forest Resource Council, has been incorporated in the FEIS from the Supplement to the DEIS. This alternative represents a continuation of the Timber Resource Plan of 1979, as amended by the Washington State Wilderness Act of 1984, without adjustments to either meet NFMA regulations or comply with the Pacific Northwest Regional Guide's spotted owl amendment.

- The total land base of the Olympic National Forest has been reduced since the DEIS from 649,700 acres to 632,324 acres. The Forest was reduced by approximately 11,900 acres through a transfer to the Bureau of Indian Affairs to be held in trust for the Quinault Indian Nation. A net of 5,972 acres were also transferred to the Olympic National Park.

- The title of the C1 management area has been changed from "Old-Growth" to "Spotted Owl Habitat Areas," and C2 has been changed from "Mature Forest" to "Pileated Woodpecker/Pine Marten Habitat." The new titles more accurately reflect the characteristics of these management areas.

- The C4 (winter range) and J1 (minimum level) management area prescriptions have been dropped since the DEIS. They proved to be unnecessary and confusing in the DEIS.

- Alternative C-Departure, D-Departure, E, F, and G received few public comments and were not needed to improve the range of alternatives, so they have been dropped from detailed consideration since the DEIS. The remaining alternatives have been modified to varying degrees.

- A summary of the analysis of management requirements having significant effects on other resources is included in the "Management Requirements" section. The detailed analysis is presented in Appendix I, which is a revision of the Appendix I, Supplement to the DEIS.

- More details on rivers eligible for Wild and Scenic status have been included and there is greater use of the River Corridor management prescription. Three additional rivers have been considered as eligible.

- As a result of public input and management concerns over protection of water and related soil and fishery resources, current management practices designed to protect and enhance water quality are highlighted in more detail. They are described briefly in the Forest-wide Standards and Guidelines and in greater detail in FEIS Appendix J, "Best Management Practices." This appendix has been included as mitigation common to all alternatives, and as a response to input to the DEIS.

- Management of spotted owl habitat was changed to comply with the standards and guidelines from the Regional Guide and spotted owl SEIS. This included changing the Spotted Owl Habitat Areas (SOHAs) from 29 areas averaging 1,000 acres each, to 30 areas with an average size of 3,000 acres.

- The FEIS includes all municipal watersheds in all alternatives other than NC. There is an increase in municipal watershed acreage compared to the DEIS.

- Visual quality is addressed in the text and tables based on viewshed conditions, rather than acres within Visual Quality Objectives (VQOs) as was done in the DEIS.

CHANGES IN TECHNICAL ANALYSIS FOR ALL ALTERNATIVES

The following are revisions and changes made in the analysis process for all alternatives:

- The yield tables used to estimate timber outputs from existing timber stands were updated to reflect growth through the midpoint of the first planning period, 1994.

- Timber species and productivity groups were modified and associated new empirical timber yield tables were developed.

- The managed timber yield tables were developed using the Stand Projection System (SPS) as well as DFSIM. Only DFSIM was used in the DEIS.

- The stand ages for all timber stands modeled in the planning model, FORPLAN, were updated to 1990. The model data base was also revised to reflect harvest activity since the last update in 1985 through the end of 1989.

- The conversion factor used to calculate board feet of timber output from the cubic feet modeled in FORPLAN was found to be in error and was corrected. The average Forest-wide factor increased from 4.35 to about 5.5 BF per CF.

- Timber yields were reduced to reflect maintenance of green trees for future wildlife snags. A number of other changes were made in managed timber yield tables relative to commercial thinning activities, fertilization, genetic gains, reductions (from root rot, defect and breakage), standing inventory, and timber revenues.

- The Fish Habitat Index Model was modified to limit the influence of upland areas on large woody debris levels and to increase the following: existing smolt habitat capability, reliance on habitat quality as determined by large woody debris levels, effectiveness of headwall leave areas in preventing landslides, efficiency of leaving streamside buffers, and the length of the recovery period before large woody debris is again produced in riparian areas after logging.

- The spotted owl habitat areas were remapped to comply with the Final Supplement to the EIS for an Amendment to the Pacific Northwest Regional Guide standards and guidelines on size and distribution of sites. Sites were increased from an average of 1,000 acres to a 3,000-acre average.

- Mapping of mature conifer habitat to be managed for wildlife species, such as the pileated woodpecker and pine marten, was adjusted to account for overlap with the new SOHA locations.

- A recovery plan for bald eagles was developed by the U.S. Fish and Wildlife Service in 1986. The habitat requirements identified in the recovery plan were incorporated into the FEIS. The number of sites decreased, but the size of the sites increased. The total acreage of habitat changed only slightly.

- The treatment of recreation values in the calculation of present net value (PNV) has been modified. In the FEIS analysis, *all* Forest recreation outputs have been included in the computation of PNV. Roaded undeveloped recreation values have been added to the developed, Wilderness, and unroaded undeveloped values used in the DEIS analysis.

- The effects of Forest activities on off-Forest fish habitat quality have been removed as a factor in the calculation of PNV. While these effects have still been estimated to facilitate comparison of alternatives, it is felt that including them in the economic calculations is inappropriate. Both the procedures used to estimate such effects and the degree to which available off-Forest habitat will actually be utilized (which determines actual output level as opposed to theoretical output level) are highly speculative. As a result, monetary values for these effects are no longer included in the PNV analysis.

- The Maximum PNV Benchmark has been included in the comparative presentation of present net value.

- Timber values used for National Forest harvest from the Shelton CSYU have been adjusted to reflect the effect of noncompetitive bidding on prices. The remaining National Forest timber values and all other resource values have been retained as in the DEIS analysis.

- Timber management costs based on the conversion of board foot information into cubic foot costs have been revised to reflect the range of updated board foot to cubic foot ratios employed in the FEIS analysis. Other management costs have been retained as in the DEIS analysis.

- The primary objective function of Alternative A-Current Direction (No Action) has been modified from "maximize timber production" to "maximize present net value." This is more consistent with the actual implementation of current direction.

- The means of implementing and/or modeling many of the management requirements associated with alternative development have been modified. The acreage of old-growth considered necessary to assure maintaining viable populations of the northern spotted owl has increased. Both the modeling technique and the means of meeting the dead and defective tree habitat MR have changed. The method for representing the riparian zone/fish habitat MR in FORPLAN has also been revised.

- Eventual termination of the Shelton CSYU Cooperative Agreement has been included in the FORPLAN analysis of Alternatives C-Preferred (Modified), H (Modified), and I.

- The alternatives considered in detail in this FEIS have been reanalyzed in FORPLAN. This model has been updated to incorporate revised data and changes in management assumptions, objectives, and specifications.

ALTERNATIVE DEVELOPMENT PROCESS

INTRODUCTION TO ALTERNATIVES

The alternatives considered in this Environmental Impact Statement represent different ways of managing the lands and resources of the Olympic National Forest. Each alternative contains a unique combination of land allocations, management prescriptions, and activity schedules. As a result, each alternative generates a different mix of goods and services for the public, and a different combination of resource outputs, land uses, and environmental effects.

An even distribution of reasonable alternatives, designed to cover a broad range of possible actions and outputs, was formulated by the Olympic National Forest Interdisciplinary Team (IDT). The team was guided by several factors in formulating these alternatives, with primary consideration being given to the public issues, management concerns, and resource use and development opportunities (ICOs) identified throughout the planning process. More information is presented on these topics in Chapter I and Appendix A of this FEIS.

NFMA planning regulations (36 CFR 219.12(f)) contain numerous requirements regarding the development of plan alternatives. These regulations specify that alternatives must:

- Be distributed within the minimum and maximum resource potentials to reflect, to the extent practicable, the full range of major commodity and environmental resource uses and values that could be produced by the Forest;

- Reflect a range of resource outputs and expenditure levels;

- Be formulated to facilitate analysis of opportunity costs and resource use and the tradeoff of environmental effects among alternatives as well as between alternatives and benchmarks;

- Provide different ways of addressing and responding to the major public issues, management concerns, and resource use opportunities identified during the planning process;

- Be formulated to facilitate evaluation of effects on present net value, benefits, and costs of achieving various outputs and nonpriced benefits;

- Be formulated to consider changes in existing laws and policies, and include implementation of such changes if needed to address issues, concerns, or opportunities;

- Respond to and incorporate the RPA Program tentative resource output objectives in at least one alternative;

- Reflect the current level of goods and services provided by the Forest and the future output levels that would be associated with continuation of current management direction in at least one alternative (the "No Action" alternative pursuant to NEPA);

- Represent to the extent practicable the most cost-efficient combination of management prescriptions examined that can meet the objectives established in each alternative;

- State the conditions and uses that will result from the long-term application of each alternative;

- State for each alternative what goods and services will be produced, including the timing and flow of outputs and the associated costs and benefits;

- Incorporate appropriate resource management standards and guidelines;

- Incorporate statements describing the purposes of proposed management direction.

In responding to the above direction, the ID Team developed a wide range of alternatives. Some of these would result in the Olympic National Forest being managed to maximize production of priced commodities, primarily timber, while others would emphasize the output of nonpriced amenities, such as unroaded recreation and scenic quality. Alternatives were developed to reflect the effects and outputs associated with continuation of current direction and to respond to RPA Program objectives. Through analysis of "benchmarks," additional alternatives were generated to represent the full range of possible operating strategies that fall within the Forest's "decision space" (see "Benchmark Analysis" later in this chapter). The resulting set of alternatives was designed to be broad and varied enough to provide the Regional Forester with a firm basis for identifying and selecting the alternative which most nearly maximizes net benefits to the public.

Alternative NC was developed from an entirely different base, i.e., the timber management plans currently in effect on the Forest. These plans were developed outside the scope of NFMA, and do not include provisions for many of the Act's requirements. In addition, the timber yield models, timberland suitability stratifications, and nontimber resource output considerations upon which the timber management plans are based are substantially different from those used in the development of the other alternatives. These differences will be discussed in detail throughout this chapter.

Since publication of the DEIS, several factors have precipitated changes in the development of alternatives. Chief among these have been public response to the DEIS, revised methods for meeting management requirements regarding viable northern spotted owl populations, and changes in basic information (i.e., inventory data and yield projections). Such changes are noted and discussed throughout this document. The effect of these factors on alternative development is covered here.

Changes in basic information influence the mix of outputs associated with a given set of management objectives. While this does not affect alternative development per se, it does alter the way each alternative responds to issues, concerns, and opportunities. A similar result is associated with the revised strategy for spotted owl management. These changes have had a significant effect in redefining the basic decision space for development of alternatives.

The most substantial changes in alternative development have resulted from public response to the DEIS. Appendix J, which provides detailed information on Best Management Practices, has been added as a component of mitigation measures which are common to all alternatives. In addition, three of the original alternatives -- B (Modified), C-Preferred (Modified), and H (Modified) -- have been revised to reflect input and suggestions received through the public comment process. As a result, the mix of alternatives presented in this FEIS represents a more refined expression of various public viewpoints than did the original set.

PURPOSE OF ALTERNATIVE DEVELOPMENT PROCESS

The primary goal of the alternative development process is to provide an adequate basis for identifying the alternative that comes closest to maximizing net public benefit (36 CFR 219.12 (f)). Net public benefits are defined as the "...overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not...consistent with the principles of multiple use and sustained yield" (36 CFR 219.3).

Full assessment of net public benefits requires consideration of both priced outputs and the output of public benefits and costs to which dollar values have not been assigned. Included in this category are nonpriced outputs (such as increased populations of endangered species), physical conditions (such as maintenance of scenic quality), and desirable distributive effects (such as increased employment in dependent communities). Some of these nonpriced benefits can be measured in quantitative terms (such as number of jobs created), while others can only be assessed qualitatively (such as enhanced cohesion within a community). Whether quantitative or qualitative in nature, the value of such outputs and effects cannot be reasonably reflected in dollar terms, since the data and/or methodology necessary to do so are not available. It is therefore important to keep in mind that monetary values alone, while a useful indicator of overall public benefit, do not and cannot tell the entire story.

Because the assessment of net public benefits includes both those outputs which have prices and those to which no price can be attached, they cannot be expressed in terms of a single, quantitative measure. Instead, they must be gauged using both quantitative and qualitative criteria. There is no precise formula for determining which alternative maximizes net public benefits. In fact, there are often differences of opinion as to whether particular outputs or effects are benefits or costs. Therefore, identification of the alternative which maximizes net public benefits is, of necessity, a subjective and judgmental process. Please refer to Appendix B for further discussion of net public benefits and priced/nonpriced outputs.

Formulation of a broad range of reasonable management alternatives to form a basis for assessing net public benefits is an extensive and complex process. Each alternative represents a distinct combination of land uses, management prescriptions, and activity and output schedules that is a unique reflection of the resource capabilities of the Forest. Each alternative is designed to manage the Forest on the basis of a specific set of alternative goals and objectives. Some objectives, such as providing Wilderness, are common to all alternatives. Others, such as timber harvest level and the extent to which inventoried Visual Quality Objectives are met, vary among alternatives.

By analyzing a variety of strategies for managing Forest resources, a wide range of management objectives and resource output mixes can be developed that respond in different ways to the issues and concerns described in Chapter I and Appendix A of this document. Management strategies can vary in terms of what is done, where it is done, and when it is done. The resulting combination of management activities, management areas, and activity schedules defines a unique combination of resource supply and environmental conditions for each alternative. The merits of each alternative are evaluated on the basis of the net public benefits each provides, with this evaluation serving as the basis for identifying a preferred alternative.

DESCRIPTION OF THE ANALYSIS PROCESS

The first steps in the analysis process include an inventory of the Forest and the construction of a data base detailing the land and resource characteristics of the Olympic National Forest. The basic information used in this process was essentially derived from existing resource inventories, with little new data being gathered specifically for Forest Plan development. The primary task at this stage of the analysis process was organizing existing data into a coordinated format useful in developing and analyzing alternatives. This was accomplished through use of a geographically-oriented data base. The Forest used the Geographic Information System (GIS) as its ultimate land attribute and production potential data base.

Within this data base, a contiguous area of the Forest with a relatively uniform set of characteristics is identified as a "capability area." These relatively small, scattered areas are then combined into noncontiguous "analysis areas," which serve as the basic building blocks in the analysis process and in the planning model, FORPLAN. Analysis areas are delineated on the basis of similarities in management costs, output values, and predicted responses to Forest management activities.

Once the analysis areas have been identified, the ID Team develops sets of activities, known as "management prescriptions," which represent specific alternative methods of managing each individual analysis area. A group of these prescriptions is generated to cover the various ways that the different analysis areas can be managed. These prescriptions provide the basic choices of how land is to be managed. Estimates of the costs, values, and resource outputs associated with each prescription are generated for use in FORPLAN.

The process of identifying and subsequently developing management prescriptions started with an ID Team review of the ICOs. Prescription goals and associated management practices were developed to address those aspects of the ICOs most closely related to allocation and scheduling decisions. Other aspects of the ICOs did not require prescription development to move toward resolution. Items which could be appropriately addressed through application of uniform standards and guidelines or development of overall management policy were handled through these mechanisms.

The set of management activities which constitutes each FORPLAN prescription was constructed by the ID Team through a sequence of prescription development steps. Initially, the Team consulted available research covering possible activities which could be used to meet prescription goals. This was enhanced by the knowledge and experience of Forest personnel familiar with the effects of given practices. The ID Team also evaluated existing policy and legislative direction for guidance in developing management prescriptions. Various stages of the process included involvement of Regional Office and Ranger District personnel, representatives of other government agencies, and interested members of the public. Finally, the management prescriptions resulting from this effort were reviewed by the Forest Management Team.

In addition to addressing issues, concerns, and opportunities, the process of designing management prescriptions was guided by the following criteria: (1) prescriptions should be achievable and contain realistic practices, (2) they should be general enough to accommodate the wide variety of on-the-ground conditions, (3) they should be specific enough to allow development of accurate yield coefficients and economic data, and (4) to the extent practicable, they should reflect the most cost-efficient means of achieving prescription goals.

Prior to use in FORPLAN, potential management prescriptions and the costs, values, and outputs associated with them are evaluated to assure their cost-efficiency in meeting management objectives. An example of such an analysis is the "Stage II" analysis of timber prescriptions (required by 36 CFR 219.14 (b)), which evaluates the present net value of each prescription on a per acre basis. This analysis was conducted during the development of the DEIS FORPLAN model, and updated in developing the final model used in the FEIS analysis.

The updated "Stage II" analysis indicates that just over 40,000 acres of tentatively suitable timberland do not provide positive PNV on a per acre basis when managed for timber production. These consist of a combination of "doghair" stands (28 percent), areas for which helicopter logging is most cost-efficient (56 percent), and scattered areas in which the combined costs of access, conventional logging, and management exceed potential returns (16 percent). This analysis, as well as other processes used to evaluate the cost-efficiency of prescriptions, are described in Appendix B, "The Forest Planning Model." Once cost-efficient strategies for meeting management objectives have been identified, they are carried forward in the analysis as FORPLAN prescriptions.

FORPLAN is a linear programming model used to analyze management objectives and how they interact. The management objectives of a given alternative, expressed as an objective function, constraints, and possible activities (represented as prescriptions) are used by the FORPLAN model to find the most cost-efficient set of prescriptions which meets the objectives. Subject to the constraints and resource output objectives imposed, the model uses contribution to present net value (PNV) as the criterion for selecting prescriptions and activity schedules. A discount rate of 4 percent is used in comparing the costs and values associated with the various prescriptions through time.

In selecting the mix of prescriptions and schedules that most efficiently meets the management objectives of a given run, the model has a great deal of flexibility. Except where constraints reflecting specific management objectives dictate otherwise, the model can select from the full range of prescriptions and timing options in developing its solution. Because of the number of prescriptions and schedules available for each analysis area, this results in a wide range of possible solutions from which the model can choose the most cost-efficient.

Once a solution is identified for the alternative in question, the Forest can be divided into "management areas." These are areas of the Forest to which a set of management practices, standards, and guidelines apply. Each management area consists of one or more prescriptions from the solution produced by the FORPLAN model. The Forest has identified 16 different management areas to which parts of the land base can be allocated in each alternative. These allocations may include different blocks of land in widely separated parts of the Forest, but the management emphasis is similar. Management areas for each alternative are identified on the maps included with this document. The management areas are described later in this chapter, and their acreage under each alternative is shown in Table II-2.

At this point, reviewers are encouraged to refer to Appendix B, which describes the analysis process. The information presented in Appendix B is more complete and more technical than the overview presented here.

It should be noted that much of the inventory data used in the analysis of alternatives has been updated since publication of the DEIS. Current fish habitat capability, recreation use figures, timberland suitability, and old-growth acreage have all been reassessed. In addition, the timber harvest base has been updated to reflect both acres of harvest through 1989 and projected growth through 1994. These changes, while having an impact on the mix of outputs associated with each alternative, have not affected the analysis process itself.

DEVELOPMENT OF WAYS OR MEANS OF MEETING MANAGEMENT REQUIREMENTS (MRs)

While the analysis process was in its early stages, national planning direction was developed to assure that the process would be consistent with the requirements of applicable laws and regulations. Subsequently, the Pacific Northwest Region developed direction to ensure that requirements would be applied consistently throughout the Region. This direction is included in "A Report on Minimum Management Requirements for Forest Planning on the National Forests of the Pacific Northwest Region" (USDA FS 1986). It provides guidelines for meeting MMRs (now referred to as MRs) pertaining to management of the following resources of the Olympic National Forest:

1. Timber
2. Fish and Wildlife
3. Soil and Water Resources and Land Productivity
4. Water Quality
5. Riparian Areas

Through examination of resource management conditions and planning issues, it was determined that many of the resources addressed in MR direction could be sufficiently protected (through the use of standards and guidelines) without affecting the production of other outputs. Specific management direction involving constraints on operations that would affect resource outputs was necessary to meet requirements in four general areas. These are: (1) dispersion and size of timber harvest units, (2) water quality in municipal watersheds, (3) riparian zone and fish habitat management, and (4) maintenance of adequate habitat for northern bald eagle, northern spotted owl, pileated woodpecker, pine marten, and cavity excavators. The ways to meet management requirements are discussed below.

DISPERSION AND SIZE OF TIMBER HARVEST UNITS

Planning regulations require that regeneration harvest units be no larger than 60 acres in size (36 CFR 219.27 (d)(2)). In addition, new units may not be harvested until previously harvested areas adjacent to them are no longer considered to be openings. An area is no longer considered to be an opening once it is adequately stocked with trees at least 4.5 feet tall. On the basis of local measurements on the Olympic, it is assumed that this height is reached an average of 10 years after final harvest.

Analysis of possible harvest patterns and timing sequences over large areas indicated that up to 25 percent of a given area could be harvested per decade without violating the above requirements. This proportion was used as a FORPLAN constraint to assure that model solutions would reflect attainment of the necessary harvest dispersion. The constraint was applied to total area assigned to harvest prescriptions within each individual drainage.

WATER QUALITY IN MUNICIPAL WATERSHEDS

Prevailing conditions in the Forest's municipal watersheds have indicated that, in order to assure that adequate water quality is maintained, harvest per decade should be limited to no more than 16 percent of the total area available for harvest. This proportion was included, where applicable, as a constraint in the FORPLAN formulation. Within the three major drainages which are municipal watersheds (Big Quilcene, Dungeness, and Little Quilcene), the 25 percent dispersion constraint discussed above was reduced to 16 percent. Within the Humptulips-Wishkah drainage (as modeled in FORPLAN), only a small part (the Wishkah component) is used as a municipal water source. In this combination of drainages, the harvest proportion constraint was reduced to 24.5 percent (reflecting 16 percent within the municipal watershed and 25 percent elsewhere).

RIPARIAN ZONE AND FISH HABITAT MANAGEMENT

Methods of meeting management requirements for riparian zones (36 CFR 219.27 (e)) were developed to assure maintenance of water quality and provide for an adequate source of large organic debris (vital for future fish rearing habitat). For modeling purposes, these took the form of reduced timber yields in the empirical and managed yield tables. The intent of this approach was to approximate, within FORPLAN, the yield conditions that would be necessary to produce the desired results. It is expected that Standards and Guidelines associated with riparian management will lead to the desired future riparian condition which the FORPLAN modeling represents.

The riparian protection allocations included in FORPLAN were cooperatively developed by the Forest Hydrologist and Forest Fisheries Biologist, and were based on consideration of both water quality and fish habitat needs. The allocations were reviewed by the Watershed Staff in the Regional Office. After investigation of several alternative possibilities, their conclusion was that the desired future riparian condition could best be represented by a set of harvest management limitations reflecting acceptable streamside condition compatible with the attainment of management goals. The process used to derive these harvest limitations is described in Appendix B. The limitations were translated into timber yield reductions for FORPLAN modeling.

MAINTENANCE OF ADEQUATE HABITAT FOR KEY WILDLIFE SPECIES

The management requirements for wildlife, as specified in 36 CFR 219.19 and 36 CFR 219.27 (a)(6), were developed on the basis of the habitat needs of indicator species. Olympic National Forest species for which methods of meeting MRs were developed include the northern spotted owl, northern bald eagle, marten, pileated woodpecker, and cavity excavators (as a species group). The sequence of steps that was followed in developing the strategies for meeting management requirements associated with these wildlife species is outlined below.

1. Sixteen historic and potential bald eagle management areas (BEMAs), established in response to the requirements of the Pacific States Bald Eagle Recovery Plan, were identified for allocation to management prescription C3 which prohibits timber harvest. Many other suitable areas exist in Wilderness, SOHAs, pileated woodpecker areas, pine marten areas, potential Wild and Scenic Rivers and River Corridor allocations.

2. Spotted Owl Habitat Areas (SOHAs) were identified based on current occupancy patterns and habitat availability. SOHAs were identified through use of distribution requirements included in Regional direction. Because of limited spotted owl habitat capability within Wilderness areas, SOHAs outside Wilderness were needed to reach the MR level. These were selected on the basis

of least impact to other resource outputs. Wherever possible, they were developed to incorporate as much unavailable and/or unsuitable timberland as possible. When it was necessary to include tentatively suitable timberland in SOHA allocations, areas involving timber management costs greater than projected revenues or capable of yielding high levels of nontimber outputs (or both) were given preference. The SOHA designation process resulted in the establishment of 30 SOHAs averaging 3,000 acres each.

3. Once SOHA allocations were established, management areas for the marten and pileated woodpecker were identified. Selection of these was based on habitat capability, distribution requirements, and the availability and suitability of timberland. In establishing these areas, full advantage of every opportunity to overlap habitat areas was taken. A majority of the pileated woodpecker allocations are included within SOHAs, and most of the marten allocations are included in either SOHAs or woodpecker areas.

When the wildlife management allocations had been established, the analysis area acreages were identified and limited within the FORPLAN model to "no harvest" prescriptions in all runs in which attainment of MRs was included as a management objective (i.e., all runs other than those benchmarks in which MRs are specifically excluded).

Methods for meeting the needs of cavity excavating species were developed independently. These were based on the need for perpetual retention of an adequate base of appropriately sized and distributed snags. The strategy for meeting these needs was modeled in FORPLAN in a manner similar to that associated with meeting riparian zone needs, with timber yield table reductions used to reflect snag retention requirements.

Selection of the management strategy for wildlife "no harvest" allocations was based on an analysis of the economic and timber output implications of the two principal options: dedication (no programmed harvesting) and management (regularly scheduled timber harvesting allowed). In the case of both old-growth habitat (bald eagle, spotted owl) and mature forest habitat (pileated woodpecker, marten), the "dedication" approach was clearly superior in terms of both present net value and timber production. Several combinations of habitat area size and rotation age were tried, but none were found that would make a regime of programmed timber harvest (while maintaining required habitat conditions) competitive with precluding harvest on much smaller "dedicated" areas. The lengthy rotations that would be needed over relatively large areas would result in substantial sacrifices of both harvest volume and present net value when compared to application of the Olympic's relatively short normal rotation lengths on all but the necessary dedicated acreage. Therefore, harvest was precluded in all wildlife MR areas in the FORPLAN analysis of benchmarks and alternatives.

The MRs described in the DEIS do not apply to Alternative NC. In the case of this alternative, the management objectives and prescriptions associated with meeting MRs will be implemented only if doing so is completely compatible with the provisions of the timber management plans forming the basis for the alternative. When MR attainment necessitates the allocation of specific land areas to prescriptions which preclude or limit timber harvest, such allocations are, in most cases, inconsistent with timber management plan objectives.

Subsequent to the development of the Olympic's Draft Forest Plan and DEIS, the incorporation of MR attainment strategies into each Forest's Current Direction alternative was appealed (appeal number 1770, brought by the Northwest Forest Resource Council on September 18, 1986). In response to decisions of the Chief of the Forest Service and the Deputy Assistant Secretary of Agriculture regarding this appeal (which was denied), Appendix I of this document was prepared as part of a Supplement to the DEIS.

The appellants requested that the appropriateness of MRs be examined through the environmental analysis process. The analysis presented in Appendix I addresses the issues raised by the appellants by examining alternative means of meeting management requirements and determining the opportunity costs associated with the selected MR strategies. If a given MR results in a reduction of over 2 percent in either the present net value (PNV) or the long-term sustained yield capacity (LTSYC) of the maximum PNV benchmark, alternative MR implementation means and opportunity costs are evaluated in Appendix I.

The Appendix I analysis (which has been updated since publication of the Supplement to the DEIS) indicates that three of the Forest's Management Requirements entail PNV or LTSYC opportunity costs over 2 percent. The largest effects are associated with the "no harvest" allocations (SOHAs) necessary to assure maintenance of viable northern spotted owl populations. The timber yield reductions resulting from riparian zone management and maintenance of viable populations of cavity excavators also involve opportunity costs exceeding the 2 percent level of significance.

The alternative implementation means selected for attaining the objectives of these three MRs were, with one exception, those having the lowest PNV and LTSYC opportunity costs. In the case of the riparian zone MR (the single exception), the selected implementation strategy was slightly higher in PNV opportunity cost than one of the alternatives. The selected method was chosen because it provides both the best representation of expected implementation practices and the most accurate modeling technique. Please refer to Appendix I for complete discussion of MRs, alternative means of their implementation, and opportunity costs of their application.

BENCHMARK ANALYSIS

Prior to the development of alternatives, benchmark analysis was completed. The purposes of this analysis were to establish the range of resource output potentials available to the Forest, identify opportunities for and limitations in responding to ICOs, and assess the opportunity costs associated with changes in a variety of basic management assumptions. Each benchmark was designed to provide specific information about resource output possibilities, while simultaneously serving as a basis for determining particular opportunity costs (through comparison with other benchmarks). The Olympic's DEIS benchmark analysis process involved the development of seventeen benchmarks. These are outlined below and are described in detail in Appendix B.

Benchmarks developed and analyzed in this stage of the alternative development process were similar to alternatives, in that each benchmark involved the application of management prescriptions to Forest land to achieve a distinct set of objectives. Unlike alternatives, however, benchmarks are usually not considered for actual implementation because of the limited scope of the objectives included in most of them. Because they are designed to establish output maximums or identify specific tradeoffs, they may lack adequate consideration of environmental effects, fail to comply with laws or regulations, or be unresponsive to public issues and management concerns. Their primary function is to establish the range of resource output levels within which the alternatives must fall. This range is referred to as the decision space.

Benchmarks fall into two categories: those that explore resource output potentials; and those that explore the tradeoffs of applying specific policies, management requirements, or planning assumptions. Specific benchmarks of both varieties are required by National Forest Management Act regulations (36 CFR 219.12(e)). These include:

- **Minimum Level:** The purpose of this benchmark is to assess the costs and outputs that would be associated with maintaining the Forest under Federal management, while conducting no active resource management programs. Only those activities necessary to protect the Forest and its incidental users will be undertaken. Management for resource output production will not occur. In the remainder of this document, the minimum level benchmark is referred to as BM 0. This benchmark was not analyzed in FORPLAN; output estimates were based on projections of resource interactions.

- **Maximum Present Net Value Based on Established Market Prices:** This benchmark was designed to determine the outputs and effects associated with maximizing present net value when only those resources having established market prices are given monetary value in the analysis. This benchmark is referred to as BM 11 in this document.

- **Maximum Present Net Value Including Assigned Values:** This benchmark was designed to determine the outputs and effects associated with maximizing present net value when those nonmarket resources that can be assigned monetary values are also valued in the analysis. This benchmark is referred to as BM 7, and is also called the "maximum PNV benchmark."

- **Maximum Timber Levels:** The Forest's maximum potential to produce timber outputs was established through the benchmark process. Several benchmarks were developed and analyzed in order to establish timber production potential under a variety of assumptions. The one most directly comparable to the alternatives is the benchmark designed to maximize timber output under constraints identical to those applied to BM 7. This is identified as BM 7T in this document.

In addition to the benchmark analysis required by the National Forest Management Act regulations, several benchmarks were analyzed to identify specific tradeoffs and effects. This analysis included assessments of the effects of:

- Management Requirements

- Restricting timber harvest to stands that have reached 95 percent of culmination of mean annual increment (CMAI)

- Nondeclining flow (NDF)

- A variety of assumptions regarding the rate at which timber value will increase

- Maintaining or discontinuing the Shelton CSYU

The analysis of benchmarks provided valuable information regarding output potential, resource interactions, and the decision space in which the Forest could operate. This information was vital in the formulation of alternatives, as it provided understanding of both the opportunities for, and limitations on, resolution of public issues and management concerns. Benchmark analysis was also instrumental in the analysis of opportunity costs associated with Management Requirements.

Maximizing timber production involves some sacrifice of all other outputs. Present net value declines for two reasons: some timber stands involve timber management costs in excess of projected revenues, and prescriptions which maximize timber output generally involve longer rotations and more intensive management than those which maximize PNV. Unroaded recreation opportunity, scenic quality (as defined by Visual Quality Objectives), and old-growth habitat disappear completely (on acres suitable for harvest), as providing these outputs requires elimination or modification of harvest. Fish and wildlife outputs are reduced as a result of the habitat changes brought about by harvest. These changes include increased sediment load and reduced streamside cover in the case of fish, and modified stand age structure in the case of wildlife.

Maximizing present net value also leads to reductions in all other areas. Its effect on timber output potential results from the elimination of harvest in areas where management costs exceed returns and the use of timber management prescriptions selected on the basis of contribution to PNV rather than timber output. Fish, wildlife, scenic quality, and old-growth outputs are affected to nearly the same degree as when timber is maximized, since a high level of timber production is associated with maximizing PNV. Unroaded recreation opportunity is affected less severely, since most of the timber stands having management costs in excess of returns lie in currently unroaded areas.

Analysis of the resource relationships which interact to form the Forest's decision space identified two key sets of tradeoff patterns that proved very useful in the formulation of alternatives and the interpretation of alternative outputs and effects. The benchmark results indicate that the tradeoffs (in timber output and PNV) associated with making even small increases in fisheries outputs, wildlife-related recreation, and availability of old-growth forest are generally substantial. This is especially true of fisheries outputs and wildlife-related recreation, as major reductions in harvest levels are needed to generate even a small increase in either of these outputs. Post-benchmark analyses have indicated that the principal opportunities to increase fish and wildlife habitat quality (other than that related to the availability of old-growth habitat) lie in implementation of localized habitat improvement projects (see "Mitigation Common to All Alternatives"). Such projects can increase habitat productivity without affecting timber harvest levels.

Conversely, relatively large increases in scenic quality, Primitive and Semi-Primitive recreation opportunity, and unroaded area retention can be obtained with only small decreases in timber output and PNV. Understanding of these tradeoff relationships was instrumental in the process of formulating alternatives. It served to identify both the areas in which a wide range of opportunities to resolve public issues and management concerns was available and those in which such opportunities would be rather limited.

The benchmark analysis process described in this section of the FEIS was designed to make it possible to assess the outputs and effects of Forest Plan alternatives in the context of a well-defined decision space of resource output opportunities. Since the original alternatives are based on the same analysis parameters (e.g. yield relationships, economic data and NFMA requirements) as the benchmarks, such assessments are appropriate. Alternative NC, on the other hand, is derived from an entirely different basis (current timber management plans). It would therefore be inappropriate to relate the outputs and effects of this alternative to the decision space developed in benchmark analysis.

The numerous changes in both basic inventory data and management requirements and opportunities that have occurred since publication of the DEIS have necessitated reanalysis of several of the benchmarks discussed above. Benchmarks 3 (maximum PNV without MRs), 7, 7T, and 11 have been reevaluated using the Forest's revised FORPLAN model. The results of the benchmark reanalysis are described in detail in Appendix B, "Benchmark Analysis." The basic conclusions regarding tradeoff relationships and decision space described above have not been contradicted by the updated analysis.

DEVELOPMENT OF THE ALTERNATIVES

The minimum and maximum potential output levels of Forest resources, as well as several important resource tradeoff relationships, were identified in the benchmark analysis process. The maximum PNV benchmark (BM 7) served to establish the most cost-efficient land allocation and schedule of activities and outputs available, given the information quantified in FORPLAN. The understanding gained from benchmark analysis, in particular the results of Benchmark 7, provided one of the two key bases for the development of alternatives.

The second principal focus of alternative development was the set of issues, concerns, and opportunities to be addressed in the planning process. While the benchmarks were useful in establishing maximum levels of output and PNV, they were not intended to address ICOs. This task called for the more subjective process of mixing understanding of production potentials and tradeoffs with knowledge of the issues to be addressed and the possible ways in which this could be done. The construction of alternatives, or possible ways to address issues, involved the development of a variety of sets of goals and objectives. Each of these was based on understanding of production possibilities and tradeoff relationships, and each represented a distinct approach to the planning questions described in Chapter I.

A key aspect of ICOs is the level of demand anticipated for each of the Forest's resources. Those outputs for which expected demand exceeds projected supply are generally the focus of issue development, since they represent scarce resources of high public value. Benchmark analysis assisted in establishing potential supply levels, while assessments of demand established the degree to which each output or resource would be desired by Forest users. In essence, all of the resources and outputs emphasized in ICOs are characterized by a level of anticipated demand which exceeds projected supply. In the case of outputs for which quantified demand projections are possible (unroaded recreation opportunity, timber volume, fish and wildlife outputs), expected demand exceeds potential supply in all cases. Outputs which are tied to a fixed land base, and for which demand projection is more qualitative than quantitative, are characterized by expectations of increased intensity of "demand" for the finite resource in question. Examples of such outputs are acres providing scenic quality, acres of old-growth, and number of designated Wild and Scenic Rivers.

Because the Forest is unable to provide any individual issue-related output at a level which will fully satisfy projected demand (let alone all such outputs in combination), the management situation faced in developing Plan alternatives is one of designing and evaluating different mixes of outputs and demand satisfaction packages. None of these packages provides the "ideal" level of any output, and all represent a different balance in the satisfaction of demand for individual outputs. Please refer to Forest Plan Chapter II for further detail regarding potential supply of and projected demand for key Forest resources. The individual resource discussions in Chapter III of this FEIS also contain demand and supply projections, and development of the Forest's decision space (through benchmark analysis) is discussed in detail in Appendix B, "Benchmark Analysis."

The establishment of alternative sets of management goals and objectives marks the initial step in the process of developing specific, detailed alternatives and analyzing their outputs and effects. In addition to the need to reflect a wide range of opportunities within the Forest's decision space and a variety of approaches to addressing ICOs, the development of alternative goal sets was conducted within the framework of three specific considerations: the cost-efficiency of FORPLAN solutions, the relationship of the Shelton CSYU to the remainder of the Forest, and the set of required alternatives included in National and Regional planning direction. These considerations are discussed individually in the following paragraphs.

NFMA regulations require that the activity and output schedule associated with each alternative reflect, to the extent practicable, the most cost-efficient combination of management prescriptions examined that can meet the objectives established for that alternative. While this requirement does not directly affect the establishment of specific alternative goals, it strongly influences the way FORPLAN analysis is conducted. In order to ensure that the ultimate solution of each FORPLAN analysis represents maximum cost-efficiency, the ID Team used "maximize PNV over the 150-year planning horizon" as the final objective function in the FORPLAN analysis of each alternative.

Working in response to the "maximize PNV" objective function, the model uses what is essentially a two-step process in developing its solution for each alternative run. The first step consists of limiting the range of possible solutions to those fully attaining the goals of the alternative (expressed as constraints and/or output objectives). The second involves identifying, from this range, the unique solution which accomplishes these goals in the most cost-efficient way. This procedure, in combination with pre-FORPLAN analysis of the cost-efficiency of prescriptions to be included in the model, assures that each alternative's goals are met in the most cost-efficient manner available.

The second important consideration influencing development of alternatives was the need to maintain the distinction between the Shelton CSYU and the remainder of the Forest. The nature and provisions of the Cooperative Agreement which govern management of the Shelton CSYU make it necessary to treat this area and the remainder of the Forest as separate entities, particularly with regard to the development of timber harvest schedules. Therefore, two distinct sets of alternative goals were developed: those relating to the CSYU (some of which include responses to the management objectives of Simpson Timber Company), and those covering management of the remaining National Forest land. Complete alternatives, covering all lands included in the planning area, were created by combining alternatives for non-CSYU lands with CSYU alternatives having similar management emphases. With the exception of DEIS Alternative F, in which dissolution of the CSYU is proposed, all alternatives were constructed on the basis of separation of the two management entities. Resource interactions do not cross the boundaries of the CSYU, and the activities and outputs of one area are in no way dependent on those of the other.

In DEIS analysis, the complete separation of the CSYU and the remainder of the Forest was maintained throughout the 150-year analysis horizon. For FEIS analysis, this approach was modified to incorporate the eventual recombination of all National Forest land upon termination of the Cooperative Agreement. The analysis of Alternatives C-Preferred (Modified), H (Modified), and I now includes merging of National Forest land at the end of the sixth decade, with the entire National Forest being treated as a single management entity from the seventh decade on. To maintain the thoroughness of the FORPLAN analysis, Simpson Timber Company land is also modeled as a distinct entity after the sixth decade. This change in modeling has had no discernible effect on first decade timber harvest levels.

Recombination was not included for Alternative A-Current Direction (No Action) because the current calculations of harvest level within and outside of the CSYU, based on timber management plans, are based exclusively on the long-term production potentials of the two separate areas. Recombination was also excluded in the analysis of Alternative B-Departure (Modified), since the departure aspect of this alternative negates any possibility that eventual merging of National Forest land could have an effect on management during the 50-year planning horizon. Including termination of the Cooperative Agreement in the analysis can only have an effect on early decade harvest levels and other outputs in the case of nondeclining flow alternatives.

An additional aspect of Shelton CSYU management which has had an influence on the development of alternatives is the question of the applicability of Management Requirements. Simpson Timber Company has expressed the concern that these requirements may not be consistent with the terms of the Cooperative Agreement, and has asked that alternatives be developed which include differing approaches to MR application. In response to this concern, two alternatives were developed in the DEIS (Alternatives B-Departure (RPA) and D-Departure) which do not fully meet Management Requirements on the Shelton CSYU. All of the alternatives considered in detail in the FEIS have been designed to fully meet MRs on National Forest land within the Shelton CSYU.

DEIS Alternative B-Departure (RPA) was formed to include MR attainment allocations which reflect current operating plans, as developed under the provisions of the Cooperative Agreement. DEIS Alternative D-Departure was structured to reflect the provisions of the current Timber Management Plan for the Shelton CSYU. Neither of these alternatives contains the wildlife habitat allocations currently considered necessary to assure long-term population viability. Therefore, the Shelton CSYU portion of these alternatives is not fully consistent with NFMA regulations. A determination that the Cooperative Agreement (or the Timber Management Plan developed under it) both precludes application of MRs and overrides NFMA regulations would be necessary before either of these alternatives could have been implemented within the Shelton CSYU.

The final consideration in the development of alternatives was the set of alternatives required by NFMA regulations and direction from the National and Regional levels. It is not required that these alternatives be considered in detail in the FEIS. The required alternatives are as follows:

- No Change: This alternative has been developed as a result of discussions between the Forest Service and the Northwest Forest Resource Council regarding Appeal No. 1588, filed by the Council in May 1986. Appellants asked that a "true no action alternative representing current management plans be included in Forest Plans and EISs." While the appeal was denied, the concerns it raises are important, and the No Change alternative has been designed to respond to these concerns. It is based on the timber output targets and land use assumptions contained in the timber management plans currently in effect on the Forest.

  Alternative NC is the No Change alternative in this document, and is identified as Alternative NC-No Change throughout.

- Current Direction (No Action): This is the alternative of "No Action" required by the Council on Environmental Quality (CEQ) regulations (40 CFR 1502.14) and the National Forest Management Act (NFMA) planning regulations (36 CFR 219.12(f)). It continues management of the Olympic National Forest as defined by existing direction in approved management plans, and involves continuation of existing policies, standards, and guidelines. It includes, to the extent possible, continued production of current levels and mixes of resources.

  Alternative A is the Current Direction alternative (or the "No Action" alternative) in this document and is identified as Alternative A-Current Direction (No Action) throughout.

- Emphasis on the Current RPA Program: This alternative attempts to meet the objectives of the current (1980) RPA Program, as distributed to the Forest through the Regional Guide.

  Alternative B-Departure (RPA) was developed in response to this objective. This alternative was considered in detail in the DEIS but is not carried forward in detail in this FEIS.

- Emphasis on Market Opportunities: This alternative has an emphasis on resource commodities that have an established market price. In the case of the Olympic National Forest, timber, fish caught for commercial enterprise, and developed recreation are the commodities with established prices. Management for other resources will be at levels consistent with the emphasis of this alternative.

  Due to the resource characteristics of this Forest, this requirement is best fulfilled by Alternative B-Departure (Modified).

- Emphasis on Nonmarket Opportunities: This alternative puts emphasis on undeveloped recreation in unroaded areas, scenic quality, wildlife, fish caught for recreational purposes, water, and other amenity values. Market resources will be produced at a level compatible with the emphasis of this alternative.

  Alternative I represents this required alternative.

- Emphasis on Nondevelopment and Intensified Management: This alternative retains most of the unroaded areas on the Forest in an undeveloped condition, while increasing production of commodities (primarily timber) from those areas already roaded. Its purpose is to mitigate the economic effects of precluding commodity production in unroaded areas.

Alternative E is the alternative which best represents this requirement. This alternative was considered in detail in the DEIS but is not carried forward in detail in this FEIS.

- Departure from Nondeclining Flow: Planning direction requires analysis of at least one "departure" alternative. This is an alternative in which the timber harvest schedule deviates from the nondeclining flow schedule associated with equivalent land allocations and management prescriptions. Timber harvest level may drop from one decade to the next under a departure regime, provided that the long-term sustained yield capacity associated with the departure is at least equal to that of the nondeclining flow alternative on which the departure is based.

- Three departure alternatives were included in the Forest's DEIS analysis: B-Departure (RPA), C-Departure, and D-Departure. Only B-Departure (Modified) is considered in detail in this FEIS.

Given the above set of requirements and considerations, and the results of the benchmark analysis process, the ID Team could begin the process of developing alternatives (in addition to the required alternatives) in response to the ICOs. This process was essentially iterative in nature, with each specific step largely dependent upon the results of the preceding step. The benchmark analysis provided key insights into production opportunities and tradeoff relationships, and was critical in defining the kinds of alternative goal sets worthy of investigation. The ICOs provided direction as to the possible objectives that should be analyzed. The set of required alternatives (which were analyzed first) provided the framework to develop additional alternatives, since they addressed individual planning questions to widely differing degrees. Finally, input received on the DEIS was used to formulate a final set of alternatives which are responsive to issues, concerns, and opportunities.

PREFERRED ALTERNATIVE

A preferred alternative is identified. The selection of the preferred alternative was made only after careful comparison of all alternatives on the basis of their resource outputs, environmental consequences, implementation costs, and the tradeoffs between them. The preferred alternative is the alternative considered to come closest to maximizing net public benefits, and is also the alternative which best responds to issues, concerns, and opportunities.

Alternative C is the preferred alternative and is referred to as Alternative C-Preferred (Modified) throughout the FEIS. This alternative is a modified version of DEIS Alternative C. The modifications reflect the Forest's response to public and internal comments regarding the Draft Forest Plan.

ALTERNATIVES CONSIDERED, BUT ELIMINATED FROM DETAILED STUDY

The process of alternative development drew from many sources of information and was designed to explore a wide range of possible responses to public issues, management concerns, and identified resource management opportunities. The IDT considered many alternatives other than the ten described in detail later in this chapter. Results of this process often closely approximated other alternative formulations. Some of the alternatives considered did not respond to the ICOs, and others could not be implemented without changes in existing laws. Still others required decisions at a level beyond the forest plan decisionmaking level before implementation. The following alternatives have been eliminated from detailed study and further consideration in this planning effort.

BENCHMARKS

As described in the "Benchmark Analysis" section of this chapter, the purpose of benchmarks is to provide information regarding maximum biological potentials and economic and resource tradeoffs for conditions on the Olympic National Forest. Information developed from the analysis of benchmarks was useful in determining the range of production capabilities of the Forest, but was less useful in addressing the issues and concerns embodied in the planning questions discussed in Chapter I. The major factor behind benchmarks not being developed into alternatives was their relatively unresponsive land allocation patterns.

Because the benchmarks were designed to identify specific output maximums or assess individual tradeoff effects, they are quite limited in the scope of their objectives. For this reason, individual benchmarks may lack adequate consideration of environmental effects, fail to comply with regulations or laws, or fail to respond to unquantified resource values in the selection of management prescriptions. Because of their narrow structure, none of the benchmarks developed during the initial stages of analysis were considered sufficiently responsive to the planning questions to be developed into a complete alternative.

VARIATIONS ON CURRENT DIRECTION

Several variations of what appears as Alternative A-Current Direction were developed during the planning process. The land allocation from existing land use plans was kept constant, but new information was used to demonstrate how current output levels would change. This new information included the Management Requirements developed in response to the NFMA, which were not considered in the development of existing plans. During benchmark analysis, a variety of differing approaches to Management Requirements (including some in which the requirements were only partially met) were tested. These variations were not considered in detail because they were not responsive to the planning questions, failed to meet the new requirements, or closely approximated other alternatives that were more responsive.

SELECTED DEIS ALTERNATIVES

The DEIS presented ten alternatives which were considered in detail. An eleventh alternative, NC, was added through the Supplement to the DEIS. Several of these alternatives have been dropped from detailed consideration since the DEIS, Alternatives C-Departure, D-Departure, E, F, and G. Alternatives

B-Departure, C, and H have been modified and are carried forward in the FEIS, along with Alternatives NC, A, and I.

During the public comment period to the DEIS, little to no support was expressed for any of the alternatives which have been dropped from detailed consideration. Given the lack of support for or comment on these alternatives, they were reviewed to determine their usefulness in the FEIS. It has been determined that the outputs, goals, and objectives of these alternatives are adequately represented by the remaining six alternatives. They are not needed to maintain an adequate range of alternatives. They needlessly complicate the FEIS with additional information which has proven to be unimportant to the public and to the decisionmaker. The analysis conducted using these alternatives proved useful in exploring management options and alternate means of addressing issues, concerns, and opportunities in the DEIS. However, the remaining six alternatives represent those receiving the most attention in the DEIS. These six provide a reasonable and appropriate range of choices for the decision on the Olympic National Forest Plan.

Alternative B-Departure (RPA) in the DEIS was modified to provide a more realistic commodity emphasis alternative. Given the effects of spotted owl requirements, efforts to achieve the decade-old 1980 RPA targets would result in a drastically extreme first decade departure from nondeclining evenflow for timber. Other RPA targets would be unachievable. The modified B-Departure in the FEIS presents a substantial but potentially implementable timber sale schedule which reflects public input for a "community stability" alternative.

Alternative H in the DEIS received considerable public support but with several suggested modifications, including some components of Alternative G. These modifications made to H created H (Modified), eliminating the need for Alternative G.

Finally, Alternative C, the identified preferred alternative in the DEIS, has been modified in the FEIS to reflect the comments received to the Draft. The FEIS C-Preferred (Modified) is more fully responsive to the issues, concerns, and opportunities of the Forest.

BASE SALE SCHEDULES FOR DEIS DEPARTURE ALTERNATIVES

The base sale schedules (nondeclining flow timber harvest levels) associated with Alternatives B-Departure (RPA) and D-Departure were explored, but not analyzed in detail. The land allocation of Alternative B-Departure's base sale schedule was very unresponsive to local issues and concerns. Its harvest base included many areas in which timber management costs exceed projected returns. The base sale schedule of Alternative D-departure closely paralleled the harvest level in Alternatives C and E and was dropped from additional consideration.

ALTERNATIVES CONSIDERED IN DETAIL

The alternatives considered in detail offer various views as to how the land and resources of the Olympic National Forest can be managed. Each is a combination of land uses, management practices, and activity schedules which, when implemented, is expected to result in a unique combination of resource levels, land uses, and environmental consequences. Together, they present a broad range of reasonable management alternatives.

Each alternative has a set of goals and output objectives. These are designed to respond to the public issues and management concerns incorporated in the planning questions discussed in Chapter I. Table II-1 displays how each alternative responds to these planning questions.

In each alternative, management options are distributed on the lands of the Forest through the allocation of different management areas (also referred to as management strategies or management prescriptions). However, some land allocations and management emphases are common to all alternatives. These are described later in this section. Acreages assigned to the different management areas vary from one alternative to another (see Table II-2). Locations of the management areas for each alternative are displayed on the maps which accompany this document.

Individual management areas are described later in this chapter with more detailed descriptions presented in Chapter IV of the Forest Plan. Each of these areas is subject to management according to specific standards and guidelines. These deal with potentially adverse environmental effects, and attempt to mitigate them by avoiding, minimizing, rectifying, or reducing them. Some Standards and Guidelines were developed by the Interdisciplinary Team specifically to respond to conditions on the Olympic National Forest. Others were adopted from the Regional Guide for the Pacific Northwest Region. The Standards and Guidelines which apply to the Preferred Alternative are found in the final Forest Plan accompanying this FEIS. Variations from or additions to these Standards and Guidelines which were developed for use in other alternatives are presented in Appendix D.

The management of the Forest outlined in the different alternatives will result in various land uses, resource output levels, and environmental effects. Many of the differences among alternatives reflect variations in specific objectives from alternative to alternative. The significant land uses, outputs, and environmental effects associated with each alternative are summarized in Tables II-14 and II-15. Table II-14 presents, by time period, those uses, effects, and output levels which are readily quantified; Table II-15 covers qualitative differences among the alternatives. (Refer also to Tables II-2 through II-14 for resource comparisons among alternatives.)

The resource interactions which result in the various levels of outputs and effects associated with the alternatives are described in Chapter III, "Affected Environment." Detailed presentations of the results of these interactions are included in Chapter IV, "Environmental Consequences."

MITIGATION COMMON TO ALL ALTERNATIVES

In addition to the Standards and Guidelines described in the Forest Plan and Appendix D, there are several mitigation and enhancement activities that are expected to be implemented in every alternative. Although the degree to which any single activity is implemented can vary among alternatives, these variations are not expected to lead to any significant differences in overall resource output levels or environmental consequences. Therefore, differences in program levels will not be developed or analyzed in detail for individual alternatives. The specific level of implementation of each activity is included in the Forest Plan for the preferred alternative.

The following activities are included in all alternatives:

- Scenic resource rehabilitation and enhancement.

  These activities are implemented in areas allocated to meet specific Visual Quality Objectives. Since some of these areas may not currently meet the assigned objective, projects are implemented to achieve the objective within a reasonable time.

- Seeding and planting for fish and wildlife habitat.

  These activities are usually implemented in areas where the vegetation has been altered by other forest management activities, such as timber harvest and road construction. The vegetation seeded or planted is expected to provide cover along stream banks to improve fish habitat and/or provide forage for wildlife to supplement those forage species altered by the initial management activity. These projects are occasionally implemented to attract wildlife species away from newly reforested areas.

- Timber harvest before culmination of mean annual increment to enhance wildlife habitat.

  This activity has not been practiced to date, but is expected to occur in the future as a means of enhancing wildlife forage in areas that have been extensively harvested and/or burned in the past. Some areas on the Forest have large contiguous acreages in the same vegetative stage. Wildlife populations, especially deer, have increased as a result of increased amounts of forage available. As the tree canopy in forage-producing areas closes, resulting in less sunlight reaching the forest floor and less forage being produced, populations may decline.

- Spawning and rearing habitat improvement.

  These projects are intended to increase or repair fish habitat by placing gravel in spawning beds, providing access to areas not previously reached, and creating pools and other rearing habitat by placing large logs or other structures in streams.

- Stream barrier modification or removal.

  These activities modify or remove natural or management-related barriers (such as water falls or log jams) that impede or prohibit fish passage.

- Pothole development and maintenance.

  These are relatively small and localized projects aimed at creating or supplementing waterfowl habitat.

- Nest structure construction and snag maintenance.

  Nesting platforms, bird houses, and other structures are occasionally constructed to enhance bird nesting opportunities in specific areas. Guy wires and other support devices are also used to keep dead and defective trees from being blown over by the wind, especially when eagle nests or occupied cavities are present.

- Fish cover development and maintenance.

  The intent of this activity is to provide fish cover through modification of vegetative conditions within or around lakes and ponds and along stream channels. The cover created provides shade over the water and instream vegetation, and thus provides cover for fish.

- Fishway construction and maintenance.

  As opposed to the stream barrier removal activities described above, these projects are designed to provide fish access to areas not previously used because of falls, cataracts, and other natural barriers. A facility is constructed on site rather than removing the cause of the obstruction.

- Best Management Practices.

  General Best Management Practices will be selected and tailored for site-specific conditions to arrive at project-level BMPs for protection of water quality. (See Appendix J, "Best Management Practices," for a discussion of the process and practices.)

- Seeding and planting for erosion control.

  As opposed to the seeding and planting for fish and wildlife, this activity is designed specifically for erosion control. The species of plants used in these projects are selected to discourage use by animals. The areas on which this kind of activity is generally implemented are sensitive soils and road cut and fill slopes.

- Water condition improvement structures.

  Rip-rapping, gabions, and other structures are occasionally used to stabilize streambanks, prevent changes in stream course, and reduce erosion.

- Road paving for resource protection.

  Paving is used as a means of reducing sediment from road use when that use occurs during the wetter times of the year, especially near prime fish habitat or domestic water supplies.

- Landing removal and rehabilitation.

  This activity is aimed at preventing the large-scale soil movement that can result from the rotting of logs and other woody debris buried during past landing construction. Landings subject to this problem are often on steep slopes. Landing failures can damage fish habitat and reduce water quality if the displaced soil reaches a stream course. It can also reduce timber site productivity and has, on occasion, destroyed plantations.

LAND ALLOCATIONS AND MANAGEMENT EMPHASES COMMON TO ALL OR MOST ALTERNATIVES

Before considering the details of the alternatives being evaluated, it is important to note that several resource management programs are treated in the same way in all alternatives (Alternative NC is sometimes an exception). These are briefly described below, and are not described further in the alternatives themselves. Additional information on all of these subjects is provided in Chapter III.

In reviewing Alternative NC, it must be noted that the allocations and management emphases common to the other alternatives would, in some cases, conflict with the land base assumptions used in the calculation of timber management plan outputs. Where this occurs, the provisions of the timber management plans take precedence in formulating Alternative NC-No Change.

MUNICIPAL WATERSHEDS

Although the kind and amount of activity proposed within each watershed varies, the Forest Service recognizes the need to protect all municipal watersheds. All alternatives except NC are designed to provide water that meets quality standards. Specific management practices and constraints are displayed in the

Forest Plan, Chapter IV, "Standards and Guidelines." Alternative NC includes the same municipal watershed areas as the original alternatives. However, the limitations on the proportion of each watershed which may be harvested in a given decade do not apply in this alternative.

THREATENED AND ENDANGERED PLANT AND ANIMAL HABITAT

Management of this resource is specified by existing laws and regulations which are a part of all alternatives (see Standards and Guidelines in Forest Plan, Chapter IV).

HISTORICAL AND CULTURAL RESOURCES

As with threatened and endangered species habitat, management of historical and cultural resources is dictated by existing laws and regulations beyond the scope of this planning process. All alternatives comply with these laws and regulations through uniformly applied programs and implementation plans.

AMERICAN INDIANS

Most lands managed by the Olympic National Forest were ceded to the United States through treaties with local Indian tribes. These treaties reserved specific rights to the Indians and are recognized and provided for in all alternatives.

TRAILS

The number of existing and proposed trails will remain the same in all alternatives, however, the "setting" or environment they pass through will vary from predominantly unmodified natural environments to environments substantially modified with management activities readily evident. The objective is to increase the miles of trail to meet projected demand while not exceeding the user density for a particular ROS class. There are a total of 227 miles of existing trail and 331 miles identified for possible trail construction. There is a need to reconstruct approximately 98 miles of existing trail. There is a need to add 7 miles of trail to meet demand for non-motorized use at the present time and an additional 45 miles will be needed by the year 2000. The demand for motorized trails will be analyzed and the Forest will look for opportunities to meet demand where resource impacts and use conflicts can be avoided.

DEVELOPED RECREATION FACILITIES

The number of existing and proposed developed recreation sites remains the same in all alternatives, however, the "setting" or environment they are in or that one must travel through to get to the facility will vary greatly from one alternative to the next. Access corridors and the area surrounding developed sites will vary from predominantly unmodified natural environments to environments substantially modified, with management activities readily evident. The objective is to increase developed site "persons at one time" (PAOT) capacity to meet demand while not exceeding the user density for a particular ROS class. Currently there is a PAOT capacity of 2,285. A PAOT capacity of 4,570 is needed by the year 2000 for developed campgrounds.

WILDERNESS

A total of 88,265 Wilderness acres remain the same in all alternatives. The five Wildernesses consist of the Buckhorn, 44,258 acres; The Brothers, 16,682 acres; Mt. Skokomish, 13,015 acres; Colonel Bob, 11,961 acres; and Wonder Mountain, 2,349 acres. The greatest effect on Wilderness will be the indirect effects of activities that take place in areas close or adjacent to Wilderness.

UNROADED AREAS

There is only one unroaded area that does not change, except for the No Change Alternative. Because the 491-acre McDonald unroaded area is in a Spotted Owl Habitat Area, it will remain unroaded in all alternatives except the No Change Alternative where it would be allocated to timber production.

RESEARCH NATURAL AREAS

The Forest has one existing area, the Quinault RNA. This area is managed in the same way in all alternatives.

NATIONAL NATURAL LANDMARKS

All identified potential areas are located within existing Wildernesses and the Quinault RNA. Since management of Wilderness and the Research Natural Area is more restrictive than that needed for National Natural Landmarks, this program is not varied between alternatives.

WILD AND SCENIC RIVERS

Based on analysis completed during this planning process, there are fourteen rivers on the Olympic Peninsula that originate upon, or flow through National Forest land that are eligible for designation as Wild and Scenic Rivers. See Appendix F for detailed information.

The Olympic National Forest has been determined to be the logical lead agency to complete suitability analyses for ten of those rivers, and these are treated differently among the alternatives. The remaining four rivers, the Quinault, Hoh, Bogachiel, and Elwha, should be studied by another agency. During the study period, regardless of the land allocation indicated in each alternative, lands within these four corridors will be managed to retain existing attributes. The allocation in each alternative serves as an indication of how the Forest Service would manage the land if future Wild and Scenic River classification studies do not recommend a given river for inclusion in the Wild and Scenic River System.

The rivers considered eligible for designation as Wild and Scenic Rivers are the same in Alternative NC as in the original alternatives. However, the four rivers for which the Olympic National Forest is not the logical lead agency in completing suitability analyses (the Quinault, Hoh, Bogachiel, and Elwha Rivers) will not receive the same treatment in Alternative NC as in the original alternatives. The provisions of Alternative NC do not include the requirement that the qualifying characteristics of these river corridors be retained until completion of classification studies.

ADMINISTRATIVE SITES

All existing administrative sites will be needed to implement the alternatives and are therefore retained. Improvements to existing facilities will be made. Refer to the Standards and Guidelines in the Forest Plan, Chapter IV.

SPECIAL USE SITES

In all Forest Plan alternatives, existing special use land allocations such as permitted electronic sites, water systems, and fish hatcheries will continue to be operated and managed under the terms and conditions of approved permits and management plans. Examples are the communications sites at Neilton Point, Buck Mountain, and North Point. Any nonconforming special uses that are contrary to applicable policy, laws, or regulations will be terminated or phased out over time through NEPA processes that include permittee and public involvement opportunities.

SEASONAL ROAD CLOSURES

The Forest currently has a program of seasonal road closures that serves as a tool in wildlife management. Continuation of the current program does not conflict with the goals and objectives of any of the alternatives. Additional road closures needed for management will vary between alternatives.

UTILITY CORRIDORS

Land allocation decisions for utility corridors and public highways have always included, among other things, consideration of the resulting long-term commitment inherent in their need, occupancy, and use. All Forest Plan alternatives for management, therefore, recognize the long-term commitment associated with existing utility corridors and public highways and that these allocations and uses are expected to remain a valid consideration. Good examples of long-term benefits to the public are utility corridors operated and maintained by several Public Utility Districts, Bonneville Power Administration, and public and private water companies. Long-term public benefits also accrue from the many miles of public highway system facilities managed and maintained by counties and the Washington State Department of Transportation.

The probability of additional need is recognized, although no specific provisions, proposals, or need for future corridors were identified throughout the Forest Plan development process. Minor improvement or widening proposals of existing corridors have been received from the Bonneville Power Administration, and improvement and relocation work is regularly programmed and scheduled for county roads and other public highways.

HARVEST CUTTING METHODS

In all alternatives, timber harvest outputs are based on the exclusive use of even-aged timber management regimes. In addition, all regeneration harvest is based on use of the clearcutting harvest system. Silvicultural and economic considerations are the basis for the selection of this approach. Although even-aged management and regeneration harvest through clearcutting are assumed in the estimation of timber outputs, use of other systems during implementation is expected. Long-term retention of "leave" trees for future snag recruitment may be prescribed in all harvest areas. Provisions for retention of existing trees for recruitment of large woody debris in streams shall be included in riparian areas. Other systems may be employed if site-specific analyses indicate that this would be preferable. Refer to Appendix G, "Selection of Harvest Cutting Methods," for detail regarding the selection of harvest systems.

COMPETING AND UNWANTED VEGETATION

The Forest Plan incorporates the Pacific Northwest Region's FEIS for Managing Competing and Unwanted Vegetation. In implementing the Forest Plan through project activities, the Forest will comply with the Record of Decision issued by the Regional Forester dated December 8, 1988, and the Mediated Agreement of August 1989. Use of all vegetation management techniques is allowed only when other methods are ineffective or will unreasonably increase project costs. Emphasis must be on prevention and early treatment of unwanted vegetation and full public involvement in all aspects of project planning and implementation.

DESCRIPTION OF ALTERNATIVES CONSIDERED IN DETAIL

INTRODUCTION

The following alternatives were selected for detailed study and evaluation. They represent a broad range within the decision space identified through benchmark analysis. They also provide a variety of ways of addressing the planning questions described in Chapter I.

Because of the distinction between the Shelton CSYU and the remainder of the Forest, the timber output displays for the various alternatives presented throughout this document must be reviewed carefully. Essentially, the total harvest level associated with each alternative is subdivided into two distinct entities: the Shelton CSYU and remaining National Forest land. The Shelton CSYU consists of Simpson Timber Company land and most of the land on the south end of the Hood Canal District. Remaining National Forest land includes the balance of the Hood Canal District, and the Quilcene, Quinault and Soleduck Districts. These lands are often referred to as the "East-West zone" or the "Eastside and Westside zones" in this document. Harvest volumes, allowable sale quantities, long-term sustained yield capacities, and other timber output variables are reported separately for Shelton CSYU and East-West zone lands.

Many of the tables throughout this FEIS display total National Forest harvest level. In many cases, this volume fluctuates up and down through time while the description of the alternative being examined includes nondeclining flow. The reason for this apparent inconsistency lies in the separate calculation of Shelton CSYU and East-West harvest levels. Shelton CSYU harvest, which is based on nondeclining flow in all alternatives, includes harvest from both National Forest and Simpson Timber Company land. Harvest from these two ownerships is aggregated to form the combined nondeclining flow harvest level from both.

East-West harvest, based on nondeclining flow in all alternatives except B-Departure, comes from all National Forest land outside the Shelton CSYU. Since harvest from the National Forest portion of the CSYU is coordinated with Simpson Timber Company harvest in establishing the Shelton CSYU harvest level, the National Forest volume alone may fluctuate a good deal from decade to decade while the CSYU as a whole is on a nondeclining flow schedule. Thus, when CSYU National Forest volume is added to East-West volume to establish total National Forest volume, this total may rise and fall from decade to decade as a result of the Forest's CSYU fluctuations.

It is important to distinguish between "sustained yield" and "nondeclining flow." "Sustained yield" refers to the principle that renewable resources are to be managed to provide a perpetual supply of each resource without impairing the productive capacity of the land. In the case of timber production, this means that areas to be managed for this resource are to be treated so that timber production will be continued in perpetuity. This implies reforestation and continued management of the stand (as opposed to harvest followed by abandonment of the site, for example). Providing for sustained yields is a legal mandate guiding Forest Service activities. The concept does *not* entail any requirement regarding the volumes of outputs to be maintained through time.

"Nondeclining flow" is one of many possible strategies for managing timber harvest on a sustained yield basis. The basic concept is that allowable sale quantity (ASQ) from a given area (e.g., Shelton CSYU) is not to decline from one period to the next (in the case of the Forest Plan, periods are decades). In other words, nondeclining flow harvest plans are to be developed to assure that harvest level can be maintained or increased through time. Nondeclining flow is a standard Forest Service policy for managing timber harvest flows, but is *not* required by law. In fact, the National Forest Management Act provides for departure from nondeclining flow if such a strategy best meets the overall objectives of the Plan (36 CFR 219.16(a)).

It should be pointed out that nondeclining flow is a *planning* concept. The idea is to *plan* timber harvest management so that nondeclining flow can be maintained. If the context in which a nondeclining flow schedule is developed is altered, a decline in actual harvest level may be unavoidable. A good example is the Preferred Alternative. The existing timber management plans covering the East-West portion of the Forest include a nondeclining flow harvest level of approximately 225 million board feet (MMBF) per year. Under the Preferred Alternative, harvest will drop to 102 MMBF (also nondeclining flow). This is not a contradiction to the nondeclining flow principle, but rather a reflection of changes in context. The land allocation pattern of the Preferred Alternative is quite different from that of the timber management plans, thus necessitating a change in nondeclining flow harvest level.

A description of each alternative considered in detail follows.

ALTERNATIVE NC-NO CHANGE

INTRODUCTION

The basis for this alternative is quite different from that of the other alternatives. It is designed to reflect the provisions and assumptions included in existing timber management plans *only* , without adjustment for direction developed or information gained subsequent to the publication of those plans (unless such changes are incorporated in Plan amendments). As a result, there are numerous important differences between Alternative NC-No Change and the remaining alternatives:

- Alternative NC does not incorporate the ways or methods to meet management requirements outlined in the regulations governing implementation of the National Forest Management Act (NFMA). The other alternatives include these requirements.

- Among the key requirements not included in Alternative NC are the means of meeting Management Requirements (MRs) developed to assure attainment of specific resource management goals. These requirements will not be applied in Alternative NC unless doing so is fully consistent with the provisions of existing timber management plans.

- Alternative NC is based on the timberland suitability stratification used in the development of the timber management plans. The other alternatives are based on the suitability reassessment conducted in support of this planning process.

- The timber yield estimates associated with Alternative NC are based on the yield tables and projection techniques used in developing the timber management plans. Timber outputs of the other alternatives are estimated on the basis of current yield information.

- The focus of the Forest's timber management plans was the establishment of timber harvest targets. Many of the resource outputs and effects analyzed in this planning process were not considered or evaluated during the development of the timber management plans. Consequently, many of the nontimber resources for which output estimates have been made for the other alternatives cannot be reasonably evaluated in the case of Alternative NC.

- Analysis of the other alternatives was conducted through use of the FORPLAN linear programming model. This model was not used in evaluating Alternative NC. For this alternative, information contained in the timber management plans served as the basic analysis tool, with extrapolations and interpretations of this information used to estimate outputs and effects where it was reasonable to do so.

- The timber output estimated for Alternative NC reflects "potential yield" (as developed in the timber management plans) rather than "allowable sale quantity." The distinction between the two is subtle, and has to do with the degree to which the timber output target is integrated with other resource management objectives. The potential yield calculations of the Olympic's timber management plans were based on the viewpoint that timber is a single resource, to be managed for its maximum yield with minimal adjustment for other resource considerations. The allowable sale quantity developed for the other alternatives, in contrast, is based on complete integration of each alternative's full range of resource management objectives in the calculation of timber output levels.

- Other alternatives were developed specifically to address the issues, concerns, and opportunities outlined in Chapter I and Appendix A of the FEIS. These were not a consideration in the development of Alternative NC.

The No Change alternative has been developed as a result of discussions between the Forest Service and the Northwest Forest Resource Council regarding Appeal No. 1588, filed by the Council in May 1986. The appeal centered on a decision by Regional Forester James F. Torrence "to require inclusion of MRs (Management Requirements) in the Current Direction alternative for each Forest Plan." The crux of the appeal was that a "true no action alternative representing current management plans" was not included in Forest Plan DEISs. While the appeal was denied, the concerns it raises are important, and the No Change alternative has been designed to respond to these concerns. This alternative is based on existing timber management plans, and thus does not comply with all provisions of NFMA and the regulations promulgated by the Secretary of Agriculture to implement this act.

The following provisions of NFMA are not fully complied with in the current timber management plans represented by the No Change Alternative:

36 CFR 219.14 - Timber resource land suitability. Requires identification of land not suited for timber production, based on risk of irreversible resource damage, lack of assurance of reforestation within five years, or withdrawal by act of Congress, Secretary of Agriculture, or Chief of the Forest Service.

36 CFR 219.15 - Specifies a process for choosing vegetation management practices. Also ties to 36 CFR 219.27, which identifies required resource protection and silvicultural practices.

36 CFR 219.16 - Requires that all alternatives identify decadal timber harvest levels and long-term sustained yield capacities, consistent with the requirements of the RPA Program and the Regional Guide. Also specifies conditions under which departures from nondeclining flow will be considered.

36 CFR 219.18 - Requires that Wilderness management direction be provided, including actions needed to limit or distribute visitor use and measures desirable to protect Wilderness and adjacent areas from wildfire, insects, or disease.

36 CFR 219.19 - Provides for viable populations of vertebrate wildlife species, the selection and monitoring of management indicator species, cooperation with wildlife management agencies, and protection of habitat critical to threatened or endangered species.

36 CFR 219.23 - Requires full consideration of water and soil resources, including estimates of current water uses, instream flow requirements, and watershed condition, and protection of water quality and wetland and flood plain values.

36 CFR 219.24 - Requires inventory, evaluation, and protection of cultural and historic resources, identification of opportunities for cultural resource interpretation, and coordination with other agencies.

36 CFR 219.26 - Provides for consideration of plant and animal community diversity.

36 CFR 219.27 - Identifies specific management requirements to be used in the development, analysis, approval, implementation, monitoring, and evaluation of forest plans. Activities covered include silvicultural practices, resource protection, vegetative manipulation, protection of riparian areas, protection of soil and water, and maintenance of diversity.

Because it does not fully comply with the provisions of NFMA, Alternative NC could not be implemented as a Forest Plan without action by Congress and/or the Secretary of Agriculture to change the law and its implementing regulations.

The above discussion is not meant to imply that current implementation of the Forest's timber management plans is being conducted in conflict with laws or regulations. All direction presently in effect is being applied in current management of the timber harvest program. The importance of the above discussion is that it highlights potential conflicts that would result from implementation of Alternative NC (No Change) into the future. Because of its inconsistencies with laws and regulations, the timber output associated with this alternative could not be maintained as projected in this FEIS. To successfully implement Alternative NC in future decades, it will be necessary to either modify the timber output goal of the alternative or revise the laws and regulations governing management of the Forest.

BACKGROUND INFORMATION

Management of the East-West portion of the Forest is currently guided by the Peninsula (1968) and Quinault (1969) Timber Management Plans. These plans specify timber harvest objectives (potential yields) for the two working circles they cover. Both plans have been amended several times. The three most critical amendments have been: (1) 1984 amendments removing Wildernesses created by the Washington State Wilderness Act of 1984 from the timber harvest base, (2) a 1988 amendment to the Quinault Plan incorporating the transfer of approximately 11,900 acres of National Forest land to the Bureau of Indian Affairs in trust for the Quinault Indian Nation, and (3) 1980 amendments which incorporated the land allocations of the Quinault, Soleduck, Satsop Block, and Canal Front Land Use Plans into the timber management plans. While the third set of amendments accounted for the allocations of the unit plans (by shifting acreage from the "standard" to the "special" component of the timber management plan land classification system), it did not change the potential yield calculation to reflect the changed allocations. This was to have been done through the Forest Planning process. The most recent amendment to these timber management plans extends their application until such time that a new Forest Plan is approved.

Management of the Shelton CSYU portion of the Forest is currently guided by the Shelton CSYU Timber Management Plan. Unlike the plans for the East-West zone, this plan includes current land use allocations as well as potential yield objectives. For this zone of the Forest, therefore, timber harvest goals are coordinated with land allocations. This plan has not been formally amended, except to extend its application to January 1, 1991.

In the development of the No Change Alternative, amendments to the original timber management plans have been considered to be an integral part of these plans. The land allocations of current unit plans are therefore assumed to be a facet of the timber management plans also. For this reason they are a component of the No Change Alternative, even though the potential yields of the East-West zone timber management plans have not been adjusted to reflect these allocations.

PURPOSE OF ALTERNATIVE NC-NO CHANGE

This is the "No Change" alternative precipitated by discussions between the Forest Service and the Northwest Forest Resource Council regarding Appeal No. 1588, filed by the Council in May 1986. Its purpose is to project the outputs and effects associated with management of the Forest on the basis of the output projections and land uses specified in existing timber management plans. The timber harvest potential yield estimates and land use assumptions on which this alternative is based are specified in the Peninsula Working Circle, Quinault Working Circle, and Shelton CSYU Timber Management Plans.

The principal guidelines and objectives underlying the development of this alternative are:

- The goal of the alternative is to provide a level of timber availability equal to the potential yield of timber specified in current timber management plans. Output of other resources is subsidiary to this primary goal.

- Land allocations and uses specified in current timber management plans will be applied.

- The ways or means of meeting Management Requirements and other elements of current planning direction that are not fully compatible with timber management plan provisions will not be applied.

- Determination of availability, capability, and suitability of land for timber harvest shall be based on timber management plan suitability stratifications, not the most recent available information.

- Timber harvest prescriptions will emphasize volume output rather than contribution to present net value (PNV), as this is the basic emphasis of current timber management plans.

- Timber yield data and resource relationship information used in the formulation of the timber management plans will serve as the data base for this alternative. FORPLAN analysis will not be conducted.

ALLOCATIONS AND MANAGEMENT PROGRAMS

A separate map of the allocations of Alternative NC has not been developed. The allocations of this alternative most closely approximate those of Alternative A-Current Direction. The principal exception to this is that the MR allocations of Alternative A are not included in Alternative NC.

Recreation

(a) Developed Recreation

Currently inventoried sites suitable for future recreation facility construction will be reserved for this purpose, and will be developed in response to public demand.

(b) Undeveloped Recreation

Unroaded recreation opportunities will be permanently retained in the following unroaded areas: Quilcene, Jupiter Ridge, Jefferson Ridge, Lightning Peak, Upper Skokomish, Moonlight Dome, and South Quinault Ridge. A total of 25,400 acres will remain unroaded.

Wilderness

No specific management emphasis for Wilderness is outlined in existing timber management plans. However, these plans do not in any way preclude continued application of historical direction and intensities of management, while meeting requirements of the Wilderness Act, as specified for Alternative A-Current Direction. No major changes in facilities, such as trail shelters, will be implemented under this management direction.

Research Natural Areas

The existing Quinault RNA will be retained.

Botanical Areas

Two areas have been identified: Pat's Prairie (414 acres) on the Quilcene District for its unusual plant associations, and an area along the South Fork Calawah River (102 acres) on the Soleduck District as an example of typical Olympic rain forest vegetation.

Resource Protection Allocations

In existing unit plans, allocations have been made to restrictive management strategies to avoid the risk of slope failures and the resulting reduction in water quality. Harvest and road construction are precluded in the Gray Wolf River (on 445 acres now largely included within the Buckhorn Wilderness) and Middle Dungeness (5,866 acres) Special Management Areas, and road construction is not allowed in the Rugged Ridge (6,168 acres) and Lower Mt. Baldy (1,750 acres) Special Management Areas. These management strategies are included in Alternative NC.

Scenery

This is one of two alternatives that will provide a middle range of protection for scenery. Two viewsheds will remain natural appearing, five viewsheds will have a slightly altered appearance, six viewsheds will have a moderately altered appearance, and seven will have a heavily altered appearance. Attainment of Retention/Partial Retention VQOs is specified for 24,400 of the 90,100 acres having these objectives.

River Corridor Designations

(a) Wild and Scenic

The Duckabush River will be recommended for designation as a Wild and Scenic River. Management activities will be designed to maintain or enhance the existing attributes within the river corridor until Congressional designation occurs and a specific management plan is developed. Refer to FEIS Appendix F for additional information on existing conditions within this corridor.

(b) Others

Other river corridors will be managed as indicated for riparian zones.

Allocations to Assure Viable Wildlife and Fish Populations

(a) Spotted Owl Habitat Areas (SOHAs)

No areas are allocated for the specific purpose of providing old-growth habitat for the northern spotted owl. Some old-growth habitat will be available as a result of other allocations.

(b) Other Wildlife Allocations

No areas are allocated for the specific purpose of providing mature forest habitat for pileated woodpeckers or pine marten. Some mature forest habitat will be available as a result of other allocations.

(c) Riparian Zone and Fish Habitat Management Allocations

The Streamside Management Units (SMUs) designated in current unit plans will be retained in this alternative. These include areas of "reduced yield" within the East-West portion of the Forest, and areas of both "reduced yield" and "no harvest" within the Shelton CSYU. In addition, Standards and Guidelines governing management activities within riparian zones will apply in Alternative NC. These allocations and standards contribute to the maintenance of fish habitat, both by protecting water quality and by providing a source of large organic debris. The riparian zone allocations of this alternative are not at the level presently felt necessary for riparian protection. This level is reflected in the riparian MR.

Timber Sale Program

Average annual allowable sale quantity during the first decade of the planning period will be 39.9 million cubic feet (224.9 million board feet) from National Forest lands not part of the CSYU, 43.3 million cubic feet (227 million board feet) from Shelton CSYU lands (including Simpson Timber Company), and 61.5 million cubic feet (340.6 million board feet) from all National Forest lands. Approximately 183 miles of new road (49 of them in currently undeveloped areas) will be constructed in the first decade in support of the timber sale program. Because of the timber output emphasis of existing timber management plans, some harvest is scheduled on lands for which timber management costs exceed projected revenues. Also, timber harvest regimes and schedules emphasize volume output rather than contribution to PNV. The rationale for this emphasis on harvest (as opposed to PNV) is social rather than economic. Employment and income levels are enhanced by increased timber output, even if this includes some harvest involving costs in excess of returns.

SOURCE OF ALTERNATIVE NC OUTPUT AND EFFECT ESTIMATES

The outputs and effects estimated for Alternative NC are derived from two principal sources. Those most closely associated with the level of timber harvest are based on the potential yield timber outputs associated with current timber management plans. Examples include timber-related employment levels and miles of road construction. Outputs most directly related to land allocation, such as Primitive/Semi-Primitive recreation opportunity and Visual Quality Objectives met, are estimated on the basis of unit plan land allocations. Qualitative estimates of those outputs and effects for which a quantitative projection could not reasonably be made are based on the expected combined effects of timber harvest level and land allocation pattern, and are usually expressed in terms of the relationship of Alternative NC to other alternatives.

Alternative NC-No Change at a Glance

Primitive/Semi-Primitive - Acres (outside Wilderness)	17,500
Retention/Partial Retention - Acres (VQOs met)	24,400
River Corridor Designations - Number	
Wild & Scenic	1
Others	0
Old-Growth after 1st Decade - Percent of Current Acres (266,800)	56
Elk Population - 1st Decade	3,032
Deer Population - 1st Decade	6,462
Sediment Index 1st Decade - Percent of Current	110
Anadromous Smolts (enhanced) 1st Decade (thousand smolts)	10,306
Annual Allowable Sale Quantity (in millions)	
Shelton CSYU--Total	
CF 1st decade	43.3
BF 1st decade	227.0
--Simpson Timber Company	
CF 1st decade	21.7
BF 1st decade	111.3
--National Forest within CSYU	
CF 1st decade	21.6
BF 1st decade	115.7
East-West Zone (NF not CSYU)	
CF 1st decade	38.2
BF 1st decade	214.8
Total National Forest	
CF 1st decade	59.8
BF 1st decade	330.5
Total (National Forest and Simpson Timber Co. Combined)	
CF 1st decade	81.5
BF 1st decade	441.8
Average Annual Road Construction, 1st Decade (miles):	
Forest-wide Total	18.3
Within Currently Undeveloped Areas	4.9
Changes in Employment - Percent of Peninsula Employment 1st Decade	+1.3
Returns to Counties - Million $/yr 1st Decade	13.4
Present Net Value - Million $ (PNV for 1st 5 decades)	1/

1/ Could not be quantitatively estimated for this alternative.

ALTERNATIVE A-CURRENT DIRECTION (NO ACTION)

PURPOSE

This is the "no action" alternative required by the Council on Environmental Quality (CEQ) regulations (40 CFR 1502.14) and NFMA regulations (36 CFR 219.12(f)(7)). Its purpose is to project the outputs and effects associated with continued management of the Forest on the basis of current plans, policies, and direction. Land allocations upon which this alternative is based are specified in the Soleduck, Quinault, Satsop Block, and Canal Front land management plans and the Timber Management Plan for the Shelton CSYU. These allocations have been adjusted as necessary to reflect current Management Requirements. Other plans which apply to this alternative are listed in Table I-1, of this FEIS.

The principal guidelines and objectives underlying the development of this alternative are:

- The goal of the alternative is to simulate as closely as possible the future condition of the Forest if implementation of current plans is continued.

- Land allocations specified in existing plans will be applied.

- The ways or means of meeting Management Requirements are to be applied.

- Determination of availability, capability, and suitability of land for timber harvest shall be based on the most recent available information, not currently approved timber management plans.

- Timber harvest schedules on both the Eastside-Westside and Shelton CSYU components of the Forest will be based on nondeclining flow.

- Timber harvest prescriptions will be selected to simulate actual current direction activities taking place on the Forest. This is best modeled with an objective function of maximizing present net value on the Eastside-Westside component of the forest and emphasizing timber output on the Shelton CSYU.

ALLOCATIONS AND MANAGEMENT PROGRAMS

Refer to the enclosed map of Alternative A-Current Direction for the location of land allocations discussed below. Of the allocations to assure viable wildlife and fish populations, the spotted owl, pileated woodpecker, and marten areas are mapped, while riparian zone allocations are not. Principal land allocations and expected effects are summarized at the end of the discussion of this alternative.

Recreation

(a) Developed Recreation

Currently inventoried sites suitable for future recreation facility construction will be reserved for this purpose, and will be developed in response to public demand.

(b) Undeveloped Recreation

Unroaded recreation opportunities will be permanently retained in the following unroaded areas: McDonald, Quilcene, Mt. Zion, Green Mtn., Jupiter Ridge, Jefferson Ridge, Lightning Peak, Upper Skokomish, Moonlight Dome, So. Quinault Ridge, Rugged Ridge, Mt. Baldy, and Madison Creek. A total of 50,500 acres will remain unroaded.

Wilderness

Management emphasis in this alternative is to continue the historical direction and intensities of management, while meeting requirements of the Wilderness Act. No major changes in facilities, such as trail shelters, will be implemented.

Research Natural Areas

The existing Quinault RNA will be retained.

Botanical Areas

Two areas have been identified: Pat's Prairie (414 acres) on the Quilcene District for its unusual plant associations, and an area along the South Fork Calawah River (102 acres) on the Soleduck District as an example of typical Olympic rain forest vegetation.

Resource Protection Allocations

In existing plans, allocations have been made to restrictive management strategies to avoid the risk of slope failures and the resulting reduction in water quality. Harvest and road construction are precluded in the Gray Wolf River (445 acres now largely included within the Buckhorn Wilderness) and Middle Dungeness (5,866 acres) Special Management Areas, and road construction is not allowed in the Rugged Ridge (6,168 acres) and Lower Mt. Baldy (1,750 acres) Special Management Areas. These restrictions will be continued in Alternative A.

Scenery

This is one of two alternatives that will provide a middle range of protection for scenery. Two viewsheds will remain natural appearing, five viewsheds will have a slightly altered appearance, six viewsheds will have a moderately altered appearance and seven will have a heavily altered appearance. Attainment of Retention/Partial Retention VQOs is specified for 24,400 of the 90,100 acres having these objectives.

River Corridor Designations

(a) Wild and Scenic

The Duckabush River will be recommended for designation as a Wild and Scenic River. Management activities will be designed to maintain or enhance the existing attributes within the river corridor until Congressional designation occurs and a specific management plan is developed. Refer to Appendix F for additional information on existing conditions within the Duckabush corridor.

(b) Others

Other river corridors will be managed as indicated for riparian zones.

Allocations to Assure Viable Wildlife and Fish Populations

(a) Spotted Owl Habitat Areas (SOHAs)

Thirty areas averaging 3000 acres each will be managed to provide perpetual old-growth habitat for the northern spotted owl. Additional old-growth habitat will be available as a result of other allocations. This SOHA allocation is presently considered to be sufficient to assure maintenance of a viable population.

(b) Other Wildlife Allocations

Areas of mature forest habitat will be allocated and managed as habitat for pine marten and pileated woodpecker populations. The extent of these allocations is currently felt to be necessary to assure maintenance of viable populations. Some of the necessary habitat will be available within SOHAs and other allocations.

(c) Riparian Zone and Fish Habitat Management Allocations

Riparian zones are allocated to reduced timber-yield prescriptions. These allocations, in combination with Standards and Guidelines governing management activities, assure that water quality standards are met. Such allocations also contribute to the maintenance of fish habitat, both by protecting water quality and by providing a source of large organic debris. The riparian zone allocations of this alternative are at the level presently felt necessary for riparian protection.

Timber Sale Program

Average annual allowable sale quantity during the first decade of the planning period will be 26.9 million cubic feet from National Forest lands not part of the CSYU, 43.4 million cubic feet from Shelton CSYU lands (including Simpson Timber Company), and 36.0 for all National Forest lands. Harvest will be on a nondeclining flow basis in both zones. Approximately 176 miles of new road (33 of them in currently undeveloped areas) will be constructed in the first decade in support of the timber sale program.

Alternative A-Current Direction (No Action) at a Glance

Primitive/Semi-Primitive - Acres (outside Wilderness)	35,800
Retention/Partial Retention - Acres (VQOs met)	24,400
River Corridor Designations - Number	
Wild & Scenic	1
Others	0
Old-Growth after 1st Decade - Percent of Current Acres (266,800)	86
Elk Population - 1st Decade	3,030
Deer Population - 1st Decade	6,433
Sediment Index 1st Decade - Percent of Current	84
Anadromous Smolts (enhanced) - 1st Decade (thousand smolts)	10,571
Annual Allowable Sale Quantity (in Millions)	
Shelton CSYU--Total	
CF 1st decade	43.4
BF 1st decade	206.0
--Simpson Timber Company	
CF 1st decade	34.3
BF 1st decade	158.6
--National Forest within CSYU	
CF 1st decade	9.1
BF 1st decade	47.4
East-West Zone (NF not CSYU)	
CF 1st decade	26.9
BF 1st decade	152.1
Total National Forest	
CF 1st decade	36.0
BF 1st decade	199.5
Total (National Forest and Simpson Timber Co. combined)	
CF 1st decade	70.3
BF 1st decade	358.1
Average Annual Road Construction, 1st Decade (miles):	
Forest-wide Total	17.6
Within Currently Undeveloped Areas	3.3
Changes in Employment - Percent of Peninsula Employment 1st Decade	-0.4
Returns to Counties - Million $/yr 1st Decade	7.1
Present Net Value - Million $ (PNV for 1st 5 decades)	568.5

ALTERNATIVE B-DEPARTURE (MODIFIED)

PURPOSE

This alternative was designed to assess the effects associated with a commodity production oriented alternative. This represents the "community stability" alternative suggested by some members of the public, including the timber industry. A departure from nondeclining evenflow is necessary to achieve the proposed timber volume output in the first decade.

The principal guidelines and objectives underlying the development of this alternative are:

- The goal of the alternative is to achieve high levels of commodity outputs while meeting management rquirements for other resources.

- Land allocations (other than those common to all alternatives) will be unconstrained to allow maximum flexibility in attaining timber targets.

- The ways or means of meeting Management Requirements are to be applied.

- Departure from nondeclining flow will be allowed on the Eastside-Westside component of the Forest. Harvest from the Shelton CSYU will be governed by the nondeclining flow policy.

- Timber harvest prescriptions will be selected to emphasize volume output rather than contribution to PNV, as this will be necessary in order to achieve targeted harvest levels.

ALLOCATIONS AND MANAGEMENT PROGRAMS

Refer to the enclosed map of Alternative B-Departure for the location of the land allocations discussed below. Of the allocations to assure viable wildlife and fish populations, the spotted owl, pileated woodpecker, and marten areas are mapped, while riparian zone allocations are not. Principal land allocations and expected effects are summarized at the end of the discussion of this alternative.

Recreation

(a) Developed Recreation

All existing recreation facilities, such as campgrounds, picnic areas, and boating sites, will be retained. Currently inventoried sites suitable for future recreation facility construction will be reserved for this purpose.

(b) Undeveloped Recreation

Unroaded recreation opportunities will be permanently retained in twelve of the thirteen unroaded areas in this alternative. Moonlight Dome is the only area that will not have any portion retained in an unroaded condition. Approximately 30,700 acres will be retained in an unroaded condition:

Wilderness

The management emphasis will be to increase the percentage of Semi-Primitive recreation opportunity within each Wilderness through maintenance of trails and other facilities, construction of new trails, expansion of trailheads, and allowing expansion of selected destination sites.

Research Natural Areas

The existing Quinault RNA will be retained.

Botanical Areas

None will be reserved.

Scenery

This alternative will provide the least protection for scenery. Three viewsheds will have a moderately altered appearance, while the remaining 17 viewsheds will have a heavily altered appearance. Under this alternative, there will be no viewsheds that will have a natural or slightly altered appearance. Attainment of Retention/Partial Retention VQOs is not specified for any of the 90,100 acres having these objectives.

River Corridors

There will be no rivers recommended for designation as Wild and Scenic and no additional management direction for management of other river corridors.

Allocations to Assure Viable Wildlife and Fish Populations

(a) Spotted Owl Habitat Areas (SOHAs)

Thirty areas averaging 3000 acres each will be managed to provide perpetual old-growth habitat for the northern spotted owl. This is the level of SOHA allocation presently considered to be sufficient to assure maintenance of a viable population within these zones.

(b) Other Wildlife Allocations

Areas of mature forest habitat will be allocated and managed as habitat for pine marten and pileated woodpecker populations. The extent of these allocations is currently felt to be necessary to assure maintenance of viable populations. Some of the necessary habitat will be available within SOHAs and other allocations.

(c) Riparian Zone and Fish Habitat Management Allocations

Forest-wide, selected areas within riparian zones are allocated to reduced timber-yield prescriptions. These allocations, in combination with Standards and Guidelines governing management activities, assure that water quality standards are met. Such allocations also contribute to the maintenance of fish habitat, both by protecting water quality and by providing a source of large organic debris. The riparian zone allocations of this alternative are at the level presently felt necessary for adequate riparian protection.

Timber Sale Program

Average annual allowable sale quantity during the first decade of the planning period will be 45.1 million cubic feet from National Forest lands not in the CSYU, 44.6 million cubic feet from Shelton CSYU lands (including Simpson Timber Company), and 55.7 from all National Forest lands. Harvest will be on a nondeclining flow basis on the Shelton CSYU, but departure from nondeclining flow will be needed on the Eastside and Westside zones in order to achieve proposed timber volume levels. The timber sale program for the Eastside and Westside zones remains high for the first four decades (averaging 37.3 million cubic feet), then drops to 19.0 million in the fifth decade. Approximately 283 miles of new road (67 of them in currently undeveloped areas) will be constructed in the first decade in support of the timber sale program.

Because of the timber output emphasis of this alternative, some harvest is scheduled on lands for which timber management costs exceed projected revenues. Also, timber harvest regimes and schedules emphasize volume output rather than contribution to PNV. The rationale for this emphasis on harvest (as opposed to PNV) is social rather than economic. Employment and income levels are enhanced by increased timber output, even if this includes some harvest involving costs in excess of returns.

Alternative B-Departure (Modified) at a Glance

Primitive/Semi-Primitive - Acres (outside Wilderness)	20,600
Retention/Partial Retention - Acres (VQOs met)	0
River Corridor Designations - Number	
Wild & Scenic	0
Others	0
Old-Growth after 1st Decade - Percent of Current Acres (266,800)	76
Elk Population - 1st Decade	3,032
Deer Population - 1st Decade	6,462
Sediment Index 1st Decade - Percent of Current	116
Anadromous Smolts (enhanced) - 1st Decade (thousand smolts)	10,219
Annual Allowable Sale Quantity (in millions)	
Shelton CSYU--Total	
CF 1st decade	44.6
BF 1st decade	213.8
--Simpson Timber Company	
CF 1st decade	34.0
BF 1st decade	157.1
--National Forest within CSYU	
CF 1st decade	10.6
BF 1st decade	56.7
East-West Zone (NF not CSYU)	
CF 1st decade	45.1
BF 1st decade	250.0
Total National Forest	
CF 1st decade	55.7
BF 1st decade	306.7
Total (National Forest and Simpson Timber Co. combined)	
CF 1st decade	89.7
BF 1st decade	463.8
Average Annual Road Construction, 1st Decade (miles):	
Forest-wide Total	28.3
Within Currently Undeveloped Areas	6.7
Changes in Employment - Percent of Peninsula Employment 1st Decade	+1.6
Returns to Counties - Million $/yr 1st Decade	11.0
Present Net Value - Million $ (PNV for 1st 5 decades)	547.2

ALTERNATIVE C - PREFERRED (MODIFIED)

PURPOSE

The purpose of this alternative is to determine the outputs and effects that would be associated with changing existing management direction to: (1) increase the emphasis on nonmarket outputs in areas of high public interest; (2) develop timber harvest schedules on the basis of contribution to PNV rather than harvest volume; and (3) provide a mix of allocations and outputs which addresses all issues, concerns, and opportunities. This alternative is a modified version of DEIS Alternative C.

The principal guidelines and objectives underlying the development of this alternative are:

- The goal of the alternative is to address all issues, concerns, and opportunities in a manner which is responsive to the input received to the DEIS.

- Land allocations have been developed based on experience gained during implementation of current plans and on input received to the DEIS.

- The ways or means of meeting Management Requirements are to be applied.

- Timber harvest schedules on both the Eastside-Westside and Shelton CSYU components of the Forest will be based on nondeclining flow.

- Timber harvest prescriptions will be primarily selected on the basis of contribution to PNV rather than volume output.

- Major modifications to this alternative between the Draft and FEIS are outlined for each resource area below.

ALLOCATIONS AND MANAGEMENT PROGRAMS

Refer to the enclosed map of Alternative C-Preferred (Modified) for the location of the allocations discussed below. Of the allocations to assure viable wildlife and fish populations, the spotted owl, pileated woodpecker, and marten areas are mapped, while riparian zone allocations are not. Principal land allocations and expected effects are summarized at the end of the discussion of this alternative.

Recreation

(a) Developed Recreation

Currently inventoried sites suitable for future recreation facility construction will be reserved for this purpose, and will be developed in response to public demand. Existing sites will continue to be maintained.

(b) Undeveloped Recreation

Non-motorized unroaded recreation opportunities will be permanently retained in all of the unroaded areas. A total of 57,500 acres will remain unroaded.

Wilderness

Management emphasis will vary by and within individual Wildernesses to reflect the setting, existing situation, and opportunities present within each. This will be done by changing trail management standards, trail construction or removal, trailhead management, and the continued use or removal of improvements such as trail shelters to encourage or redirect use at specific sites within Wildernesses to meet objectives.

Research Natural Areas

In addition to retaining the Quinault RNA, Wet Weather Creek is proposed as an RNA.

Botanical Areas

Twelve areas have been identified reflecting the increased emphasis on protection of native plant species between the Draft and FEIS. (Three areas were proposed in the DEIS.) The twelve areas included in this alternative are:

- Three Peaks Botanical Area
- Cranberry Bog Botanical Area
- Pat's Prairie Botanical Area
- Buckhorn
- Three O'Clock Ridge Botanical Area
- Tyler Peak Botanical Area
- "Bill's Bog" Botanical Area
- Matheny Prairie, Old Western Redcedar Botanical Area
- Matheny Ridge, Old Alaska Yellowcedar Botanical Area
- North Fork Matheny Ponds, Old Alaska Yellowcedar Botanical Area
- Pine Mountain Botanical Area
- South Fork Calawah River Botanical Area

Scenery

The Preferred Alternative involves a high range of scenic protection. Seven viewsheds will maintain a natural appearance, while the remaining thirteen will have a slightly altered appearance. No viewsheds will have a moderately or heavily altered appearance. All areas having Retention/Partial Retention VQOs are expected to be managed to meet these objectives. Although about 30 percent of these areas lie within Management Area E1 (Timber Management) in this alternative, standards and guidelines calling for VQO attainment will apply.

River Corridors

(a) Wild and Scenic

The Dungeness, Gray Wolf, and Duckabush Rivers will be recommended for designation as Wild and Scenic Rivers. Management activities will be designed to maintain or enhance the existing attributes within the river corridors until Congressional designation occurs and specific management plans are developed. Refer to Appendix F for additional information on existing conditions within these river corridors.

(b) Others

A corridor of variable width (approximately 1/8 mile on each side of river) for fourteen rivers has been allocated to a prescription designed to provide a variety of recreation opportunities in a pleasing scenic environment while maintaining or enhancing water quality and wildlife and fish habitat. This is an increase of twelve rivers from the two provided in the DEIS. The fourteen rivers include portions of the Dosewallips, Hamma Hamma, S. Fork Skokomish, Wynoochee, E. Fork Humptulips, W. Fork and main Humptulips, Soleduck, Sam's, Calawah system, Big Quilcene, Quinault, Elwha, Bogachiel, and Hoh.

Allocations to Assure Viable Wildlife and Fish Populations

(a) Spotted Owl Habitat Areas (SOHAs)

Thirty areas averaging 3,000 acres each will be managed to provide perpetual old-growth habitat for the northern spotted owl. Additional old-growth habitat will be available as a result of other allocations. This SOHA allocation is presently considered to be sufficient to assure maintenance of a viable population.

(b) Other Wildlife Allocations

In addition to habitat included in SOHAs, 4 areas of 300 acres each have been allocated as mature forest habitat for pileated woodpeckers and 22, 160-acre areas of similar habitat have been reserved for pine marten. It is currently felt this allocation exceeds that which is minimally adequate to assure maintenance of viable populations of these indicator species and the associations they represent. In addition, 16 Bald Eagle Management Areas (BEMAs) will be designated. No timber harvest will be permitted within these areas.

(c) Riparian Zone and Fish Habitat Management Allocations

Selected areas within riparian zones are allocated to reduced timber-yield prescriptions. These allocations, in combination with standards and guidelines governing management activities, serve to assure that water quality standards are met. Such allocations also contribute to the maintenance of fish habitat, both by protecting water quality and by providing a source of large organic debris. The riparian zone allocations of this alternative are at the level presently felt necessary for riparian protection.

Timber Sale Program

Average annual allowable sale quantity during the first decade of the planning period will be 19.0 million cubic feet from National Forest lands not part of the CSYU and 41.2 million cubic feet from Shelton CSYU lands (including Simpson Timber Company). Total from National Forest lands will be 20.6 MMCF. Harvest will be on a nondeclining flow basis in both zones. Approximately 141 miles of new road (28 of them in currently undeveloped areas) will be constructed in the first decade in support of the timber sale program.

Alternative C - Preferred (Modified) at a Glance

Primitive/Semi-Primitive - Acres (outside Wilderness)	41,900
Retention/Partial Retention - Acres (VQOs met)	90,100
River Corridor Designations - Number	
Wild & Scenic	3
Others	14
Old-Growth after 1st Decade - Percent of Current Acres (266,800)	92
Elk Population - 1st Decade	3,031
Deer Population - 1st Decade	6,423
Sediment Index 1st Decade - Percent of Current	59
Anadromous Smolts (enhanced) 1st Decade (thousand smolts)	10,595
Annual Allowable Sale Quantity (in millions)	
Shelton CSYU--Total	
CF 1st decade	41.2
BF 1st decade	192.7
--Simpson Timber Company	
CF 1st decade	39.6
BF 1st decade	183.4
--National Forest within CSYU	
CF 1st decade	1.6
BF 1st decade	9.3
East-West Zone (NF not CSYU)	
CF 1st decade	19.0
BF 1st decade	101.6
Total National Forest	
CF 1st decade	20.6
BF 1st decade	110.9
Total (National Forest and Simpson Timber Co. combined)	
CF 1st decade	60.2
BF 1st decade	294.3
Average Annual Road Construction, 1st Decade (miles):	
Forest-wide Total	14.1
Within Currently Undeveloped Areas	2.8
Changes in Employment - Percent of Peninsula Employment 1st Decade	-1.6
Returns to Counties - Million $/yr 1st Decade	4.5
Present Net Value - Million $ (PNV for 1st 5 decades)	520.3

ALTERNATIVE H (MODIFIED)

PURPOSE

This alternative was initially developed primarily in response to the wildlife habitat issue. It was designed to evaluate the effects associated with providing an age class distribution that would yield the best mix of habitat conditions for elk and deer populations, while also stressing the availability of habitat for old-growth dependent species and retaining the amenity emphasis of Alternative I in other respects. Substantial input into the structuring of Alternative H was provided by the State of Washington Department of Wildlife. Between the Draft and FEIS, this alternative was modified to reflect changes suggested by environmental organizations and others.

The principal guidelines and objectives underlying the development of this alternative are:

- Land allocations will be based on the goal of providing amenity outputs and nonpriced benefits. With the exception of a few areas in which timber harvest would be beneficial to big game populations, all areas capable of producing nontimber outputs related to issues or concerns will be allocated to prescriptions which provide these outputs.

- The ways or means of meeting Management Requirements are to be applied.

- Timber harvest schedules on both the Eastside-Westside and Shelton CSYU components of the Forest will be based on nondeclining flow.

- Timber harvest prescriptions will be selected on the basis of contribution to PNV rather than volume output.

- The existing acreage of old-growth in deer and elk winter range will be retained throughout the 150-year analysis horizon.

ALLOCATIONS AND MANAGEMENT PROGRAMS

Refer to the enclosed map of Alternative H for the location of the land allocations discussed below. Of the allocations to assure viable wildlife and fish populations, the spotted owl, pileated woodpecker, and marten areas are mapped, while riparian zone allocations are not. Principal land allocations and expected effects are summarized at the end of the discussion of this alternative.

Recreation

(a) Developed Recreation

Currently inventoried sites suitable for future recreation facility construction will be reserved for this purpose, and will be developed in response to public demand.

(b) Undeveloped Recreation

With the exception of parts of the Quilcene and Jupiter Ridge unroaded areas, all areas currently providing Primitive and Semi-Primitive recreation opportunities are permanently retained. Approximately 80,000 acres will remain unroaded.

Wilderness

Emphasis in this alternative is to retain or increase the availability of primitive recreation opportunity in each Wilderness. This will be done through planned removal of facilities such as trail shelters, a reduction in trail maintenance and construction standards, management practices to limit occupancy or access at trailheads, and other appropriate methods needed to control Wilderness use. The objective is to reduce the likelihood that Wilderness users will meet more people than is consistent with providing a primitive recreation experience.

Research Natural Areas

In addition to retaining the Quinault RNA, Wet Weather Creek and Buckhorn are proposed as RNAs.

Botanical Areas

Eleven areas have been identified:

- Three Peaks Botanical Area
- Cranberry Bog Botanical Area
- Pat's Prairie Botanical Area
- Three O'Clock Ridge Botanical Area
- Tyler Peak Botanical Area
- "Bill's Bog" Botanical Area
- Matheny Prairie, Old Western Redcedar Botanical Area
- Matheny Ridge, Old Alaska Yellowcedar Botanical Area
- North Fork Matheny Ponds, Old Alaska Yellowcedar Botanical Area
- Pine Mountain Botanical Area
- South Fork Calawah River Botanical Area

Old-Growth

The current amount of old-growth in winter range will remain. Some existing stands will be harvested in the future as today's younger stands achieve old-growth conditions. No specific old-growth allocations are made in areas outside winter range except when included as part of other allocations such as undeveloped recreation and spotted owl management.

Scenery

This is one of two alternatives that will provide the highest protection for scenery. Seven of the viewsheds will retain a natural appearance, while the remaining thirteen viewsheds will have a slightly altered appearance. No viewsheds will have a moderately or heavily altered appearance. Attainment of Retention/Partial Retention VQOs is specified for all of the 90,100 acres having these objectives.

River Corridors

(a) Wild and Scenic

All rivers meeting eligibility criteria for Wild and Scenic River designation and for which the Forest Service has been identified as the logical lead agency will be recommended for inclusion in the National Wild and Scenic Rivers System. These include the Dungeness, Gray Wolf, Dosewallips, Duckabush, Hamma Hamma, main stem and West Fork of the Humptulips and West Fork, Soleduck, S. Fork Humptulips, E. Fork Humptulips, S. Fork Skokomish, and Wynoochee. Refer to Appendix F for additional information.

(b) Others

Olympic National Forest lands within the corridors of the Quinault, Bogachiel, Hoh, and Elwha Rivers will be managed to protect the existing attributes that also make these rivers eligible for consideration as Wild and Scenic Rivers. In addition, the Big Quilcene, Calawah and its three forks, and Sam's River will be managed under the River Corridor management prescription.

Allocations to Assure Viable Wildlife and Fish Populations

(a) Spotted Owl Habitat Areas (SOHAs)

Thirty areas averaging 3,000 acres each will be managed to provide perpetual old-growth habitat for the northern spotted owl. Significant amounts of additional old-growth habitat will be available as a result of other allocations. This SOHA allocation is presently considered to be sufficient to provide the necessary to assure maintenance of a viable population.

(b) Other Wildlife Allocations

Mature forest habitat for pileated woodpeckers and pine marten will substantially exceed the amount currently felt to be necessary to assure maintenance of viable populations of these indicator species and the associations they represent. In addition, 16 Bald Eagle Management Areas (BEMAs) will be designated. No timber harvest will be permitted within these areas.

(c) Riparian Zone and Fish Habitat Management Allocations

Where timber harvesting is permitted within riparian zones, reduced timber-yield prescriptions are included to assure the minimum protection currently felt necessary for riparian zones. These allocations, in combination with Standards and Guidelines governing management activities, serve to assure that water quality standards are met. Such allocations also contribute to the maintenance of fish habitat, both by protecting water quality and by providing a source of large organic debris.

Timber Sale Program

Average annual allowable sale quantity during the first decade of the planning period will be 12.3 million cubic feet from National Forest lands not part of the CSYU, 31.7 million cubic feet from Shelton CSYU lands (including Simpson Timber Company), and 13.3 MMCF from all National Forest lands. Harvest will be on a nondeclining flow basis in both zones. Approximately 92 miles of new road (16 of them in currently undeveloped areas) will be constructed in the first decade in support of the timber sale program.

Alternative H (Modified) at a Glance

Primitive/Semi-Primitive - Acres (outside Wilderness)	55,200
Retention/Partial Retention - Acres (VQOs met)	90,100
River Corridor Designations - Number	
Wild & Scenic	10
Others	7
Old-Growth after 1st Decade - Percent of Current Acres (266,800)	95
Elk Population - 1st Decade	3,081
Deer Population - 1st Decade	6,523
Sediment Index 1st Decade - Percent of Current	48
Anadromous Smolts (enhanced) 1st Decade (thousand smolts)	10,674
Annual Allowable Sale Quantity (in millions)	
Shelton CSYU--Total	
CF 1st decade	31.7
BF 1st decade	147.1
--Simpson Timber Company	
CF 1st decade	30.7
BF 1st decade	142.1
--National Forest within CSYU	
CF 1st decade	1.0
BF 1st decade	5.0
East-West Zone (NF not CSYU)	
CF 1st decade	12.3
BF 1st decade	64.3
Total National Forest	
CF 1st decade	13.3
BF 1st decade	69.3
Total (National Forest and Simpson Timber Co. combined)	
CF 1st decade	44.0
BF 1st decade	211.4
Average Annual Road Construction, 1st Decade (miles):	
Forest-wide Total	9.2
Within Currently Undeveloped Areas	1.6
Changes in Employment - Percent of Peninsula Employment 1st Decade	-3.5
Returns to Counties - Million $/yr 1st Decade	3.0
Present Net Value - Million $ (PNV for 1st 5 decades)	452.6

ALTERNATIVE I

PURPOSE

This alternative was developed to provide the maximum possible level of amenity outputs and nonpriced benefits that can be obtained from the Forest. It is the "amenity emphasis" alternative specified in Regional planning direction, and represents an approach to the resolution of issues and concerns that limits commodity production to that which is fully compatible with management for nontimber resources.

The principal guidelines and objectives underlying the development of this alternative are:

- Land allocations will be based on the goal of providing amenity outputs and nonpriced benefits. All areas capable of producing nontimber outputs related to issues or concerns will be allocated to prescriptions which provide these outputs.

- The ways or means of meeting Management Requirements are to be applied.

- Timber harvest schedules on both the Eastside-Westside and Shelton CSYU components of the Forest will be based on nondeclining flow.

- Timber harvest prescriptions will be selected on the basis of contribution to PNV rather than volume output.

- The existing acreage of old-growth (267,000 acres Forest-wide) will be retained throughout the 150-year analysis horizon.

ALLOCATIONS AND MANAGEMENT PROGRAMS

Refer to the enclosed map of Alternative I for the location of the land allocations discussed below. Of the allocations to assure viable wildlife and fish populations, the spotted owl, pileated woodpecker, and marten areas are mapped, while riparian zone allocations are not. Principal land allocations and expected effects are summarized at the end of the discussion of this alternative.

Recreation

(a) Developed Recreation

Currently inventoried sites suitable for future recreation facility construction will be reserved for this purpose, and will be developed in response to public demand.

(b) Undeveloped Recreation

Unroaded recreation opportunities are permanently retained in all areas currently providing this type of experience. The existing 85,800 acres of unroaded areas would be retained.

Wilderness

Emphasis in this alternative is to retain or increase the availability of primitive recreation opportunity in each Wilderness. This will be done through planned removal of facilities such as trail shelters, a reduction in trail maintenance and construction standards, management practices to limit occupancy or access at trail-heads, and other appropriate methods needed to control Wilderness use. The objective is to reduce the likelihood that Wilderness users will meet more people than is consistent with providing a primitive recreation experience.

Research Natural Areas

In addition to retaining the Quinault RNA, this alternative proposes adding the Wet Weather Creek and Buckhorn RNAs.

Botanical Areas

Eleven areas have been identified:

- Three Peaks Botanical Area
- Cranberry Bog Botanical Area
- Pat's Prairie Botanical Area
- Three O'Clock Ridge Botanical Area
- Tyler Peak Botanical Area
- "Bill's Bog" Botanical Area
- Matheny Prairie, Old Western Redcedar Botanical Area
- Matheny Ridge, Old Alaska Yellowcedar Botanical Area
- North Fork Matheny Ponds, Old Alaska Yellowcedar Botanical Area
- Pine Mountain Botanical Area
- South Fork Calawah River Botanical Area

Old-Growth

The current amount of old-growth will remain.

Scenery

This is one of two alternatives that will provide the highest protection for scenery. Seven of the viewsheds will retain a natural appearance, while the remaining thirteen viewsheds will have a slightly altered appearance. No viewsheds will have a moderately or heavily altered appearance. Attainment of Retention/Partial Retention VQOs is specified for all of the 90,100 acres having these objectives.

River Corridors

(a) Wild and Scenic

All rivers meeting eligibility criteria for Wild and Scenic River designation and for which the Forest Service has been identified as the logical lead agency will be recommended for inclusion in the National Wild and Scenic Rivers System. These include the Dungeness, Gray Wolf, Dosewallips, Duckabush, Hamma Hamma, Humptulips and West Fork, Soleduck, S. Fork Skokomish, E. Fork Humptulips, and Wynoochee. Refer to Appendix F for additional information.

(b) Others

Olympic National Forest lands within the corridors of the Quinault, Bogachiel, Hoh, and Elwha Rivers will be managed to protect the existing attributes that also make these rivers eligible for consideration as Wild and Scenic Rivers. In addition, the Big Quilcene, Calawah and its three forks, and Sam's River will be managed under the River Corridor prescription.

Allocations to Assure Viable Wildlife and Fish Populations

(a) Spotted Owl Habitat Areas (SOHAs)

Thirty areas averaging 3,000 acres each will be managed to provide perpetual old-growth habitat for the northern spotted owl. Significant amounts of additional old-growth habitat will be available as a result of other allocations. The available old-growth is presently considered to greatly exceed that necessary to assure maintenance of a viable population.

(b) Other Wildlife Allocations

Mature forest habitat for pileated woodpeckers and pine marten will greatly exceed the amount currently felt to be necessary to assure maintenance of viable populations of these indicator species and the associations they represent. In addition, 16 Bald Eagle Management Areas (BEMAs) will be designated. Timber harvest will not be permitted within these areas.

(c) Riparian Zone and Fish Habitat Management Allocations

Where timber harvesting is permitted within riparian zones, reduced timber-yield prescriptions are included to assure the minimum protection currently felt necessary for riparian zones. These allocations, in combination with Standards and Guidelines governing management activities, serve to assure that water quality standards are met. Such allocations also contribute to the maintenance of fish habitat, both by protecting water quality and by providing a source of large organic debris.

Timber Sale Program

Average annual allowable sale quantity during the first decade of the planning period will be 2.3 million cubic feet from National Forest lands not part of the CSYU and 31.6 million cubic feet from Shelton CSYU lands (including Simpson Timber Company). No timber will be harvested from the National Forest portions of the CSYU in the first decade. Harvest will be on a nondeclining flow basis in both zones. Approximately 20 miles of new road (none are currently in undeveloped areas) will be constructed in the first decade in support of the timber sale program.

Alternative I at a Glance

Primitive/Semi-Primitive - Acres (outside Wilderness)	60,600
Retention/Partial Retention - Acres (VQOs met)	90,100
River Corridor Designations - Number	
Wild & Scenic	10
Others	7
Old-Growth after 1st Decade - Percent of Current Acres (266,800)	100
Elk Population - 1st Decade	3,065
Deer Population - 1st Decade	6,481
Sediment Index 1st Decade - Percent of Current	29
Anadromous Smolts (enhanced) 1st Decade (thousand smolts)	10,837
Annual Allowable Sale Quantity (in millions)	
Shelton CSYU--Total	
CF 1st decade	31.6
BF 1st decade	146.1
--Simpson Timber Company	
CF 1st decade	31.6
BF 1st decade	146.1
--National Forest within CSYU	
CF 1st decade	0.0
BF 1st decade	0.0
East-West Zone (NF not CSYU)	
CF 1st decade	2.3
BF 1st decade	10.4
Total National Forest	
CF 1st decade	2.3
BF 1st decade	10.4
Total (National Forest and Simpson Timber Co. combined)	
CF 1st decade	33.9
BF 1st decade	156.5
Average Annual Road Construction, 1st Decade (miles):	
Forest-wide Total	2.0
Within Currently Undeveloped Areas	0
Changes in Employment - Percent of Peninsula Employment 1st Decade	-4.6
Returns to Counties - Million $/yr 1st Decade	0.6
Present Net Value - Million $ (PNV for 1st 5 decades)	351.2

COMPARISON OF ALTERNATIVES CONSIDERED IN DETAIL

OVERVIEW

This section presents the outputs and effects of the alternatives in a manner designed to facilitate comparison. The aspects of alternatives which are presented for comparison include:

- Responsiveness to issues and concerns
- Allocations of land to specific management areas
- Resource outputs and environmental effects
- Costs, benefits, and present net value

The above items are presented in both tabular and written form, with the intent of condensing a great deal of complex information into a format which allows efficient and effective comparison of alternatives. The section is concluded with a discussion of the principal tradeoffs associated with each alternative.

The purpose of forest planning is to identify and select for implementation the alternative which most nearly maximizes net public benefits. Net public benefits are defined as the "...overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs) whether they can be quantitatively valued or not...consistent with the principles of multiple use and sustained yield" (36 CFR 219.3).

The assessment of net public benefits must include both those outputs which have prices (such as timber and developed recreation) and those to which no price can be attached (such as scenic quality and the maintenance of viable wildlife populations). Thus, net public benefits cannot be expressed as a single, quantitative measure, but must be gauged using both quantitative and qualitative criteria. There is no precise formula for determining which alternative maximizes net public benefits. Indeed, there are often differences of opinion as to whether particular outputs or effects are benefits or costs. Therefore, it is necessary to separately identify the major effects of each alternative as the basis for analysis, judgment, and selection of the preferred alternative.

The output and effect estimates which aided in the selection of the preferred alternative are presented on the following pages.

RESPONSE TO ISSUES, CONCERNS AND OPPORTUNITIES

One of the primary reasons for developing alternatives is to provide a variety of responses to the issues and concerns which affect the Forest and its public. Each alternative represents a unique approach to the resolution of these. While all alternatives address the entire range of issues and concerns, none can successfully resolve all of them concurrently. This is because the issues and concerns, taken as a whole, reflect the full gamut of desires for uses of, and outputs from, a limited land and resource base. Many of these outputs and uses are competitive or mutually exclusive, thus creating the need for a variety of issue resolution packages (or alternatives). Table II-1 displays the responsiveness of each of the Forest's alternatives to its issues and concerns, as expressed by the planning questions described in Chapter I. Benchmarks are not included in this table, since they are essentially bases for further analysis rather than comprehensive issue resolution proposals. The reader will note that many of the outputs or effects covered in this table are not discussed as fully for Alternative NC as for the other alternatives. This is because the timber management plans upon which this alternative is based do not provide enough information to allow reasonable estimation of many of the outputs and effects that were more fully evaluated for the original ten alternatives.

As can be seen in Table II-1, which starts on the next page, the alternatives vary widely in their approaches to the issues. The issue resolution package represented by Alternative B-Departure (Modified) leans heavily toward timber production, while that of Alternative I emphasizes amenity outputs and low risk of adverse changes in environmental quality.

Table II-1. Response to Issues, Concerns and Opportunities by Alternative

Planning Question	Outputs or Effects to be Measured	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Scenery	Number of Viewsheds	2 Natural Appearing, 5 Slightly Altered, 6 moderately altered, 7 Heavily Altered.	2 Natural Appearing, 5 Slightly Altered, 6 Moderately Altered, 7 Heavily Altered.	3 Moderately Altered, 17 Heavily Altered.	7 Natural Appearing, 13 Slightly Altered.	7 Natural Appearing, 13 Slightly Altered.	7 Natural Appearing, 13 Slightly Altered.
	Acres Retention and Partial Retention Met	24,400	24,400	0	90,100	90,100	90,100
Outdoor Recreation	Acres of Primitive/Semi-Primitive ROS Outside Wilderness	17,500 acres. Primitive and Semi-Primitive opportunities retained in portions of 7 unroaded areas. 6 unroaded areas would be eliminated, (McDonald, Mt. Zion, Green Mtn., Rugged Ridge, Mt. Baldy, and Madison Creek). Opportunities in the Satsop and Klone Lake areas would also be eliminated. 30% of unroaded area acres would be retained.	35,800 acres. Primitive and Semi-Primitive opportunities retained in portions of 12 unroaded areas and in all of 1 unroaded area. 59% of unroaded area acres would be retained. Satsop and Klone Lake areas would also provide Primitive and Semi-Primitive opportunities.	20,600 acres. Primitive and Semi-Primitive opportunities retained in portions of 11 unroaded areas and in all of 1 unroaded area. 1 unroaded area would be eliminated (Moonlight Dome). Satsop and Klone Lake areas would also be eliminated. 36% of unroaded area acres would be retained.	41,900 acres. Primitive and Semi-Primitive opportunities retained in portions of 11 unroaded areas and in all of 2 unroaded areas. 67% of unroaded area acres would be retained. Satsop and Klone Lake areas would also provide Primitive and Semi-Primitive opportunities.	55,200 acres. Primitive and Semi-Primitive opportunities retained in portions of 2 unroaded areas and in all of 11 unroaded areas. 93% of unroaded area acres would be retained. Satsop and Klone Lake areas would also provide Primitive and Semi-Primitive opportunities.	60,600 acres. Primitive and Semi-Primitive opportunities retained in all 13 unroaded areas. 100% of unroaded acres are retained. Satsop Lakes, Klone Lakes, and Alckee Ridge would also provide Primitive and Semi-Primitive opportunities.
	Developed Camping PAOT	A campground construction program aimed at meeting PAOT demand projections is the same in all alternatives. This would require an additional 2,300 PAOT by the end of the first decade, 400 additional PAOT by the end of the second decade and 1,700 additional PAOT by the end of the fifth decade.					
	Miles of Trail Construction	A trail construction program aimed at meeting demand projections for trail miles is the same in all alternatives. This would require 52 miles of new trail by the end of the first decade, 31 additional miles by the end of the second decade, and additional 114 miles by the end of the fifth decade.					
Old-Growth	Acres at midpoint of:						
	1st decade	197,903	248,271	235,225	255,815	259,800	266,800
	2nd decade	147,633	214,428	184,710	233,893	246,255	266,800
	5th decade	126,834	175,496	151,498	186,558	219,784	266,800

Table II-1. (Cont'd.)

Planning Question	Outputs or Effects to be Measured	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Timber Harvest Schedule and Location	Ave. Annual NF Allowable Sale Quantity						
	1st Decade						
	MMCF	59.8	36.0	55.7	20.6	13.3	2.3
	MMBF	330.5	199.5	306.7	110.9	69.3	10.4
	2nd Decade						
	MMCF	46.2	29.9	50.8	23.7	14.5	4.5
	Acres Assigned to Harvest Prescriptions	497,800	357,868	372,526	352,109	300,034	239,981
Transportation System Management	Ave. Annual Miles Road Construction						
	1st Decade	18	18	28	14	9	2
	2nd Decade	14	12	23	12	8	3
	Ave. Annual Miles Road Construction in Undeveloped Areas						
	1st Decade	5	3	7	3	2	1
	2nd Decade	4	3	5	2	1	0
	Public Access Miles Open/Closed						
	1st Decade	2,055/722	2,048/722	2,154/723	1,998/737	1,927/759	1,830/784
	2nd Decade	2,190/775	2,069/825	2,284/826	1,989/867	1,853/912	1,673/972
Native Plant Protection	Number/Acres of RNAs & BAs						
	RNAs	1/1,500	1/1,500	1/1,500	2/2,600	3/5,700	3/5,700
	BAs	2/500	2/500	0/0	12/6,200	11/3,100	11/3,100

Table II-1. (Cont'd.)

Planning Question	Outputs or Effects to be Measured	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Soil, Water, Riparian Areas, Hydropower	Sediment Index Tons/ Year, 1st 20 years	191,200	153,600	225,000	122,800	97,500	62,800
	Riparian Acres Harvested, % 1st 20 years	17.1	10.9	19.2	7.9	5.1	1.4
	Energy Developed Restrictions	Low	Low	Low	Moderate	High	High
Fish & Wildlife Habitat	1000s of Anadromous Smolts (on-Forest enhanced)						
	1st Decade	10,306	10,571	10,219	10,595	10,674	10,837
	50 year Ave	11,115	11,237	10,993	11,312	11,378	11,527
	Number Deer						
	1st Decade	6,462	6,433	6,462	6,423	6,523	6,481
	2nd Decade	6,147	6,038	6,147	6,125	6,264	6,213
	Number Elk						
	1st Decade	3,032	3,030	3,032	3,031	3,081	3,065
	2nd Decade	2,844	2,834	2,844	2,829	2,895	2,886
	Snag Dependent Animals	Information available indicates that sufficient numbers and sizes of snags will be available for all Alternatives to meet or exceed the MR level. An exception is Alternative NC, which includes snag retention provisions expected to be inadequate in meeting MRs. Alternatives with fewer acres allocated to timber harvest will provide more abundant snag habitat than those with high harvest levels.					
Unroaded Areas	Acres/% of Acres Retained	25,400 acres. Unroaded acres will be retained in portions of 7 unroaded areas. 6 unroaded areas would be eliminated. 30% of unroaded acres are retained.	50,500 acres. Unroaded acres will be retained in portions of 12 unroaded areas and in all of 1 unroaded area. 59% of unroaded acres are retained.	30,700 acres. Unroaded acres will be retained in portions of 11 unroaded areas and in all of 1 unroaded area. 1 unroaded area would be eliminated, (Moonlight Dome). 36% of unroaded acres are retained.	57,500 acres. Unroaded acres will be retained in portions of 11 unroaded areas and in all of 2 unroaded areas. 67% of unroaded acres retained.	80,000 acres. Unroaded acres will be retained in portions of 2 unroaded areas and in all of 11 unroaded areas. 93% of unroaded acres are retained.	85,800 acres. Unroaded acres will be retained in all 13 unroaded areas. 100% of unroaded acres are retained.

Table II-1. (Cont'd.)

Planning Question	Outputs or Effects to be Measured	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Wild & Scenic Rivers	Number of rivers to be recommended for inclusion in Wild & Scenic River System	1. Duckabush River	1. Duckabush River	0	3. Dungeness, Gray Wolf, and Duckabush Rivers	10. Dungeness, Gray Wolf, Duckabush, Dosewallips, Hamma Hamma, Humptulips & West Fork, East Fork Humptulips, Soleduck, South Fork Skokomish, and Wynoochee.	10. Dungeness, Gray Wolf, Duckabush, Dosewallips, Hamma Hamma, Humptulips & West Fork, East Fork Humptulips, Soleduck, South Fork Skokomish, and Wynoochee.
Shelton CSYU	1st Decade Harvest from NF Land	Yes. 21.7 MMCF	Yes. 9.1 MMCF	Yes. 10.6 MMCF	Yes. 1.6 MMCF	Yes. 1.0 MMCF	No
Management of Areas in which Timber Costs exceed returns		This is generally taken care of through the primary objective function associated with each alternative. With the exception of Alternatives NC and B, the primary objective for each alternative was "maximize present net value." Therefore, in all alternatives other than NC and B, those areas in which timber harvest would not contribute to PNV have not been assigned to harvest prescriptions. In Alternative B the primary objective function was "maximize timber output." Alternative NC, which was not analyzed in FORPLAN, is very similar in basic objectives to this alternative. Therefore, these two alternatives involve some assignment of areas in which timber management costs exceed returns to harvest prescriptions. Such allocations are designed to provide the increased employment level associated with additional timber harvest.					
Employment	Change Jobs (% Peninsula Labor Force) 1st Decade	+1.3	-0.4	+1.6	-1.6	-3.5	-4.6

MANAGEMENT AREAS

Each alternative distributes the lands of the Olympic National Forest to different management strategies. Acres assigned to these strategies in each alternative are included in Table II-2, which follows the general description of each strategy. The assignment of areas to management strategies was assisted by FORPLAN analysis (see also "Description of the Analysis Process"). Management area acreages for Alternative NC are based on interpretations of timber management plan allocations and assumptions.

A management strategy is a combination of management practices and intensities selected and scheduled to attain specific goals and objectives. A management area is the unit of land to which a management strategy is applied. Management area locations are depicted on the alternative maps which accompany this document. More information on management strategies is included in Chapter IV of the Forest Plan.

Although certain resources are emphasized in each of the following management area descriptions, each strategy provides a combination of forest uses. All management strategies provide water, wildlife habitat, and many types of outdoor recreation. Many also provide for timber commodities. Management direction identifies the resource use which has the highest priority and therefore tends to limit the output levels of other resources which may be competing on the same land. A brief description of each management area follows:

MANAGEMENT AREA A1A - UNDEVELOPED RECREATION (NON-MOTORIZED) (OUTSIDE WILDERNESS)

The goal is to provide Primitive and Semi-Primitive Non-Motorized recreation opportunities in areas characterized by a predominantly natural or natural- appearing environment. The desired future condition is one in which campsites, sanitation facilities, and other management activities are not conspicuous. The area generally affords visitors an experience free from the sights and sounds of other people.

MANAGEMENT AREA A1B - UNDEVELOPED RECREATION (MOTORIZED) (OUTSIDE WILDERNESS)

The goal of management for this area is to provide a variety of undeveloped recreation opportunities in settings where motorized use is permitted. That is the major difference from Management Area A1A described above. The desired future condition is the same.

MANAGEMENT AREA A2 - SCENIC

Management is aimed at providing a pleasing scenic experience as viewed from selected travel routes and use areas. Travel corridors and vistas accommodate a variety of activities which, to the casual observer, are either not evident or are visually subordinate to the natural landscape. Vegetation is diverse and includes a wide variety of species and sizes.

MANAGEMENT AREA A3 - DEVELOPED RECREATION SITES AND ADMINISTRATIVE SITES

These areas provide readily accessible, appropriately designed facilities for concentrated use by: (1) people seeking a convenient recreational experience, (2) employees performing duties and visitors seeking information, and (3) employees needing residential space. Roads, buildings, ramps, bulletin boards, tables, and other physical facilities are evident. Openings usually exist only to: (1) accommodate facilities, provide scenic views, or meet vegetative management goals within the developed site; and (2) accommodate facilities and provide space for administrative sites.

MANAGEMENT AREA A4A - WILD, SCENIC, AND RECREATIONAL RIVERS

The goal of management is to provide a variety of experiences in keeping with the characteristics of a river corridor that made it eligible for consideration as a Wild, Scenic, or Recreational River. Additional information is available in Appendix F of this FEIS and the Forest Plan, Chapter IV.

MANAGEMENT AREA A4B - RIVER CORRIDORS

These areas are managed to provide a variety of recreation opportunities in a pleasing, scenic environment while maintaining or enhancing wildlife and fish habitat. Some river corridors of concern are not eligible for designation as Wild or Scenic, but have resource values similar to those of eligible rivers. Other corridors included in this management area are eligible, but are not being recommended for inclusion in the National system at this time. Three management intensities are available. These are described in more detail in the Standards and Guidelines of the Forest Plan, Chapter IV.

MANAGEMENT AREA B1 - WILDERNESS

This management area includes the five Wildernesses on the Forest. The goal of management is to preserve and protect the wilderness character of each area and provide a variety of opportunities for solitude, challenge, self-reliance, closeness to nature, and risk.

MANAGEMENT AREA C1 - SPOTTED OWL HABITAT AREAS (SOHAs)

The primary goal of management is the maintenance of suitable habitat to meet the needs of spotted owls and other species associated with this type of habitat. Land assigned to this management area also provides a "storehouse" of genetic variability for the future, as well as opportunities to view the natural conditions of Olympic Peninsula forests before the advent of timber harvesting. Much of this habitat, including some of the SOHAs, occurs in other Management Areas such as Wilderness and Undeveloped Recreation areas.

The desired future condition of this habitat includes an overstory of mature and over-mature trees larger than 32 inches in diameter with deformed, broken, or dead tops, large gnarled limbs with mosses and lichens present, deeply furrowed bark, and internal defects. Under the Desired Future Condition, average diameter of the stand as a whole will be greater than 21 inches.

MANAGEMENT AREA C2 - PILEATED WOODPECKER/PINE MARTEN HABITAT AREAS

The goal of management for this area is similar to that of area C1. This management area provides habitat for wildlife species such as the pileated woodpecker, marten, and other species associated with mature forest habitats. Old-growth forest provides the same essential characteristics as mature forest, and is an acceptable substitute. Mature forest habitat areas will eventually develop into old-growth habitat. Like SOHAs, much of the habitat for these species is included in other Management Areas such as Wilderness and Undeveloped Recreation areas.

The forest characterized by mature habitat includes a multi-layered tree canopy of at least two layers. Overstory trees will be dominated by conifers with diameters greater than 21 inches, with incised bark, slowed crown growth, and rounded tops. Overstory trees should have a minimum crown canopy cover of 50 percent. Additional stand characteristics will be broken-topped trees and at least two standing dead trees per acre with diameters greater than 12 inches. At least 8 percent of the dead trees in the stand should be greater than 20 inches in diameter.

MANAGEMENT AREA C3 - BALD EAGLE MANAGEMENT AREAS (BEMAs)

The goal of management in this area is to maintain or enhance sufficient habitat for nesting and wintering bald eagles, thereby contributing to removal of this species from the Federal and State threatened or endangered species lists. The management requirements are identified in the Pacific States Bald Eagle Recovery Plan.

MANAGEMENT AREA E1 - TIMBER MANAGEMENT

The primary goal is to produce timber on a sustained basis. All silvicultural practices and techniques are available for use. Evidence of land intensively managed for timber crops and other forest products is apparent. All tree sizes and mixtures of native species, from seedlings to mature sawtimber, are well distributed and have the mix of age classes needed to sustain yield. Most stands are even-aged. Harvest generally occurs at or near culmination mean annual increment. Clearcuts are common but the land is managed in accordance with the Forest-wide Standards and Guidelines (see Chapter IV of the Forest Plan). In general, Visual Quality Objectives are expected to be achieved within the E1 area.

MANAGEMENT AREA F1 - MUNICIPAL WATERSHEDS

The primary goal of management is to provide high quality water for domestic use. A secondary goal is to minimize soil erosion associated with management activities. To meet these goals, activities within municipal watersheds should meet or exceed applicable "Best Management Practices." The watershed will consist of a mosaic of even-aged timber stands which represent all age classes up to rotation age.

MANAGEMENT AREA F2 - RIPARIAN AREAS

The primary goal is to protect, manage, or improve the unique values of riparian areas for wildlife and fish habitat and water quality. Activities within riparian areas should result in a diversity of vegetative communities of various species, sizes, and age classes to provide the following conditions:

1. Maintain stream channel and bank structure sufficient to maintain water quality in Class I, II, and III streams at or above existing levels;

2. Provide a permanent source of natural woody debris to maintain fish habitat at or above existing levels (in general, most woody debris which enters a stream comes from the zone within 100 feet of the channel);

3. Provide habitat for wildlife species; and

4. Provide filtration zone for upslope debris and sedimentation.

MANAGEMENT AREA J2 - RESEARCH NATURAL AREAS

The goal of management is to provide opportunities for research and education on areas of National Forest land where natural processes are allowed to occur without intervention by people.

MANAGEMENT AREA J3 - BOTANICAL AREAS

The goal of management is to provide opportunities for botanical research and education on lands where unusual plant communities or associations are maintained while protecting the native plant species from development or exploitation.

Table II-2 on the following page displays the acreages allocated to each management area in each alternative.

Table II-2. Management Area Allocations (Thousands of Acres) 1/

	Alternatives					
Management Area	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I 2/
A1A - Undeveloped Rec. (non-motorized)	14.8	14.8	0.0	34.5	63.1	56.7
A1B - Undeveloped Rec. (motorized)	15.2	15.2	0.0	6.1	22.8	28.7
A2 - Scenic	23.4	23.4	0.0	38.2	54.5	57.0
A3 - Developed Rec. Sites & Admin. Sites	1.1	1.1	1.1	1.1	1.1	1.1
A4A - Wild, Scenic, and Rec. Rivers	1.1	1.1	0.0	1.8	20.9	19.0
A4B - River Corridors	0.0	0.0	0.0	17.3	7.1	7.1
B1 - Wilderness	88.3	88.3	88.3	88.3	88.3	88.3
C1 - SOHAs	0.0	75.7	81.8	75.7	63.5	62.7
C2 - P. Woodpecker & P. Marten Areas	0.0	4.1	4.1	4.5	4.5	4.5
C3 - Bald Eagle Management Areas	1.2	1.2	1.2	1.2	1.2	1.2
E1 - Timber Management 3/	445.3	385.6	419.2	325.7	276.5	276.7
F1 - Municipal Watersheds	40.0	19.8	35.1	33.2	24.1	24.6
F2 - Riparian Areas 4/	--	--	--	--	--	--
J2 - Research Natural Areas	1.5	1.5	1.5	1.5	1.5	1.5
J3 - Botanical Areas	0.4	0.4	0.0	3.2	3.2	3.2
TOTAL NATIONAL FOREST ACRES	632.3	632.3	632.3	632.3	632.3	632.3

1/ All figures are mutually exclusive, e.g., A4A, J2, J3, etc., within Wilderness (B1) are reported only as B1. Generally, the acres are reported for the management area felt to be the most restrictive.
2/ No existing old-growth is available for harvest in Alternative I. Therefore, much of the land within allocations such as E1 and F1 is not available. For example, of the 276,700 acres in E1 under Alternative I, 80,000 are old-growth and will not be harvested.
3/ Contains some riparian area, some constrained visual areas, and some unsuitable timber land. Other acres within E1 may not prove to be cost-effective for meeting the objectives of a given alternative.
4/ The 177,050 acres of Riparian Area are distributed across the Forest and are included in the acreage for the other management areas. Constraints are placed on management of these acres when necessary to achieve Riparian Area protection objectives.

COMPARISON OF FOREST RESOURCE PROGRAMS

In the following section, a general comparison of the management program for each resource is described for each alternative. For additional scientific information relative to environmental consequences of these alternative outputs and effects, please refer to Chapter IV of this FEIS. Demand and supply information for each resource output is detailed in Chapter III.

TIMBER RESOURCE MANAGEMENT

Timber harvest provides a wide range of goods and benefits which are realized in the broader economy rather than within the Forest itself. Logs removed from the Forest provide the raw material for production of lumber, paper products, and other consumer goods. Associated with the harvest of timber and the processing of logs are social and economic benefits: employment and income for those involved in the timber industry (either directly or indirectly), and revenues for county governments and the National Treasury. The higher the harvest level, the greater the output of consumer goods and the level of associated social and economic benefits. Many members of the public feel that the Forest's timber should be managed to provide these goods and benefits. Others feel that the costs of timber harvest, in terms of the tradeoff of other resource outputs are too great. Each alternative addresses the issue of timber management in varying ways.

Table II-3 displays data related to timber resource management. The benchmarks and alternatives have been arranged in descending order of acres allocated to timber production (line 1). The data represent the yields and capabilities of National Forest land (both within and outside of the Shelton CSYU) only. Data for Alternative No Change (NC) are based on information contained in timber management plans. Much of the data shown for the original alternatives is not available for Alternative NC. Because of these differences, Alternative NC is not fully comparable with the others. The information presented for this alternative is based on assumptions and yield relationships that do not apply to the remaining alternatives.

The suitable acres listed on line 1 reflect the differences in acreage allocation among the alternatives. These allocations are a direct function of the goals and objectives of each alternative. Alternatives NC, B-Departure (Modified) and A-Current Direction (No Action) have timber production as a primary goal, and therefore have relatively large acreages classified as suitable. The objectives of Alternative C-Preferred (Modified) include use of contribution to present net value, rather than timber output, as a criterion governing land allocation. This objective, in combination with greater emphases on nontimber outputs in this alternative, results in a reduced acreage of suitable timberland. The suitable acreage associated with Alternative NC was developed on the basis of a different land classification and suitability stratification than was used for the original alternatives, and does not reflect current information regarding land capabilities.

Alternatives H (Modified) and I include stronger emphases on outputs which are not compatible with timber harvest. Alternative H (Modified) includes high levels of the nontimber output objectives and adds the objective of retaining all existing old-growth within winter range for the entire 150 year analysis horizon. Alternative I extends the old-growth retention objective of Alternative H (Modified) to the entire Forest.

The inventory values (lines 2, 3, and 4) vary with suitable area. Beginning inventory values (lines 2 and 3) are a direct function of suitable acreage, and vary in the same pattern as the area allocated to prescriptions which include timber harvest. Ending inventory volume (line 4) also depends strongly on suitable acreage, although this varies with the ending age class distribution and the management intensity of timber harvest prescriptions.

First decade allowable sale quantity (lines 5 through 7) is a function of several factors related to the objectives of each alternative. Total suitable acreage is important in establishing ASQ, as it dictates the total acreage available in the harvest base. The harvest flow objectives of each alternative are also a key factor, as are the limitations on harvesting old-growth in Alternatives H (Modified) and I. Alternative B-Departure (Modified) has a first decade departure from nondeclining flow on the East-West component of the Forest, while the remaining alternatives have flow objectives which limit East-West ASQ to the long term sustained yield capacity (LTSYC) or less. The harvest limitations of Alternatives H (Modified) and (especially) I greatly reduce the base of harvest-age timber available in the first decade. All these factors interact to generate the first decade ASQ for each alternative. In the case of Alternative NC, first decade ASQ reflects the first decade potential yield contained in existing timber management plans. Since potential yield is developed on the basis of managing timber as a single resource (as opposed to the integrated resource management that serves as the basis for the ASQ calculations of the other alternatives), the yields projected for Alternative NC are not fully comparable to those of the original alternatives.

The LTSYC display, line 8, reflects the suitable acreage and timber harvest management intensity of each alternative. The average annual net growth figures (lines 11 and 12) are a reflection of age class distributions, site productivity mixes, and harvest intensities on suitable lands. With a few exceptions, the differences in these factors are not sufficient to generate substantial differences in the per-acre growth rates of the alternatives. Alternative I has a relatively high first decade growth rate because a high proportion of the slow-growing stands have been removed from its harvest base. The 2030 growth rate of Alternative C-Preferred (Modified) is low because, in this alternative, there is a larger acreage of slow-growing stands in the harvest base than in Alternative I. Also, relatively little intensive management has been conducted by the end of the fifth decade when compared to the more timber-oriented Alternatives A-Current Direction (No Action) and B-Departure (Modified).

The display of acreages and percentages of suitable land by timber yield level (lines 14 through 19) reflects changes in allocation pattern from alternative to alternative. Allocations to the "50 to 90 percent yield level" represent the prescriptions needed to meet the Scenic quality, Wild and Scenic River and River Corridor protection, and Riparian Area management objectives of each alternative. In the case of Alternative NC, the "reduced yield" column reflects the acreage included in the "special" component in current timber management plans. The "special" component includes all areas designated for some form of special management, and involves prescriptions ranging from "no harvest" to "full yield" for individual blocks within the overall classification. The Quinault and Peninsula Working Circle Plans have been amended to incorporate the special management acreages of the relevant unit plans into the "special" component acreage. Potential yield volumes, on the other hand, were left unrevised pending completion of the Forest Plan. Based on estimates contained in unit plans, the average yield from "special" areas is expected to be roughly two-thirds of full yield. None of the harvest prescriptions of any alternative entails timber yield reductions of over 50 percent.

The display of regeneration harvest acres, lines 20 through 23, varies with the harvest levels of the alternatives. The harvest total percent, line 23, also relates to the rate of regeneration harvest by alternatives. The higher the percent, the shorter the length of time to fully harvest the Forest at the rates established in the first decade. There are no acres of shelterwood/seed tree or selection harvest in any of the alternatives.

Table II-3. Timber Resource Management Information by Benchmarks and Alternatives

			Benchmarks		Alternatives					
		Unit of Measure	BM 7T-Max Timber	BM7-Max PNV	No Change	B-Dep (Modified)	A-Current Direction	C-Pref (Modified)	H (Modified)	I
1.	**Suitable Lands** 1/	M acres	374.6	367.4	497.8	372.5	357.9	352.1	300.0	240.0
	Inventory									
2.	Begin	MMCF	1,440	1,433	2,615	1,440	1,355	1,263	912	453
3.	Begin/CF 2/	Acre	3,845	3,899	5,253	3,866	3,785	3,587	3,040	1,888
4.	End	MMCF	1,310	1,448	3/	1,686	1,360	1,388	1,194	1,009
	Average Annual ASQ - First Decade									
5.		MMCF	42.6	28.7	59.8	55.7	36.0	20.6	13.3	2.3
6.		Percent 4/	3.0	2.0	2.4	3.9	2.7	1.6	1.5	0.5
7.		MMBF	223.2	162.5	330.5	306.7	199.5	110.9	69.3	10.4
	LTSYC									
8.		MMCF	40.4	38.8	43.9	39.2	37.8	35.9	30.8	25.4
9.		Percent 5/	3.1	2.7	2/	2.3	2.8	2.6	2.6	2.5
10.a.	EW 6/	Decade met	1	11	1	11	11	7	7	6
10.b.	SYU 6/	Decade met	7	7	8	7	7	7	7	6
	Average Annual Net Growth									
11.	Present	CF/Acre	61.8	64.2	2/	61.7	63.6	62.9	68.9	79.7
12.	Decade 5	CF/Acre	116.2	105.1	2/	115.0	109.5	96.6	101.2	113.8
13.	Decade 5 8/	MMCF	43.5	38.6	2/	42.9	39.2	34.0	30.4	27.3
	Area and percent of Suitable Land by Yield Level									
14.	Full Yield	M Acre	374.6	367.4	373.0	372.5	333.4	280.5	239.5	197.2
15.	Full Yield	Percent 8/	100.0	100.0	74.9	100.0	93.2	79.7	79.8	82.2
16.	50-90% Yield	M Acre	0.0	0.0	124.8	0.0	24.5	71.6	60.5	42.8
17.	50-90% Yield	Percent 8/	0.0	0.0	25.1	0.0	6.8	20.3	20.2	17.8
18.	Under 50% Yield	M Acre	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19.	Under 50% Yield	Percent 8/	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table II-3. (Contd.)

	Benchmarks	Alternatives								
		Unit of Measure	BM 7T-Max Timber	BM7-Max PNV	No Change	B-Dep (Modified)	A-Current Direction	C-Pref (Modified)	H (Modified)	I
	Shelterwood - First Decade									
20.	Clearcut	M Acres	59.0	29.3	62.6	65.6	40.9	24.1	15.8	2.0
21.	Seed Tree	M Acres	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22.	Selection	M Acres	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23.	Harvest Total	Percent 8/	15.8	8.0	12.6	17.6	11.4	6.8	5.3	0.8

1/ Tentatively suitable lands for original alternatives: 446,939 acres; Alt. NC: 507,930 acres tentatively suitable. Present inventory 2,668 MMCF.
2/ The average volume per acre (cubic feet) of the beginning inventory.
3/ Alternative NC not analyzed in FORPLAN. Data needed to estimate these variables quantitatively not available.
4/ The relationship of the average annual allowable sale quantity in the first decade to the beginning inventory (first decade average volume MMCF divided by beginning inventory volume MMCF).
5/ The relationship of the long-term sustained yield capacity to the ending inventory (LTSYC in MMCF divided by ending inventory volume MMCF).
6/ The East-West Zone and Shelton CSYU remain separate perpetually in Benchmarks 7 and 7T and in Alternatives NC, B-Departure, and A. In Alternative C-Preferred, H, and I, National Forest lands within the Shelton CSYU are recombined with remaining NF lands after termination of the Cooperative Agreement. The display of attainment of LTSYC for these alternatives reflects this recombination.
7/ The total annual net growth (all suitable lands) in Decade 5, in million cubic feet.
8/ Percent of land suitable for timber production (see Column 1).

Olympic National Forest Existing Timber Management Plans (Alternative No Change)

Data from the timber management plans (Quinault and Peninsula Working Circle and Shelton Timber Management Plan):

1. Average annual chargeable volume sold from 1975 through 1989 was 291.8 million board feet.
2. Total acres of standard, special, and marginal lands used to develop the potential yield is 507,930 acres. In current planning process, 446,939 acres are classified as tentatively suitable. This is a difference of 60,991 acres. There are 48,216 acres previously classified as marginal that are now classified unsuitable (lands subject to irreversible damage and unreforestable lands). If these areas were removed from the timber management plan acreage, the result would be very close to the current tentatively suitable acreage.

PAST AND PRESENT TIMBER OUTPUTS

Table II-4 shows a comparison of past timber volumes sold and harvested, current timber management plan potential yield calculation, and the allowable sale quantity calculated for each alternative considered in the Forest Plan.

The figures in the table may not be directly comparable due to the different ways they were calculated. However, they can be used to estimate changes that may occur with implementation of any of the alternatives.

Actual sold volumes will generally be higher than actual harvested volumes because some sales may not be harvested for one reason or another. During the period November 1985 to July 31, 1986, 33 sales on the Olympic National Forest, involving 223.4 million board feet of timber, were turned back to the Government under the Federal Timber Contract Modification Act of 1984. Two sales, totaling 30.8 million board feet, are now in spotted owl habitat areas and will not be reoffered.

Actual sold volumes may also differ from existing timber management plan potential yield calculations, since there were times when the full potential yield was not programmed or funded for sale. In some cases, timber management plan amendments have decreased the potential yield, and the long-term historical sold volume may average higher than the current potential yield. Various amendments to the Quinault and Peninsula Working Circle Timber Management Plans and the Shelton CSYU Timber Resource Plan have reduced the potential yield from 354.7 million board feet in 1975 to 330.5 million board feet in 1989.

The allowable sale quantity (ASQ) calculated for each alternative is lower when compared to existing timber plan volumes. Most of this reduction is the result of shifting the harvest from National Forest land to Simpson Timber Company land within the Shelton CSYU. Since 1946, harvest on the Shelton CSYU has been concentrated on National Forest lands. The transition to harvesting on Simpson Timber Company lands began about 1980. This scheduled shift of potential yield volume from National Forest to Simpson lands would have reduced the existing timber management plan potential yield from 330.5 million board feet to 214.8 million board feet in 1989.

The ASQ is the amount of timber planned for sale each year under the provisions of plan alternatives. Actual sale volumes may vary, however, depending on annual budgets. ASQ includes only "chargeable" wood volume. Actual historical sold and cut harvest figures have been adjusted to include only chargeable wood volume. The total of volume chargeable and volume not considered chargeable was 291.8 million board feet actually sold, and 263.3 million board feet actually harvested, from 1975 to 1989.

Table II-4. Comparison - Past, Present and Alternative Timber Outputs 1/
(volume in million board feet)

	1975 to 1989 Actual Annual Average 2/			Alternatives					
Timber Outputs	Sold	Cut	Existing TM-Plans 3/	No Change	A-Current Direction 4/	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
I. Allowable Sale Quantity (ASQ) 5/									
A. Green			314.4	330.5	199.5	306.7	110.9	69.3	10.4
B. Salvage			16.1						
TOTAL VOLUME	259.7	235.7	330.5	330.5	199.5	306.7	110.9	69.3	10.4
II. Sawtimber from Lands Designated Unsuitable for Timber Production 6/									
A. Green									
B. Salvage									
TOTAL VOLUME			0.0	0.0	0.0	0.0	0.0	0.0	0.0
III. Submerchantable Volume from all Lands 7/									
A. Fuelwood				11.3	6.7	10.2	3.7	2.3	0.02
B. Other 8/				26.5	15.5	23.9	8.6	5.4	0.18
TOTAL VOLUME	32.1	27.6	0.0	37.8	22.2	34.1	12.3	7.7	0.20
Total Net Merchantable Sawtimber (I + II)			330.5	330.5	199.5	306.7	110.9	69.3	10.4
Total Nonchargeable Volume (II + III)	32.1	27.6	0.0	37.8	22.2	34.1	12.3	7.7	0.20
IV. Timber Sale Program Quantity (I + II + III) 9/	291.8	263.3	330.5	368.3	221.7	340.8	123.2	77.0	10.6

Table II-4. (Cont'd.)

1/ Due to different bases for calculating, these figures may not be directly comparable. However, they may be used to show changes in specific components or as a basis for assessing broad changes over time. Simpson Timber Company volume is not included. There is a major shift in Allowable Sale Quantity from National Forest land within the Shelton CSYU to Simpson Timber Company land for the period 1/1/87 to 12/30/96.

2/ Actual annual average volume from 1975 through 1989 (15.25 years).

3/ The assumptions that were used in the existing timber management plans to calculate potential yield differ from those that were used to calculate Allowable Sale Quantity. While potential yield represented a level that could be produced, allowable sale quantity represents a timber objective and program for achievement of planned levels. However, both the potential yield and the allowable sale quantity do represent a ceiling on the amount of chargeable timber volume that could be sold for a given decade. In this context, the two terms are comparable. Potential yield includes timber projected for the following plans: (a) Quinault Working Circle 7/1/69 to 6/30/78, extended to until the Final Forest Plan is approved, and amended in 1973, 1980, 1984, 1987, and 1989; (b) Peninsula Working Circle 7/1/68 to 6/30/77, extended to until the Final Forest Plan is approved, and amended in 1974, 1977, 1980, 1984, 1987, and 1989; and (c) Shelton CSYU Timber Management Plan 1/1/77 to 12/31/86, extended to 1/1/91 and amended in 1987, 1989 and 1990.

4/ Allowable sale quantity calculated for the current land and resource management plan direction, projected into the future using new scientific information, such as yield tables and suitability for timber harvest, and FORPLAN analysis model.

5/ Allowable sale quantity (ASQ) - The allowable sale quantity is composed of those volumes resulting from the yield projections of FORPLAN. ASQ is obtained from lands designated as suitable for timber production under NFMA standards, and meets the utilization standards in the Regional Guide. When sold, the volume is called "chargeable", and is used to determine achievement of planned allowable sale quantity goals.

6/ Sawtimber from lands designated unsuitable for timber production - This incidental volume is an estimate of timber that will be sold from lands not designated for timber production. These sales are generally associated with vegetative management for other resources. Through meeting Regional Guide utilization standards, this volume is not considered "chargeable" against the planned allowable sale quantity goals.

7/ Submerchantable volume from all lands - The estimated timber volume that do not meet the utilization standards in the Regional Guide, but which could be utilized for products other than sawtimber. It is not considered "chargeable" against planned allowable sale quantity goals.

8/ Other - Includes cull material.

9/ Timber sale program quantity - The timber sale program quantity includes the allowable sale quantity for the first decade and estimated additional volume planned for sale during the first decade, such as fuelwood.

OLD-GROWTH

Considerable interest has been expressed regarding the management of old-growth on the Forest. This issue relates to the amount of land the Forest will manage to retain old-growth vegetative conditions, as well as which existing old-growth areas will be made available for a variety of consumptive uses. Many members of the public wish to see old-growth retained for its scenic value and its contributions to fish and wildlife habitat quality. Timber harvest will be precluded within areas in which existing old-growth is to be retained, and harvest rotations must be lengthened considerably in stands to be managed as old-growth during part of the rotation period. Therefore, timber harvest levels are likely to decrease as acreage managed for old-growth conditions increases.

High harvest alternatives result in the greatest changes in acreage of old-growth forest (see Tables II-5 and II-6). Old-growth distribution within each management area for each alternative is displayed in Table II-6.

Table II-5. Total National Forest Acres of Old-Growth at End of Decade (thousands of acres)

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Decade 1						
Wilderness	46.8	46.8	46.8	46.8	46.8	46.8
Nonwilderness						
In Allocations Precluding Harvest	25.0	86.9	68.7	94.3	138.3	220.0
Physically Unsuitable in Allocations Permitting Harvest 1/	39.7	26.2	36.0	24.2	22.0	0
Suitable for Timber Production	86.4	69.8	52.1	79.5	45.4	0
Total Old-Growth	197.9	229.7	203.6	244.8	252.5	266.8
Percent 2/	74%	86%	76%	92%	95%	100%
Decade 2						
Wilderness	46.8	46.8	46.8	46.8	46.8	46.8
Nonwilderness						
In Allocations Precluding Harvest	25.0	86.9	68.7	94.3	138.3	220.0
Physically Unsuitable in Allocations Permitting Harvest 1/	34.7	26.2	36.0	24.2	22.0	0
Suitable for Timber Production	41.1	39.2	14.3	57.7	32.9	0
Total Old-Growth	147.6	199.1	165.8	223.0	240.0	266.8
Percent 2/	55%	75%	62%	84%	90%	100%
Decade 5						
Wilderness	46.8	46.8	46.8	46.8	46.8	46.8
Nonwilderness						
In Allocations Precluding Harvest	25.0	86.9	68.7	94.3	138.3	220.0
Physically Unsuitable in Allocations Permitting Harvest 1/	19.7	26.2	36.0	24.2	22.0	0
Suitable for Timber Production	35.3	13.8	0	19.7	11.8	0
Total Old-Growth	126.8	173.7	151.5	185.0	218.9	266.8
Percent 2/	48%	65%	57%	69%	82%	100%

1/ This acreage is based on current definition of unsuitable lands for timber production. The No Change Alternative is based on the timber land suitability stratification used in the development of existing timber management plans.
2/ Percent based on current acreage of old-growth (266,800).

Table II-6. Old-Growth Acreage Within Management Area Allocations (thousands of acres) 1/

	Alternatives					
Management Area	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I 2/
A1A - Undeveloped Rec. (non-motorized)	11.9	11.9	0.0	24.5	44.5	40.2
A1B - Undeveloped Rec. (motorized)	10.9	10.9	0.0	4.1	11.4	15.5
A2 - Scenic	13.1	13.1	0.0	14.8	14.4	14.7
A3 - Developed Rec. Sites & Admin. Sites	0.1	0.1	0.1	0.1	0.1	0.1
A4A - Wild, Scenic and Rec. Rivers	0.0	0.0	0.0	0.3	8.5	7.1
A4B - River Corridors	0.0	0.0	0.0	8.2	3.9	3.7
B1 - Wilderness	46.8	46.8	46.8	46.8	46.8	46.8
C1 - SOHAs	0.0	60.5	65.2	57.2	44.1	46.0
C2 - P. Woodpecker & P. Marten Areas	0.0	1.4	1.4	3.3	3.3	3.3
C3 - Bald Eagle Management Areas	0.7	0.7	0.7	0.7	0.7	0.7
E1 - Timber Management 3/	165.9	112.1	140.6	94.9	80.2	79.9
F1 - Municipal Watersheds	16.0	7.9	9.3	8.2	5.3	5.4
F2 - Riparian Areas 4/	--	--	--	--	--	--
J2 - Research Natural Areas	1.4	1.4	1.4	1.5	1.5	1.5
J3 - Botanical Areas	0.0	0.0	0.0	2.3	2.3	2.3
TOTAL OLD-GROWTH ACRES	266.8	266.8	266.8	266.8	266.8	266.8
OLD-GROWTH WITHIN AREAS NOT PERMITTING TIMBER HARVEST	71.8	133.7	115.5	141.1	185.1	266.8
PERCENT WITHIN AREAS NOT PERMITTING TIMBER HARVEST	26.9%	50.1%	43.3%	52.9%	58.3%	100%

1/ All figures are mutually exclusive, e.g., A4A, J2, J3, etc., within Wilderness (B1) are reported only as B1. Generally, the acres are reported for the management area felt to be the most restrictive.
2/ No existing old-growth is available for harvest in Alternative I. Therefore, all of the old-growth within allocations such as E1 and F1 is not available. The entire 266,800 acres of old-growth are unavailable for timber harvest in Alternative I.
3/ Contains some riparian area, some constrained visual areas, and some unsuitable timber land. Other acres within E1 may not prove to be cost-effective for meeting the objectives of a given alternative.
4/ The 177,050 acres of Riparian Area are distributed across the Forest and are included in the acreage for the other management areas. Constraints are placed on management of these acres when necessary to achieve Riparian Area protection objectives.

NATIVE PLANT SPECIES AND COMMUNITIES

Another key component of vegetation is the effects of the alternatives on native plant species and communities, particularly those which are unusual, sensitive, threatened, or endangered. Two means of addressing this issue are protection of plants through allocations of land to Research Natural Areas (RNAs) or Botanical Areas (BAs). Table II-7 displays the number and area of RNAs and BAs for each alternative. The existing Quinault RNA (1,500 acres) is retained in all of the alternatives. Two additional RNAs are added to Alternatives H (Modified) and I, these are Buckhorn (approximately 3,000 acres) and Wet Weather Creek (approximately 1,100 acres). Alternative C-Preferred (Modified) adds Wet Weather Creek as an RNA but allocates Buckhorn, which is entirely within the Buckhorn Wilderness, to the Botanical Area prescription. The name-specific RNA and BA allocations are identified for each alternative in the descriptions of the alternatives within this chapter.

Table II-7. Research Natural Areas and Botanical Areas 1/

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Research Natural Areas						
Number	1	1	1	2	3	3
1000 Acres	1.5	1.5	1.5	2.6	5.7	5.7
Botanical Areas						
Number	2	2	0	12	11	11
1000 Acres	.5	.5	0	6.2	3.1	3.1

1/ Acreage shown is **total** area within RNAs and BAs. Discrepancies with Table II-2 are due to cases where RNA or BA acres are within more restrictive allocations such as Wilderness. In such cases, Table II-2 reports these acres as B1 (Wilderness) rather than J2 (RNA) or J3 (BA).

WATER

Maintaining water quality at a level suitable for domestic use is an important concern to the many residents and municipalities dependent upon water from the Forest's municipal watersheds. Water quality is also critical to the maintenance of fish habitat, both in Forest streams and in downstream drainages and estuaries. Management of vegetation riparian zones is becoming more of a concern to many people. Riparian vegetation provides a stream channel with a source of large, woody debris which is now recognized as an important component of fish habitat. Riparian vegetation also plays an important role in providing wildlife habitat. Managing for reduced sediment levels (the primary variable affecting water quality on the Forest) and/or maintenance of riparian area vegetation could necessitate reductions in timber harvest.

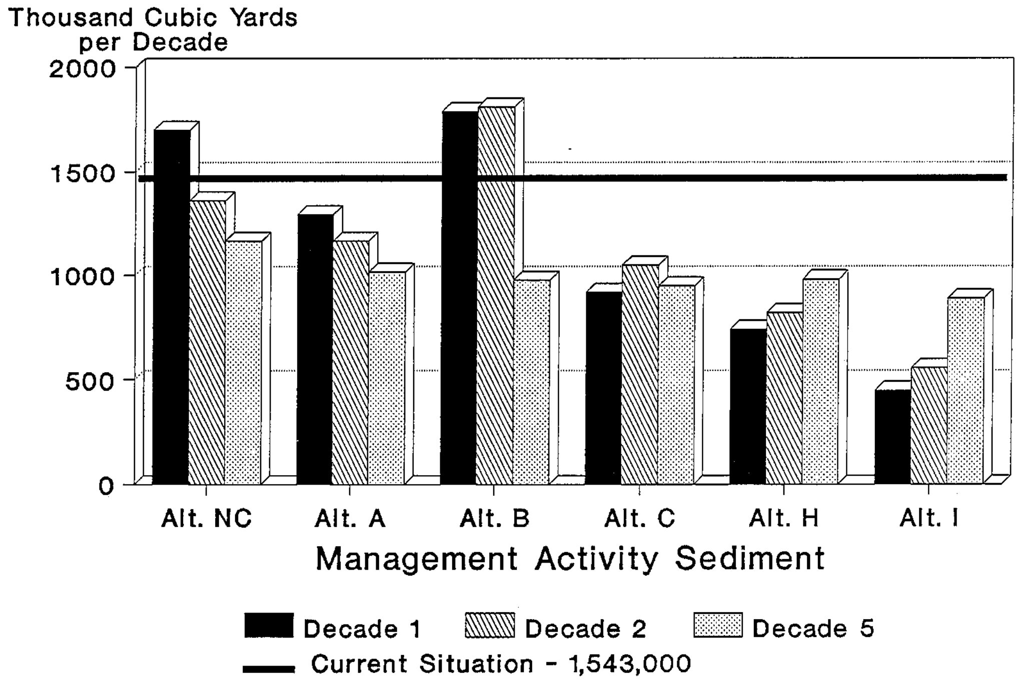
The hydropower facet of this issue is relatively new compared to the others, surfacing during the energy "crisis" in the early 1980's. It is primarily associated with new technology that resulted in lower development costs and new legislation that provided incentives to develop hydropower resources. The major concerns are those associated with construction of dams and other instream obstructions that preclude or restrict movement of fish, especially anadromous species. This water concern is best addressed under the Wild and Scenic River section since recommendation as a Wild and Scenic River will affect the availability of a river for hydropower development. Those alternatives with the highest number of recommended rivers will have the lowest potential for hydropower development.

The amount and location of timber harvest and the associated road construction, reconstruction, and use directly affects water quality. Those alternatives with high timber harvest levels, such as Alternatives NC and B-Departure (Modified), will generally affect water quality more than those with lower harvest levels. This is related to the amount of sediment generated by harvest-related activities. Alternative A-Current Direction will generate less sediment than NC or B-Departure (Modified), C-Preferred (Modified), and H (Modified) will generate less than A. Alternative I, with its amenity emphasis, will produce the least sediment.

Appendix J of this FEIS discusses the Best Management Practices (BMPs) for soil and water protection. These BMPs are applicable to all alternatives to assure that activities will meet or exceed water quality standards. In addition, during Plan implementation, monitoring of project activities will be done to ensure meeting water quality goals. Refer to Forest Plan, Chapter V and Plan Appendix B for monitoring details.

The effects alternatives are expected to have on water quality are displayed in Figure II-1, which displays estimated sediment yield indices for on-Forest activities. Additional information on sediment yield and watershed condition improvement acres for each alternative is displayed in the alternative comparison matrices (Tables II-14 and II-15) in this chapter. Also refer to Chapter IV for a more detailed discussion of the environmental consequences of the alternatives on water quality.

Figure II-1. Forest-Wide Sediment Indices 1/



1/ Natural Sediment - 901,000 cubic yards per decade.
Thousands of cubic yards per decade. These indices are from Forest activities only and do not include background levels.

SOILS

Timber harvest, residue treatment, and road construction are the principal forest management activities that cause soil compaction, soil erosion, and alteration of nutrient cycling. The amount of compacted soils is normally insignificant in the Forest-wide situation. However, site-specific areas can be adversely affected where undesirable practices occur.

Using information displayed in the tables for acreage and volume of timber harvest (see Tables II-3 and II-4), effects of the alternatives on soil can be estimated. In general, the more acres harvested, the greater the acreage to be broadcast burned. When burning occurs, the risk of soil damage and nutrient loss increases.

Because most soil movement is associated with the road system, alternatives that involve higher levels of road construction are more likely to trigger slope failures. Table II-8 displays estimated road construction for each alternative. This is the primary indicator of the level of soil loss through erosion. Erosion loss from road surfaces and cutslopes is accounted for in the sediment yield indices (see Figure II-1). Also note there is additional sediment yield information in the alternative comparison matrix, Table II-14.

Table II-8. Road Construction by Alternatives 1/

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
1st. Decade	18	18	28	14	9	2
50-yr Average	11	9	13	8	5	2

1/ Figures represent miles per year.

WILDLIFE

The quality of habitat available for wildlife varies with each alternative. Since wildlife species vary widely in their responses to habitat conditions, the management emphasis of each alternative is likely to be favorable to some species and unfavorable to others.

Generally, those alternatives which retain the most old-growth (see Tables II-5 and II-6) will be most favorable for spotted owls, pileated woodpeckers, marten, and snag-dependent species. Such alternatives will also be favorable to big game species, since old-growth (in its role as thermal cover) is a limiting factor in winter range in some areas. However, timber harvesting is also important to big game, as it stimulates growth of shrubs and grasses which are used as forage. For these reasons, those alternatives with a mid-range harvest level might be most favorable to big game.

Each alternative, other than NC, has 30 Spotted Owl Habitat Areas averaging 3,000 acres in size. The extent to which these SOHAs fall within other management areas varies among the alternatives. As indicated by Table II-2, which displays acres by management area, the more commodity-oriented alternatives such as B-Departure (Modified) appear to have more acres allocated to the SOHA prescription. In actuality, all alternatives other than NC have approximately 90,000 acres in the SOHA (C1) management area. The numbers in Table II-2 are mutually exclusive and acres are generally reported for the most restrictive management area prescription. Therefore, in amenity alternatives such as H (Modified) and I, many of the SOHA acres are within other restrictive allocations (e.g., Undeveloped Recreation or Botanical Areas). The relative absence of these amenity allocations in Alternative B-Departure (Modified) results in a higher number of acres being reported as SOHAs.

Roads improve access to the Forest, and can lead to increased hunting pressure and disturbance of wildlife. Those alternatives with the most road construction (see Table II-8) present the greatest risk of disturbing wildlife. This disturbance can be greatly reduced by closing roads, either permanently or during critical seasons. The results of management activities of the alternatives result in varying estimated wildlife outputs. These outputs, including wildlife-related recreation (wildlife and fish user days (WFUDs)) and estimated numbers of animals of selected indicator species are displayed for each alternative in Table II-14.

FISHERIES

Public resource management agencies, the commercial fishing industry, Peninsula American Indian tribes, and the general public have a strong interest in maintenance of productive fish habitat in rivers and streams, both on and off the Forest, and the estuaries into which they flow. Demand for both commercial and sport fishing continues to increase. American Indian tribal members and organizations and several coastal communities are dependent on commercial and sport fisheries for economic stability.

Timber harvest can adversely affect fish habitat productivity by reducing sediment entering the stream system and filling pools or silting spawning beds. The road construction, reconstruction, and use associated with timber harvest are the primary sources of nonnatural sediment in Forest streams. Because of these relationships, managing for improved fish habitat quality can lead to reductions in timber harvest.

Sediment is the primary variable used in estimating the effects of alternatives on fish. Therefore, estimated habitat capability varies with volume of timber harvested and the associated road construction, reconstruction, and use. Refer to Figure II-1 for sediment yield indices by alternative. The changes in fish habitat capability anticipated for each alternative are displayed in Table II-9. Additional fisheries output information, including recreation use and anadromous commercial production is presented in the large, alternative comparison matrix, Table II-14. The effects of Alternative NC on fish habitat capability could not reasonably be projected quantitatively. It is expected that the habitat capability associated with this alternative would fall between Alternative A-Current Direction and B-Departure (Modified), especially in the first decade.

Table II-9. Estimated Anadromous Fish Habitat Capability Index (Thousands of Smolt Anadromous Fish Produced Per Year Per Decade)

Alternatives	Decade 1	Decade 2	Decade 5
No Change	9,369	9,485	9,682
A-Current Direction	9,639	9,682	9,659
B-Dep (Modified)	9,328	9,030	9,549
C-Pref (Modified)	9,635	9,581	9,683
H (Modified)	9,700	9,685	9,683
I	9,840	9,801	9,754

RECREATION

The main facet of the outdoor recreation issue is the availability of opportunities to recreate in an environment that is not noticeably altered by the sights and sounds of human activity. The recreation opportunities of most concern in this planning question are those associated with the Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized classes of the Recreation Opportunity Spectrum (ROS). Many members of the public specifically desire these forms of recreation. In order to provide such opportunities in a given area, it is necessary to limit management activities to those which will not compromise the undeveloped nature of the area. Therefore, road construction and timber harvest are generally incompatible with Primitive and Semi-Primitive recreation. To the extent that areas are allocated to this use, the area available for timber harvest decreases.

The alternatives are very similar for developed recreation. They provide for the same levels of developed recreation site construction and reconstruction. The setting or surrounding environment of the developed recreation site is expected to vary among alternatives. In general, it is assumed that those alternatives with high commodity outputs, such as B-Departure (Modified) and NC, will result in a more modified, less natural appearing setting/environment than in the amenity oriented alternatives such as H (Modified) and I. Alternative C-Preferred (Modified) falls between this range.

The effects of alternatives on undeveloped recreation are best summarized by looking at acres that will provide different kinds of recreation opportunities. These are expressed in terms of a Recreation Opportunity Spectrum (ROS) which represents a range of recreation experiences. Please see Chapter III for a detailed discussion of the ROS concept. The opportunity spectrum is represented by classifying land into categories, referred to as ROS classes. Table II-10 displays acres available at the end of the fifth decade in each ROS class. Please refer to the alternative comparison matrices, Tables II-14 and II-15, for additional recreation output information, including estimated recreation use levels, for each alternative.

Table II-10. Acres by ROS Class (End of 5th Decade) 1/

ROS Class	Current Situation 2/	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Primitive	4.9	1.4	2.9	1.7	3.4	4.5	4.9
Semi-Primitive Non-Motorized	49.1	14.2	29.0	16.7	33.0	44.7	49.1
Semi-Primitive Motorized	6.6	1.9	3.9	2.2	4.6	6.0	6.6
Roaded Natural & Modified	478.4	521.4	503.1	518.3	497.0	483.7	478.3
Rural	5.1	5.1	5.1	5.1	5.1	5.1	5.1

1/ Figures in thousands of acres. Does not include acres inside Wildernesses.
2/ At beginning of first decade

SCENERY

The scenic quality of the Forest is important to both Forest visitors and the numerous residents of the greater Puget Sound area who view parts of the Forest from their homes. Both groups prefer to see natural-appearing landscapes when viewing the Forest, and are often dissatisfied when management activities are highly visible. In order to provide landscapes of high scenic quality, it is necessary to place limitations on those management activities having the potential to detract from the natural appearance of the landscape. The principal such activities are timber harvest and road construction. While the limitations on these activities needed to maintain scenic quality generally do not preclude the activity entirely, they can result in increased management costs and reductions in timber output.

The effects that each alternative has on scenery are measured by identifying the visual condition of each viewshed. The visual condition is the visual appearance of a given viewshed and is described in terms of the degree of alteration of the natural appearing landscape. The four degrees of visual alteration are described in the "Scenery" section of Chapter III. Table II-11 displays the future condition of each viewshed by alternative. In addition to this information, Table II-14 also reports acres by Visual Quality Objectives (VQOs) for each alternative.

Table II-11. Future Condition of Sensitivity Level 1 Viewsheds - Visual Condition at the end of 5th Decade 1/

Viewshed	Existing Visual Condition	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Hoodsport Hwy 101	NA	MA	MA	HA	SA	SA	SA
Dosewallips Road	MA	MA	MA	HA	SA	SA	SA
Jupiter Ridge Trail	HA	HA	HA	HA	NA	NA	NA
Duckabush Road	NA	SA	SA	HA	NA	NA	NA
Hamma Hamma Road	NA	HA	HA	HA	NA	NA	NA
Lena Lake Trail	NA	NA	NA	HA	NA	NA	NA
Big Creek Road	MA	MA	MA	HA	SA	SA	SA
Lake Cushman Road	SA	MA	MA	HA	NA	NA	NA
Quilcene Hwy 101	SA	HA	HA	HA	SA	SA	SA
Mt. Walker	HA	MA	MA	HA	NA	NA	NA
Quinault Hwy 101	NA	HA	HA	HA	SA	SA	SA
N. Shore Road	SA	SA	SA	MA	SA	SA	SA
S. Shore Road	NA	NA	NA	HA	NA	NA	NA
Moclips Hwy	NA	HA	HA	HA	SA	SA	SA
Soleduck Hwy 101	SA	HA	HA	HA	SA	SA	SA
Soleduck Park Road	SA	MA	MA	MA	SA	SA	SA
Elwha Park Road	NA	SA	SA	MA	SA	SA	SA
Hoh Road	NA	HA	HA	HA	SA	SA	SA
Wynoochee	MA	SA	SA	HA	SA	SA	SA
S. Fork Skokomish Road	SA	SA	SA	HA	SA	SA	SA

1/ NA = Natural Appearance, SA = Slightly Altered, MA = Moderately Altered, and HA = Heavily Altered.

WILDERNESS

Allocation to Wilderness is constant in all alternatives, and includes 88,265 acres within the five Olympic National Forest Wildernesses established by the Washington State Wilderness Act of 1984. The degree of management activity in close proximity to Wilderness boundaries is largely determined by the degree to which existing unroaded areas are maintained in each alternative. Please refer to the "Unroaded Areas" discussion in this Section for the level of unroaded area retention by alternative.

WILD AND SCENIC RIVERS

The subject of the management of potential Wild and Scenic Rivers became an issue on the Olympic Peninsula during the energy crisis of the early 1980's. Many hydropower projects were being proposed, and people became more concerned about potential loss of anadromous fish habitat. Some people feel that any river with an anadromous fishery possesses an outstandingly remarkable feature and is therefore eligible for designation as a Wild, Scenic, or Recreational River. Others would like to see such designations to preserve the free-flowing nature of the Peninsula's rivers. In contrast, some segments of the public would prefer that rivers not be designated Wild and Scenic, both to preserve options for hydropower development and to avoid limitations on timber harvest activity.

The effects of the alternatives on potential Wild and Scenic River corridors are best summarized by identifying which alternatives protect existing attributes of eligible rivers. This is summarized in Table II-12. Specific river allocations are identified for each alternative in the "Description of Alternatives Considered in Detail" section of this Chapter. Appendix F presents a very detailed analysis and discussion of potential candidates to the Wild and Scenic River System.

Table II-12. Management of Eligible Wild and Scenic Rivers

Rivers Receiving National Forest Study	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Dungeness				X	X	X
Dosewallips				Y	X	X
Duckabush	X	X		X	X	X
East Fork Humptulips				Y	X	X
Gray Wolf				X	X	X
Hamma Hamma				Y	X	X
Soleduck				Y	X	X
S. Fork Skokomish				Y	X	X
M. Stem/ W.F. Humptulips				Y	X	X
Wynoochee				Y	X	X

X = Recommended for inclusion in the Wild and Scenic River System
Y = Not recommended for inclusion in System, but assigned to River Corridor management area prescription.

Rivers to be Studied by Other Agencies	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Quinault				Z	Z	Z
Hoh				Z	Z	Z
Bogachiel				Z	Z	Z
Elwha				Z	Z	Z

Z = Assigned to River Corridor management area prescription. Management activities will be delayed until study is completed to maintain qualifying characteristics.

UNROADED AREAS

Many members of the public would prefer that the Forest's unroaded areas be retained in an undeveloped condition, both for the values associated with maintaining relatively undisturbed environments and for the unroaded undeveloped recreation opportunities they provide. To provide such environments and opportunities in a given area, it is necessary to limit management activities to those which will not compromise the undeveloped nature of the area. Therefore, road construction and timber harvest are generally incompatible with unroaded area retention. To the extent that areas are allocated to this use, the area available for timber harvest decreases.

The future condition of unroaded areas on the Olympic National Forest varies widely among the alternatives. This information is presented in detail in Appendix C of the FEIS. Estimated acreage within each unroaded area which will remain undeveloped through the end of the fifth decade is displayed in Table II-13. For additional information, refer to Table II-2, which presents acres for each management area by alternative. Table II-2 displays the number of acres allocated to Motorized (A1B) and Non-Motorized (A1A) Undeveloped Recreation management areas as well as other management areas which limit management activities such as roading.

Table II-13. Unroaded Areas - End of 5th Decade

(Thousands of Acres)

Unroaded Area	Current Situation 1/	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
McDonald	0.5	0.0	0.5	0.5	0.5	0.5	0.5
Quilcene	19.0	3.8	14.2	13.3	14.2	14.2	19.0
Mt. Zion	5.4	0.0	1.8	1.8	3.6	5.4	5.4
Green Mtn.	4.5	0.0	0.7	0.7	0.7	4.5	4.5
Jupiter Ridge	8.3	1.6	2.8	1.2	4.5	7.3	8.3
Jefferson Ridge	9.4	3.8	4.3	0.5	4.3	9.4	9.4
Lightning Peak	7.2	3.6	5.4	1.8	5.4	7.2	7.2
Upper Skokomish	6.2	4.3	5.0	1.9	5.0	6.2	6.2
Moonlight Dome	5.9	5.3	5.3	0.0	5.9	5.9	5.9
South Quinault Ridge	9.8	3.0	4.5	3.0	7.4	9.8	9.8
Rugged Ridge	4.6	0.0	2.5	2.5	2.5	4.6	4.6
Mt. Baldy	3.9	0.0	0.0	2.5	2.5	3.9	3.9
Madison Creek	1.1	0.0	1.0	1.0	1.0	1.1	1.1
TOTAL ACRES	85.8	25.4	50.5	30.7	57.5	80.0	85.8

1/ At beginning of first decade.

TRANSPORTATION

The development and management of the Forest's transportation system is a concern to much of the public. There is a wide range of opinion as to how this system should be managed to best serve recreational needs and resource management objectives. Many people feel that roads should be developed and maintained to provide a high level of access to the entire Forest. Others feel that the road system is already over-developed, and that road closures and road obliteration should be used to reduce or eliminate some of the environmental effects associated with roads and road use.

Data on road and trail construction and reconstruction is presented for each alternative in the alternative comparison matrix, Table II-14.

SUMMARY OF RESOURCE OUTPUTS, ENVIRONMENTAL EFFECTS, ACTIVITIES, AND COSTS

Tabular summaries of the resource outputs, environmental effects, activities, and costs associated with each of the alternatives are presented in Tables II-14 and II-15. For comparison purposes, much of the same information is shown for some of the key benchmarks. Unless otherwise noted, output and effect figures represent total results--direct, indirect, induced, and cumulative. Comparison of these tables with Table II-1 (Response to Issues, Concerns, and Opportunities by Alternative) provides insight into the linkage between issues and concerns and the outputs and effects generated by various management strategies.

Many of the outputs and effects displayed in Tables II-14 and II-15 are derived from the analysis described in Appendix B. Detailed coverage of many of the results of this analysis can be found in Chapter IV. Consult these sections for further information regarding analytical procedures and expected environmental consequences. For definitions of terms and explanations of abbreviations and units of measure, refer to the list of Abbreviations and Acronyms and Glossary. Please note that the entries in Table II-15 are brief, simplistic summaries of qualitative effects that are generally quite complex. Reference to more detailed discussions in this chapter and in Chapter IV is needed to gain full understanding of these effects.

The outputs and effects shown in Table II-14 represent average annual outputs or effects expected during plan implementation. Actual outputs may vary up or down from one year to another during a given decade, but should average the figures shown over the full decade.

The source of entries in Table II-14 for the No Change alternative is quite different from that used to develop output and effect estimates for the other alternatives. The output targets, land allocations, management assumptions, inventory information, and yield estimation procedures contained in the current timber management plans are the primary source of Alternative NC output and effect estimates. Where this information was sufficient to enable a reasonable projection of outputs or effects, estimates were made. Where making such projections would have been unreasonable, no estimate was developed. Alternative NC outputs for which quantitative estimates could not be reasonably developed are noted in Table II-14.

The reader should also note that the projected timber output of Alternative NC, and the effects associated with it (where estimated), are based on the potential yield figures of the timber management plans. These represent what can best be termed as a "maximum production" approach to setting harvest levels. Over the last ten years the volume of timber actually harvested has been considerably below potential yield.

Table II-14. Quantifiable Resource Outputs and Environmental Effects by Alternatives

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Developed Recreation Use	1000 RVDs										
Decade 1		388.5	388.5	355.3	411.1	422.3	441.7	443.5	404.1	364.2	396.6
Decade 2		441.2	441.2	391.8	447.6	463.8	481.6	493.1	429.4	428.8	433.0
Decade 5		594.9	594.9	600.9	600.0	597.2	604.6	646.0	589.6	577.0	586.0
Undeveloped Recreation Use (Non-Wilderness)	1000 RVDs										
Roaded											
Decade 1		866.9	866.9	793.0	917.3	942.3	983.5	990.0	901.6	812.7	884.9
Decade 2		988.3	988.3	878.0	1,002.6	1,039.9	1,079.7	1,104.5	961.8	960.4	970.0
Decade 5		1,363.0	1,363.0	1,377.7	1,374.4	1,368.3	1,385.1	1,480.0	1,350.9	1,322.0	1,342.6
Unroaded											
Decade 1		14.3	28.5	17.3	32.4	45.1	48.4	48.4	26.0	17.3	21.6
Decade 2		16.2	32.1	19.5	36.6	50.9	54.6	54.6	29.2	19.5	24.4
Decade 5		21.7	43.1	26.2	49.1	68.3	73.3	73.3	39.3	26.2	32.8
Wilderness Use	1000 RVDs										
Decade 1		92.0	92.0	84.1	97.3	100.0	104.4	105.0	95.7	86.2	93.9
Decade 2		103.2	103.2	92.0	104.7	108.5	112.6	115.3	100.4	100.3	101.3
Decade 5		139.0	139.0	140.5	140.2	139.6	141.3	151.0	137.8	134.9	137.0
Trail Construction	Miles										
Decade 1		5.2	5.2	5.2	5.2	5.2	5.2	Not estimated for benchmarks.			
Decade 2		3.1	3.1	3.1	3.1	3.1	3.1				
Decade 5		4.2	4.2	4.2	4.2	4.2	4.2				
Trail Reconstruction	Miles										
Decade 1		9.4	9.4	9.4	9.4	9.4	9.4	Not estimated for benchmarks.			
Decade 2		5.7	5.7	5.7	5.7	5.7	5.7				
Decade 5		3.0	3.0	3.0	3.0	3.0	3.0				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Developed Site Construction	PAOT										
Decade 1		230	230	230	230	230	230	Not estimated for benchmarks.			
Decade 2		40	40	40	40	40	40				
Decade 5		58	58	58	58	58	58				
Developed Site Reconstruction	PAOT										
Decade 1		95	95	95	95	95	95	Not estimated for benchmarks.			
Decade 2		80	80	80	80	80	80				
Decade 5		56	56	56	56	56	56				
Scenery Visual Condition	Number of Viewsheds										
Natural Appearing Decade 5		2	2	0	7	7	7	Not estimated for benchmarks.			
Slightly Altered Decade 5		5	5	0	13	13	13				
Moderately Altered Decade 5		6	6	3	0	0	0				
Heavily Altered Decade 5		7	7	17	0	0	0				
Visual Quality Objectives	Acres										
Preservation		89,700	89,700	89,700	89,700	89,700	89,700	89,700	89,700	89,700	89,700
Retention		3,300	3,300	0	22,600	22,600	22,600	22,600	0	0	0
Partial Retention		21,100	21,100	0	67,500	67,500	67,500	67,500	18,000	12,000	18,000
Modification		191,600	191,600	216,000	125,900	125,900	125,900	125,900	198,000	204,000	198,000
Maximum Modification		326,600	326,600	326,600	326,600	326,600	326,600	326,600	326,600	326,600	326,600

Table II-14 (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Unroaded Areas Assigned to Unroaded Management Prescriptions	Acres	25.4	50.5	30.7	57.5	80.0	85.8	Not estimated for benchmarks.			
Wild & Scenic Rivers	Number of Rivers	1	1	0	3	10	10				
Wild	Miles	4.4	4.4	0	18.1	27.4	27.4	Not estimated for benchmarks.			
Scenic		3.4	3.4	0	11.9	65.2	65.2				
Recreational		0	0	0	0	53.8	53.8				
TOTAL		**7.8**	**7.8**	**0**	**30.0**	**146.4**	**146.4**				
Air Quality											
Total Suspended Particulates	Tons										
Decade 1		5,798	2,804	4,498	1,654	1,081	139	Not estimated for benchmarks.			
Decade 2		Unestimated	2,380	4,647	2,086	1,344	528				
Decade 5		Unestimated	1,788	1,578	1,613	1,707	1,450				
Wildlife & Fish Use	WFUDs										
Decade 1		76,850	79,048	76,489	80,063	81,386	82,188	Not estimated for benchmarks			
Decade 2		75,281	75,903	73,355	76,757	78,756	79,425				
Decade 5		74,279	70,127	75,465	71,190	70,459	70,056				
Anadromous Fish	1,000s of Smolts										
Decade 1		9,369	9,639	9,328	9,635	9,700	9,840	Not estimated for benchmarks.			
Decade 2		9,485	9,682	9,030	9,581	9,685	9,801				
Decade 5		9,682	9,659	9,549	9,683	9,683	9,754				
Anadromous Fish (Commercial Harvest)	1,000s of Pounds (Unen-hanced)										
Decade 1		1,084	1,133	1,077	1,178	1,193	1,221	Not estimated for benchmarks.			
Decade 2		1,135	1,160	1,078	1,165	1,189	1,216				
Decade 5		1,160	1,166	1,172	1,178	1,177	1,186				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Anadromous Fish (Additional Commercial Harvest)	1,000s of Pounds (From Habitat Enhancement)										
Decade 1		108	112	103	118	121	126	Not estimated for benchmarks.			
Decade 2		228	228	204	232	240	248				
Decade 5		232	235	237	237	236	238				
Old-Growth Forest	Acres										
Midpoint of:											
Decade 1		197,903	248,271	235,225	255,815	259,652	266,800	266,800	252,131	245,755	249,338
Decade 2		147,633	214,428	184,710	233,893	246,255	266,800	266,800	216,138	210,346	211,776
Decade 5		126,834	175,496	151,598	186,558	219,784	266,800	266,800	171,278	151,498	167,575
Management Indicator Species											
Northern Spotted Owl	Number of Pairs										
Decade 1		66	78	70	83	86	91	Not estimated for benchmarks.			
Decade 2		49	66	57	76	82	91				
Decade 5		42	56	52	63	75	91				
Pileated Woodpecker	Number of Pairs										
Decade 1		660	763	676	814	839	887				
Decade 2		492	661	550	741	803	887				
Decade 5		423	576	502	614	733	887				
Pine Marten	Number of Pairs										
Decade 1		1,237	1,431	1,268	1,525	1,573	1,663				
Decade 2		923	1,240	1,031	1,389	1,506	1,663				
Decade 5		793	1,081	942	1,151	1,374	1,663				
Primary Cavity Excavators	Percent of Potential Population										
Decade 1		53	68	65	70	71	72				
Decade 2		40	65	62	67	69	72				
Decade 5		34	62	60	64	67	72				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Management Indicator Species (cont.)											
Columbian Black-Tailed Deer	Number										
Decade 1		6,462	6,433	6,463	6,423	6,523	6,481	Not estimated for benchmarks.			
Decade 2		6,147	6,038	6,147	6,125	6,264	6,213				
Decade 5		6,008	5,140	6,008	5,179	5,016	4,826				
Roosevelt Elk	Number										
Decade 1		3,032	3,030	3,032	3,031	3,081	3,065				
Decade 2		2,844	2,834	2,844	2,829	2,895	2,886				
Decade 5		2,525	2,536	2,525	2,619	2,650	2,723				
Bald Eagle	Nesting Sites										
Decade 1		662	744	723	756	762	774				
Decade 2		580	689	640	720	741	774				
Decade 5		546	625	586	643	697	774				
Wildlife Habitat Improvement											
Decade 1	Structures	442	442	442	442	442	442	Not estimated for benchmarks.			
Decade 2		442	442	442	442	442	442				
Decade 5		442	442	442	442	442	442				
Decade 1	Acres	715	715	715	715	715	715				
Decade 2		715	715	715	715	715	715				
Decade 5		715	715	715	715	715	715				
TE&S Habitat Improvement											
Decade 1	Structures	7	7	7	7	7	7	Not estimated for benchmarks.			
Decade 2		7	7	7	7	7	7				
Decade 5		7	7	7	7	7	7				
Decade 1	Acres	800	800	800	800	800	800				
Decade 2		800	800	800	800	800	800				
Decade 5		800	800	800	800	800	800				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Anadromous Fish Habitat Improvement											
Decade 1	Struct-ures	302	302	302	302	302	302	Not estimated for benchmarks.			
Decade 2		302	302	302	302	302	302				
Decade 5		302	302	302	302	302	302				
Decade 1	Acres	17	17	17	17	17	17				
Decade 2		17	17	17	17	17	17				
Decade 5		17	17	17	17	17	17				
Inland Fish Habitat Improvement											
Decade 1	Struct-ures	34	34	34	34	34	34	Not estimated for benchmarks.			
Decade 2		34	34	34	34	34	34				
Decade 5		34	34	34	34	34	34				
Decade 1	Acres	8	8	8	8	8	8				
Decade 2		8	8	8	8	8	8				
Decade 5		8	8	8	8	8	8				
Wildlife Recreation Use											
Decade 1	WFUDs	51,088	50,911	51,088	50,858	51,661	51,344	Not estimated for benchmarks.			
Decade 2		48,406	47,735	48,406	48,208	49,308	48,977				
Decade 5		46,111	41,214	46,111	41,827	41,046	40,304				
Fisheries Recreation Use											
Decade 1	WFUDs	25,762	28,137	25,401	29,205	29,725	30,843	Not estimated for benchmarks.			
Decade 2		26,875	28,168	24,952	28,550	29,448	30,448				
Decade 5		28,168	28,913	29,354	29,363	29,413	29,752				
Range-Permitted Grazing	1000 AUMs										
Decade 1		0.2	0.2	0.2	0.2	0.2	0.2	Not estimated for benchmarks.			
Decade 2		0.2	0.2	0.2	0.2	0.2	0.2				
Decade 5		0.2	0.2	0.2	0.2	0.2	0.2				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Timber Sale Program Quantity	Million BF										
CSYU Total											
Decade 1		252.2	228.9	237.6	214.1	163.5	162.3	N/A	180.2	237.6	185.7
Simpson Timber Co.											
Decade 1		123.7	176.2	174.6	203.8	157.9	162.3	N/A	171.9	174.6	161.1
National Forest in CSYU											
Decade 1		128.5	52.7	63.0	10.3	5.6	0	0	8.3	63.0	24.6
East-West Zone											
Decade 1		239.8	169.0	277.8	112.9	71.4	10.6	0	172.2	185.0	177.7
Total National Forest											
Decade 1		368.3	221.7	340.8	123.2	77.0	10.6	0	180.5	248.0	202.3
TOTAL											
Decade 1		492.0	397.9	515.4	327.0	234.9	172.9	N/A	352.4	422.6	363.4
Timber Sale Program Quantity	Million CF										
CSYU Total											
Decade 1		48.1	48.1	49.6	45.8	35.2	35.1	N/A	38.6	49.6	39.4
Decade 2		46.6	46.6	47.9	44.3	35.7	34.0	N/A	37.4	47.9	38.1
Decade 5		44.2	44.3	45.5	47.2	58.3	61.1	N/A	50.2	45.5	49.1
Simpson Timber Co.											
Decade 1		24.1	38.1	37.8	44.0	34.1	35.1	N/A	37.2	37.8	34.8
Decade 2		34.8	43.4	41.8	41.0	34.6	34.0	N/A	28.8	41.8	32.6
Decade 5		25.2	39.2	41.1	44.6	51.3	54.3	N/A	43.5	42.3	42.4
National Forest CSYU											
Decade 1		24.0	10.1	11.8	1.8	1.1	0	0	1.4	11.8	4.6
Decade 2		11.7	3.2	6.1	3.3	1.1	0	0	8.6	6.1	5.5
Decade 5		19.0	5.1	4.4	2.6	7.0	6.8	0	6.7	3.2	6.7

Table II-14. (Cont'd.)

Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	Alternatives: No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	Benchmarks: BM O	BM 7	BM 7T	BM 11
Timber Sale Program (cont.)											
East-West Zone	Million CF										
Decade 1		42.6	29.9	50.1	21.1	13.7	2.3	0	30.4	35.6	31.0
Decade 2		38.1	28.9	48.5	22.2	14.5	4.6	0	29.5	34.4	30.0
Decade 5		34.0	27.4	19.4	26.2	23.0	19.5	0	28.0	32.7	28.5
Total National Forest											
Decade 1		66.6	40.0	61.9	22.9	14.8	2.3	0	31.8	47.4	35.6
Decade 2		49.8	32.1	54.6	25.5	15.6	4.6	0	38.1	40.5	35.5
Decade 5		53.0	32.5	23.8	28.8	30.0	26.3	0	34.7	35.9	35.2
TOTAL											
Decade 1		90.7	78.1	99.7	66.9	48.9	37.4	N/A	69.0	85.2	70.4
Decade 2		84.6	75.5	96.4	66.5	50.2	38.6	N/A	66.9	82.3	68.1
Decade 5		78.2	71.7	64.9	73.4	81.3	80.6	N/A	78.2	78.2	77.6
Recent Planned/Accomplished Output Levels (for comparison) - Annual Average for 1975-89 Timber Cut - 263.3, Timber Sold - 291.8, Timber Management Plan Potential Yield - 330.5											
Allowable Sale Quantity	Million BF										
CSYU Total											
Decade 1		227.0	206.0	213.8	192.7	147.1	146.1	N/A	162.2	213.8	167.1
Simpson Timber Co.											
Decade 1		111.3	158.6	157.1	183.4	142.1	146.1	N/A	154.7	157.1	145.0
National Forest CSYU											
Decade 1		115.7	47.4	56.7	9.3	5.0	0	0	7.5	56.7	22.1
East-West Zone											
Decade 1		214.8	152.1	250.0	101.6	64.3	10.4	0	155.0	166.5	159.9
Total National Forest											
Decade 1		330.5	199.5	306.7	110.9	69.3	10.4	0	162.5	223.2	182.0
TOTAL											
Decade 1		441.8	358.1	463.8	294.3	211.4	156.5	N/A	317.2	380.3	327.0

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Allowable Sale Quantity	Million CF										
CSYU Total											
Decade 1		43.3	43.4	44.6	41.2	31.7	31.6	N/A	34.8	44.6	35.4
Decade 2		43.3	43.4	44.6	41.2	33.2	31.6	N/A	34.8	44.6	35.4
Decade 5		43.3	43.4	44.6	46.2	57.2	59.9	N/A	49.2	44.6	48.2
Simpson Timber Co.											
Decade 1		21.7	34.3	34.0	39.6	30.7	31.6	N/A	33.5	34.0	31.3
Decade 2		32.4	40.4	38.9	38.1	32.2	31.6	N/A	26.8	38.9	30.3
Decade 5		24.7	38.4	40.3	43.7	50.3	53.2	N/A	42.6	41.5	41.6
National Forest CSYU											
Decade 1		21.6	9.1	10.6	1.6	1.0	0	0	1.3	10.6	4.1
Decade 2		10.9	3.0	5.7	3.1	1.0	0	0	8.0	5.7	5.1
Decade 5		18.6	5.0	4.3	2.5	6.9	6.7	0	6.6	3.1	6.6
East-West Zone											
Decade 1		38.2	26.9	45.1	19.0	12.3	2.3	0	27.4	32.0	27.9
Decade 2		35.3	26.9	45.1	20.6	13.5	4.5	0	27.4	32.0	27.9
Decade 5		33.3	26.9	19.0	25.7	22.5	19.1	0	27.4	32.0	27.9
Total National Forest											
Decade 1		59.8	36.0	55.7	20.6	13.3	2.3	0	28.7	42.6	32.0
Decade 2		46.2	29.9	50.8	23.7	14.5	4.5	0	35.4	37.7	33.0
Decade 5		51.9	31.9	23.3	28.2	29.4	25.8	0	34.0	35.1	34.5
TOTAL											
Decade 1		81.5	70.3	89.7	60.2	44.0	33.9	N/A	62.2	76.6	63.3
Decade 2		78.6	70.3	89.7	61.8	46.7	36.1	N/A	62.2	76.6	63.3
Decade 5		76.6	70.3	63.6	71.9	79.7	79.0	N/A	76.6	76.6	76.1
Fuel Wood	1000 CF										
Decade 1		2,050	1200	1860	690	440	20	0	960	1,420	1,070
Decade 2		1,545	960	1640	760	470	50	0	1,140	1,220	1,060
Decade 5		550	330	240	290	300	260	0	350	360	350

Table II-14. (Cont'd.)

Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	Alternatives: No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	Benchmarks: BM O	BM 7	BM 7T	BM 11
Reforestation	Acres										
National Forest											
Decade 1		6,260	4,091	6,561	2,412	1,578	203	0	2,934	5,899	3,492
Decade 2		4,552	3,473	6,779	3,045	1,960	770	0	4,265	4,306	4,020
Decade 5		4,076	2,610	2,302	2,354	2,490	2,116	0	2,879	3,525	3,063
Simpson Timber Co.											
Decade 1		2,132	4,855	4,812	5,497	4,431	4,533	N/A	4,752	4,812	4,503
Decade 2		3,304	5,079	4,924	4,871	4,431	4,168	N/A	3,693	4,924	4,034
Decade 5		2,000	4,009	4,237	4,503	4,000	4,282	N/A	3,375	4,405	3,280
Timber Stand Improvement	Acres										
National Forest											
Decade 1		1/ 3,534	3,501	3,534	3,502	3,474	3,472	0	3,712	3,712	3,530
Decade 2		1/ 3,534	3,445	3,450	3,434	3,364	3,369	0	3,450	3,450	3,450
Decade 5		1/ 3,534	2,574	3,208	2,338	1,562	682	0	2,485	2,643	2,579
Simpson Timber Co.											
Decade 1		1/ 2,004	1,124	1,124	1,124	1,124	1,124	N/A	1,124	1,124	1,124
Decade 2		1/ 2,004	1,966	1,966	1,966	1,966	1,966	N/A	1,966	1,966	1,966
Decade 5		1/ 2,004	4,701	4,809	4,218	3,595	3,550	N/A	3,807	4,809	3,862
Long-Term Sustained Yield	Million CF										
National Forest		43.9	37.8	39.2	35.9	30.8	25.4	0	38.8	40.4	38.4
East-West Zone		32.4	29.5	30.5	27.9	23.6	19.1	0	30.4	32.0	30.1
CSYU		61.8	64.1	64.3	62.1	64.4	63.4	N/A	66.3	63.9	66.2
Timber Growth in Decade 5	Million CF										
National Forest		Unestimated	39.2	42.9	34.0	30.4	27.3	N/A	38.6	43.5	39.3

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Water Yield	1000 AF										
Decade 1		5,941	5,936	5,941	5,933	5,931	5,928	5,928	5,938	5,938	5,938
Decade 2		5,937	5,935	5,941	5,934	5,932	5,929	5,928	5,937	5,936	5,936
Decade 5		5,935	5,933	5,933	5,933	5,933	5,932	5,928	5,938	5,937	5,938
Sediment Index	Tons/Yr										
Decade 1		212,500	161,600	223,700	114,600	92,600	56,000	50,000	191,100	199,900	190,100
Decade 2		169,900	145,500	226,400	131,000	102,400	69,500	50,000	161,200	171,800	166,500
Decade 5		145,500	126,900	121,700	118,400	122,400	110,900	50,000	189,200	179,600	194,500
Improved Watershed Condition	Acres										
Decade 1		400	250	400	150	100	35	340	315	345	320
Decade 2		250	185	300	100	75	50	0	195	235	200
Decade 5		200	135	150	75	50	95	0	140	150	145
Total Energy Consumption	Billion BTUs										
Decade 1		-4,232.9	-2,101.1	-3,417.2	-1,675.9	-486.4	+241.6	Not estimated for benchmarks.			
Decade 2		Unestimated	-1,687.0	-3,093.6	-1,982.1	-565.9	+126.5				
Decade 5		Unestimated	-1,832.9	-1,266.6	-2,430.6	-1,520.1	-1,280.5				
Energy Potential	Billion BTUs										
Biomass											
Decade 1		1,049.6	580.5	933.5	342.7	221.4	24.5	Not estimated for benchmarks.			
Decade 2		Unestimated	492.1	964.7	431.1	276.1	106.0				
Decade 5		Unestimated	379.6	324.9	332.4	351.8	298.3				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Fire Management Effectiveness Index	$/1,000 Protected Acres										
Decade 1		2,096.40	1,554.52	1,857.18	1,373.88	1,744.61	1,051.52	Not estimated for benchmarks.			
Decade 2		--	1,485.29	1,897.39	1,501.14	1,390.48	1,390.42				
Decade 5		--	1,389.21	1,343.15	1,434.35	1,523.22	1,523.14				
Estimated Fire Occurrence	Number of Fires										
Decade 1		18.8	16.1	15.0	15.9	15.7	15.7	Not estimated for benchmarks.			
Decade 2		--	17.3	15.7	16.9	16.9	13.1				
Decade 5		--	21.2	19.5	19.8	21.0	21.4				
Estimated Burned Area	Number of Acres										
Decade 1		135.9	70.8	107.5	47.2	33.3	8.3	Not estimated for benchmarks.			
Decade 2		--	62.3	112.3	57.1	38.4	17.5				
Decade 5		--	50.3	44.9	49.5	50.2	45.6				
Research Natural Areas	Number	1	1	1	2	3	3	Not estimated for benchmarks.			
	1,000 Acres	1.5	1.5	1.5	2.6	5.7	5.7				
Botanical Areas	Number	2	2	0	12	11	11	Not estimated for benchmarks.			
	1,000 Acres	.5	.5	0	6.2	3.1	3.1				
Arterial & Collector Road Construction/ Major Reconstruction	Miles										
Decade 1		2/3	1/2	2/2	1/2	1/1	0/0	0/0	1/2	2/2	1/2
Decade 2		2/3	1/2	2/2	1/2	1/1	0/1	0/0	1/2	1/2	1/2
Decade 5		1/2	0/2	0/2	0/2	0/2	0/1	0/0	0/2	0/2	0/2

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Timber Purchaser Road Construction/Major Reconstruction	Miles										
Decade 1		16/20	17/12	26/12	13/12	8/9	2/6	0/0	14/12	25/12	15/12
Decade 2		12/15	11/12	21/14	11/12	7/9	3/6	0/0	13/12	16/13	12/12
Decade 5		3/19	2/13	0/14	1/13	1/12	1/12	0/0	2/13	3/14	2/13
Roads Suitable for Public Use	Miles										
Passenger Car											
Decade 1		735	733	759	717	696	668	Not estimated for benchmarks.			
Decade 2		746	717	768	689	648	594				
Decade 5		739	703	767	665	602	520				
High Clearance Vehicle Only											
Decade 1		1,320	1,315	1,395	1,281	1,231	1,162	Not estimated for benchmarks.			
Decade 2		1,444	1,352	1,516	1,300	1,205	1,079				
Decade 5		1,498	1,407	1,569	1,338	1,190	1,008				
Fuel Treatment	Acres										
Decade 1		4,263	2,062	3,307	1,216	795	102	Not estimated for benchmarks.			
Decade 2		Unestimated	1,750	3,417	1,534	988	388				
Decade 5		Unestimated	1,315	1,160	1,186	1,295	1,066				
Operational Costs	Million $										
Decade 1		15.2	11.1	14.1	9.0	7.9	6.3	Not estimated for benchmarks.			
Decade 2		13.5	10.5	14.4	9.6	8.3	6.8				
Decade 5		15.2	10.8	9.7	10.3	10.2	9.5				
Capital Investment Costs	Million $										
Decade 1		15.8	9.3	14.2	6.7	5.2	2.6	Not estimated for benchmarks			
Decade 2		12.8	8.6	14.6	7.5	5.6	3.5				
Decade 5		13.5	7.9	6.7	7.3	6.8	5.8				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Total-National Forest System	Million $										
Allocated											
Decade 1		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Decade 2		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Decade 5		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Appropriated											
Decade 1		30.9	20.3	28.2	15.6	13.0	8.8	7.8	17.9	24.7	19.1
Decade 2		26.2	19.0	28.9	17.0	13.8	10.2	7.8	20.7	21.6	20.2
Decade 5		28.5	18.5	16.2	17.4	16.8	15.1	7.7	19.3	21.2	19.9
Returns to Government	Million $										
Decade 1		22.4	8.1	15.9	2.2	-1.3	-6.4	Not estimated for benchmarks.			
Decade 2		18.1	9.6	13.6	5.7	1.0	-4.7				
Decade 5		22.6	3.6	-1.8	5.0	5.2	3.6				
Human Resource Program	Person-Years										
Decade 1		14	14	14	14	14	14	14	14	14	14
Decade 2		16	16	16	16	16	16	16	16	16	16
Decade 5		16	16	16	16	16	16	16	16	16	16
Change in Jobs	Total Change in Number										
Decade 1		+650	-200	+850	-800	-1,850	-2,400	Not estimated for benchmarks.			
Changes in Income	Total Change in Million $										
Decade 1		+14	-5	+18	-17	-38	-50	Not estimated for benchmarks			
Payment to Counties	Million $										
Decade 1		13.4	7.1	11.0	4.5	3.0	0.6	Not estimated for benchmarks			
Decade 2		11.1	7.2	10.6	5.7	3.7	1.4				
Decade 5		12.8	5.6	3.6	5.6	5.6	4.7				

Table II-14. (Cont'd.)

		Alternatives						Benchmarks			
Annual Resource Output, Environmental Effect, Activity or Cost	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	BM O	BM 7	BM 7T	BM 11
Area Available for Specific Resource Uses	Acres										
Timber Harvest		497,800	357,868	372,526	352,109	300,034	239,981	0	367,446	374,625	367,931
Grazing		2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
Mineral Exploration		553,200	543,840	543,840	543,840	543,840	543,840	543,840	543,840	543,840	543,840
Acreages of Available Timber Harvest Pre-scriptions	Acres										
Clearcut		497,800	357,868	372,526	352,109	300,034	239,981	0	367,446	374,625	367,931
Shelterwood		0	0	0	0	0	0	0	0	0	0
Selective Cut		0	0	0	0	0	0	0	0	0	0
Lands Tentatively Suitable for Timber Production	Acres	507,930	446,939	446,939	446,939	446,939	446,939	446,939	446,939	446,939	446,939
Lands Suitable for Timber Production	Acres	497,800	357,868	372,526	352,109	300,034	239,981	0	367,446	374,625	637,931
Lands with Timber Yield Reductions	Acres										
91-100% of Full Yield		373,000	333,388	372,526	280,501	239,526	197,160	0	367,446	374,625	367,931
50-90% of Full Yield		2/ 124,800	24,480	0	71,608	60,508	42,821	0	0	0	0
1-49% of Full Yield		0	0	0	0	0	0	0	0	0	0

1/ Estimates for Decade 1, 2, and 5 are extensions of projections in TM plans and may not reflect actual needs in these periods.
2/ For Alternative NC, this is the "special" component of current TM Plans. This component actually includes allocations ranging from "no harvest" to "full yield;" all are classed as "special" in TM Plan terminology. The average yield from these areas is expected to be approximately two-thirds of full yield.

Table II-15, starting on the following page, represents qualitative comparisons of some of the key resource outputs and effects associated with each of the alternatives. Comparison of this table with Table II-1 (Response to Issues, Concerns, and Opportunities by Alternative) provides insight into the linkage between issues and concerns and the outputs and effects generated by various management strategies.

The source of entries in Table II-15 for the No Change alternative is quite different from that used to develop output and effect estimates for the other alternatives. The output targets, land allocations, management assumptions, inventory information, and yield estimation procedures contained in the current timber management plans are the primary source of the qualitative effect estimates in Alternative NC.

Table II-15. Qualitative Resource Outputs and Environmental Effects by Alternatives

Outputs & Effects	No Change	A - Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Vegetative Character and Diversity	Similar to Alternative A. Transition will occur at a faster rate (similar to Alternative B) due to higher overall harvest level. Largest acreage to be managed for timber production	Relatively large acreage to be managed for timber production. Timber stand ages will be diverse and evenly distributed. Area in vegetative types not associated with intensive timber management regimes will be substantially reduced from existing acreage.	Similar to Alternative A. Transition will occur at a faster rate due to departure. Larger acreage to be managed for timber production.	Acreage to be managed for timber production reduced relative to Alternative A. Intensively managed timber stands will have the even age distribution of Alternative A; a smaller area will have this characteristic. Area in vegetative types not associated with intensive timber management will be greater that in Alternative A.	Similar to Alternative C in summer ranger (over 1,500' elevation). In winter range, management for timber production limited to assure that current acreage of old-growth is maintained. Winter range areas will retain essentially the same characteristics as are present today. Even age distribution will evolve in timber management areas.	Management for timber production limited to assure that current acreage of old-growth is retained at all elevations. Existing mix of age classes and vegetative types will be retained essentially as currently found throughout the forest.
Fish Habitat Quality	With the exception of Alternative NC, all alternatives are similar in that they are designed to maintain the existing productivity of both rearing and spawning habitat. Rearing habitat is maintained through the provisions of riparian Management Requirements assuring an adequate source of large organic debris for future habitat development. Spawning habitat is maintained at present levels of productivity through the application of enhancement activities as needed. Despite these similarities, however, there are qualitative differences in fish habitat among the alternatives. These are described below. Alternative NC differs from the others in that no specific MRs are applied to maintain fish habitat. While this alternative does include streamside management allocations and prescriptions designed to protect riparian areas, these may not be sufficient to assure attainment of current requirements.					
	Falls close to Alternative B in overall effect, particularly in the early decades.	Both spawning and rearing habitat are slightly improved in quality when compared to current conditions. Reduced sedimentation due to lower harvest level is the primary cause.	High harvest level and substantial departure result in lowest level of overall habitat quality among the alternatives.	Overall habitat quality is improved relative to Alternative A. Reductions in harvest and road construction are the principal factors involved.	Habitat conditions markedly improved relative to Alternative A. Retention of old-growth in winter range, the location of most fish habitat (other than supportive), is the primary cause.	Similar to Alternative H, but with additional improvement resulting from retention of old-growth Forest-wide.
Wildlife Habitat Quality	With the exception of Alternative NC, all alternatives are similar in that they are designed to maintain viable populations of all native vertebrate species (through application of Management Requirements). There are, however, qualitative differences in wildlife habitat characteristics from alternative to alternative. These are described below. Alternative NC differs from the others in that it includes no wildlife MRs.					

Table II-15. (Cont'd.)

Outputs & Effects	No Change	A - Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Wildlife Habitat Quality	Falls between Alternatives A and B in overall effect. Habitat conditions likely to be closer to B as a result of high harvest level. Lack of MR provisions may result in failure to maintain necessary habitat in older age classes.	Wildlife habitat characteristics will move toward conditions favorable to species dependent on a mix of seral stages and unfavorable to those dependent on older age classes. Relatively large allocation of land to timber management is primary cause.	Similar to Alternative A, but more favorable to species using younger age classes. Habitat transition will be faster due to departure..	Mix of habitat types somewhat more favorable to species dependent on older age classes than Alternative A.	Alternative is designed to provide a mix of wildlife habitat types which is near optimum. Seral stages will be mixed in summer range and favor species dependent on older age classes in winter range.	Forest-wide retention of current level of old-growth availability clearly favorable to species dependent on older age classes. Lack of harvest, particularly in early decades, unfavorable to species dependent on a balanced age class mix.
Water Quality	Application of MRs and use of appropriate logging and road construction practices (as specified in Standards and Guidelines) will assure that water quality is maintained at present levels in all alternatives. Nonetheless, there are qualitative differences among the alternatives. These are discussed below.					
	Similar to Alternative B for the first decade. Water quality improves in subsequent decades with sedimentation levels falling between Alternatives A and B.	Sedimentation associated with high levels of timber harvest and road construction results in a relatively low level of water quality when compared to many of the other alternatives.	High harvest level and substantial departure result in lowest level of overall water quality among the alternatives.	Overall water quality is significantly improved relative to Alternative A. Larger reductions in harvest and road construction are the principal factors involved.	Water quality is significantly improved relative to Alternative A. Substantial reductions in harvest and road construction levels are the primary cause.	Similar to Alternative H, but with additional improvement resulting from further reductions in harvest and road construction, particularly in the early decades.
Air Quality	Significant effects on overall air quality are not anticipated in any alternative, but occasional, short-term reduction of air quality may occur in local areas as a result of slash treatment activities. The probable frequency of such reductions varies by alternative.					
	Probability of temporary reductions in air quality similar to Alternative B in early decades.	Probability of localized short-term reductions of air quality is moderate. Essentially the same as at present.	High harvest level of this alternative results in high probability of short-term air quality reductions. Probability is greatest in the early decades due to departure.	Probability of short-term air quality reductions is somewhat below that of Alternative A due to reduced harvest level.	Similar to Alternative C, but with a more substantial reduction in probability.	Low harvest level leads to the lowest degree of likelihood that air quality will be adversely affected. This is particularly true in the early decades.
Visual Character	Long-term effect will be similar to that of Alternative A. Transition to "altered" appearance will be faster due to higher timber harvest level.	Timber management and road construction activities will be evident in many visually sensitive areas, as well as most of the less frequently viewed portions of the Forest. In general, the Forest will appear "altered" (as opposed to natural).	Scenic quality receives no emphasis in this alternative. As a result, the entire Forest (other than administratively withdrawn areas) will appear altered.	More of the visually sensitive areas will be natural in appearance than in Alternative A. Less frequently viewed areas will, generally, appear altered.	Similar to Alternative C, but with a greater proportion of the less sensitive areas within winter range in a natural-appearing condition.	Similar to Alternative H. Forest-wide maintenance of current old-growth availability will result in the least altered appearance, in all areas, of any of the alternatives.

Table II-15. (Cont'd)

Outputs & Effects	No Change	A - Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Recreational Character	Similar to Alternative B. Harvest of existing undeveloped areas to be managed for timber production is likely to occur at a slightly faster rate than in Alternative B.	Recreational opportunities will be predominantly of the developed and roaded types. Unroaded recreation opportunity will be less available than at present.	With the exception of Wilderness, recreational opportunities will largely be of the developed and roaded types. Unroaded recreation opportunity outside Wilderness is not a goal of this alternative, and future opportunity will be limited.	Greater availability of unroaded recreation opportunity than in Alternative A. Developed and roaded opportunities essentially the same as Alternative A.	Greater availability of unroaded recreation opportunity than in Alternative C. Environment in which roaded recreation activities occur is more natural in character than in Alternative C due to retention of old-growth in winter range. Road system availability reduced relative to Alternative C.	Similar to Alternative H, but with further reduction in road system availability. Roaded recreation environment is the most natural among the alternatives.
Access for Developmental Uses	Accessibility for activities such as mineral exploration, hydropower development, and utility corridor development depends largely on the extent to which a given alternative contains allocations which are incompatible with, or constraining upon, the use in question. In general, alternatives with relatively few allocations which preclude or limit timber harvest will be relatively accessible for developmental uses, while those which place substantial limitations on harvest will limit opportunities for other development as well.					
	Essentially the same as Alternative B.	Relatively high degree of accessibility for developmental uses.	Highest degree of accessibility for developmental uses. Few limitations outside of administratively withdrawn areas.	Accessibility somewhat reduced relative to Alternative A.	Accessibility reduced relative to Alternative C. Old-growth retention objective may increase limitations to some extent.	Same as Alternative H, but with some increase in potential for restrictions due to expanded old-growth retention objectives.
Cultural Resource Protection	Legal obligations to identify and protect cultural resources will be fulfilled in all alternatives. The likelihood that an undiscovered resource will be inadvertently disturbed during management activity varies from alternative to alternative, primarily as a result of differences in proposed levels of ground-disturbing activity. In general, alternatives with high timber harvest levels entail the greatest risk of cultural resource disturbance. Conversely, such alternatives also provide the greatest opportunity for discovery of new cultural resource sites.					
	Similar to Alternative B. Highest level of ground-disturbing activity in the first decade.	Relatively large area subject to ground-disturbing activity.	Greatest area subject to ground-disturbing activity among the alternatives.	Area subject to disturbance reduced somewhat relative to Alternative A.	Similar to Alternative C, but with additional area reserved from disturbance due to retention of old-growth in winter range.	Smallest area subject to ground-disturbing activity among the alternatives. Disturbance particularly light in early decades.
Social Effects						
Lifestyles	Close to Alternative B in first decade. Long-term effect most similar to Alternative B.	Slight decrease in opportunity for harvest-based employment. Little change in quality of Forest-based leisure activity.	Substantial increase in harvest-based employment opportunity, combined with greatest decrease in quality of Forest-based leisure activity.	Substantial decrease in opportunity for harvest-based employment. Quality of Forest-based leisure activity greater than that of Alternative A.	Increase in quality of Forest-based leisure activity relative to Alternative C. Substantial reductions in harvest-based employment opportunity.	Similar to Alternative H, but with greater reduction in opportunity for harvest-based employment, particularly in the early decades.

Table II-15. (Cont'd)

Outputs & Effects	No Change	A - Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Social Effects						
Values	Similar to Alternative B. Possibly stronger in both effects in the early decades.	Essentially neutral, but perhaps slightly unfavorable to those whose values center around the "timber" ethic.	Favorable to those whose values center around the "timber" ethic. Unfavorable to those with environmentally-oriented values.	Relative to Alternative A, increased compatibility with environmentally-oriented values, decreased compatibility with "timber" ethic.	Substantial increases in compatability with environmentally -oriented values and decreases in compatibility with "timber" ethic.	Similar to Alternative H, but stronger decrease in compatibility with the "timber" ethic.
Cohesion	Similar to Alternative B.	Potential for slight increase in conflict as harvest-base decreases.	Potential for substantial increases in conflict as amenity output base decreases.	Potential for substantial increases in conflict as harvest-base decreases.	Potential for substantial increases in conflict.	Similar to Alternative H, but with greater potential for increased conflict.
Stability	No effect anticipated.	No effect anticipated.	No effect anticipated.	No effect anticipated.	Slight potential to affect stability of Westside communities.	Overall impact may affect stability of Westside communities.
Effects on American Indians	All alternatives are designed to assure that the treaty rights of Peninsula tribes are accommodated. The alternatives vary considerably in their effects on the American Indian community group. These differences are summarized below.					
	Expected to fall close to Alternative B in overall effect. Some potential to affect stability, although this is less likely than with Alternative B.	Expected to result in slightly decreased employment opportunity and little change in opportunity for leisure/subsistence activities and traditional cultural and religious practices.	Expected to result in substantially increased employment opportunity and significant decreases in opportunity for leisure/subsistence activities and traditional cultural and religious practices. Lack of emphasis on traditional values have some potential to affect the stability of this community group.	Expected to result in slightly increased opportunity for traditional leisure, cultural, and religious practices. Reduction in employment opportunity is anticipated.	Similar to Alternative C, but considerably stronger in all effects.	Similar to Alternative H, but involving more substantial reduction in employment opportunity, particularly in the early decades. Reduction in employment opportunity could affect stability within this community group.

COMPARISON OF ECONOMIC ASPECTS OF ALTERNATIVES

DIFFERENCES IN PRESENT NET VALUES

The economic implications of the alternatives are displayed in Tables II-16, II-17, and II-18. Following the tables are discussions of the variations in costs, benefits, PNV, and cash flow among the alternatives. Very little of the economic data in these tables could reasonably be estimated for Alternative NC-No Change, as this alternative was developed and analyzed on the basis of timber management plan information rather than FORPLAN optimization. Where appropriate, the relationship of Alternative NC to the other alternatives has been subjectively evaluated and discussed. Note that the cost and benefit figures displayed in Tables II-16 and II-17 include all values considered in the analysis of alternatives, while the cost and receipt entries in Table II-18 reflect only the items affecting cash flow to and from the U.S. Treasury. For this reason, the figures in Table II-18 are not directly comparable to those included in the other two tables.

Present net value (PNV) is the quantitative measure of cost-efficiency, making it a key variable in the comparison of alternatives. It is defined as the difference between the discounted value (benefits) of all outputs to which monetary values or established market prices have been assigned and the total discounted costs of managing the planning area. "Discounting" is the procedure used to adjust all future costs and benefits to their present-day equivalent values in order to enable a meaningful comparison of dollar flows through time. A discount rate of 4 percent has been used. The discounted benefit and cost flows represent the potential net dollar return for each alternative--the larger the PNV, the greater the potential return. For a more detailed discussion of PNV calculation and its significance, refer to the "Economic Analysis" section of Appendix B.

By providing a monetary, quantitative measure of cost-efficiency, PNV is a very useful indicator of differences among alternatives in their total output of public benefits. Full assessment of net public benefits requires that the output of public benefits and costs to which dollar values have not been assigned be considered in addition to PNV (see "Alternative Development Process" in this chapter for definition). Included in this category are outputs (such as increased populations of endangered species), physical conditions (such as maintenance of scenic quality), and desirable distributive effects (such as increased employment in dependent communities). The value of such outputs and effects cannot be reasonably reflected in dollar terms because the necessary data and/or methodology are not available. It is important to keep in mind that PNV, while an important indicator of overall public benefit, does not and cannot tell the entire story.

Table II-16 summarizes the benefits, costs, and PNV associated with each of the alternatives. Table II-17 disaggregates benefits and costs, displaying the contributions of specific priced outputs to benefits and assigning approximate costs to major accounting or budgeting categories. Note that it would be incorrect to assume a direct relationship between the dollar benefits associated with a particular output and the cost figure assigned to it. This is because Forest-wide production of any specific output is generally supported by complex combinations of input costs. All dollar values presented in these tables, and elsewhere throughout this FEIS, are base year 1982 dollars (see Appendix B, "Economic Analysis," for discussion of this concept).

In order to effectively represent the differences among alternatives as they affect National Forest land and its economic value, only the National Forest contributions to PNV are displayed in Table II-16 (and elsewhere throughout this document). The contribution to total PNV resulting from management of Simpson Timber Company land is not displayed. Since the Simpson contribution to PNV is very close to the same in all alternatives, doing this does not bias the comparison of alternatives, but does serve to highlight differences resulting from land use variations on National Forest land. The need to avoid undue disclosure regarding Simpson operations precludes presentation of both total PNV and National Forest contribution by alternative.

Table II-16. Present Net Value and Discounted Costs and Benefits of Alternatives 1/
(Figures represent millions of 1982 dollars)

Alternatives	PNV	Change	Discounted Costs	Change	Discounted Benefits	Change
MaxPNV BM 2/	592.1		996.0		1,588.1	
		-23.6		+9.5		-14.1
A-Current Direction	568.5		1,005.5		1,574.0	
		-21.3		+380.0		+358.7
B-Dep (Modified)	547.2		1,385.5		1,932.7	
		-26.9		-555.3		-582.2
C-Pref (Modified)	520.3		830.2		1,350.5	
		-67.7		-195.9		-263.6
H (Modified)	452.6		634.3		1,086.9	
		-101.4		-251.8		-353.2
I	351.2		382.5		733.7	

1/ Alternative NC is not included. Data necessary to estimate discounted costs and benefits (and thus PNV) throughout the 50-year planning horizon are not available in timber management plans. Alternative NC is estimated to have a PNV slightly below Alternative B-Departure (Modified).
2/ The maximum PNV benchmark is included solely as a basis for comparison.

Several of the entries in Table II-17, presented below, require explanation to enhance understanding. The following notes are presented as an aid to the reader:

Timber benefits are expressed in terms of total mill value (value delivered at the mill) rather than stumpage value. This approach was taken to facilitate variation of logging costs by land type within the planning model. Therefore, the benefit shown has logging cost embodied within it.

Timber costs represent both management costs and the cost of getting the timber to the mill, or logging cost. Logging cost represents about 80 percent of total timber cost in all alternatives. PNV is not affected by this approach, but total timber benefits and costs are shown to be considerably higher than would be the case if stumpage value alone were used.

Wildlife and fish user days (WFUD) represent the recreation benefits generated by wildlife and fish outputs.

Recreation benefits include all forms of recreation (other than WFUD) which occur on the Forest: developed, roaded and unroaded dispersed, and Wilderness use.

Commercial fishery benefits represent harvest of commercial fish produced by on-Forest fish habitat.

Fish and wildlife habitat management (F&WL) and *recreation management costs* represent the cost of managing these programs.

Other costs represent the bulk of the Forest's fixed cost, primarily administration.

Table II-17. Present Net Value and Discounted Benefits and Costs by Resource Group

(Millions of 1982 Dollars) 1/

		Discounted Benefits				Discounted Costs				
Alternatives	PNV	Timber	Recreation	WFUD	Commercial Fish	Timber	Roads	F&WL	Recreation	Other
A-Current Direction	569	1,167	331	45	32	702	129	15	12	148
B-Dep (Modified)	547	1,545	312	46	29	1,016	194	15	12	148
C-Pref (Modified)	520	934	339	46	31	555	100	15	12	148
H (Modified)	453	660	348	47	32	399	60	15	12	148
I	351	294	360	47	32	179	28	15	12	148

1/ Alternative NC is not included. Data necessary to estimate discounted costs and benefits by resource group throughout the 50-year planning horizon are not available in timber management plans.

Among the alternatives, PNV ranges from a low of $351 million (Alternative I) to a high of $569 million (Alternative A-Current Direction (No Action)). The maximum PNV that could be attained under present laws and regulations and with a nondeclining flow harvest schedule is $592 million (Maximum PNV Benchmark). The total discounted value of priced outputs varies from $734 million (Alternative I) to $1,933 million (Alternative B-Departure (Modified)), while discounted costs range from $383 million in Alternative I to $1,386 million in Alternative B-Departure. Variations in PNV among the alternatives are due to the wide range of possible costs and benefits which the alternatives represent. Each alternative is designed to produce a unique set of priced and nonpriced outputs and effects, each of which generates a distinct pattern of values and costs.

The principal factor which influences priced benefits, costs, and PNV is the volume and timing of timber harvest. Since this activity has relatively large investment costs and dollar returns associated with it, the extent of harvest is the primary determinant of the magnitude of the economic variables in each alternative. Timing of harvest (departure vs. nondeclining flow) is also important, as departure schedules both increase total harvest level and accelerate investments and returns, increasing PNV relative to their nondeclining flow counterparts.

The changes in PNV and total costs and benefits among the alternatives are determined by three primary factors: harvest timing, the contribution to PNV of harvest on lands that are added to or removed from the harvest base of each alternative, and the relative cost-efficiency of prescriptions selected for areas to be managed for timber production. The effect of timing is best illustrated by Alternative B-Departure. Because this alternative is a departure, the harvest investments and returns associated with it occur earlier than would those of the same basic alternative with a nondeclining flow schedule, thereby making discounted costs, discounted benefits, and PNV all relatively high. The PNV of Alternative B-Departure is $547 million, while that of its base sale schedule (the nondeclining flow counterpart) is $522 million.

The roles in establishing PNV of both the PNV contribution of lands allocated to harvest and the selection of prescriptions on lands to be managed for timber output are also best demonstrated by Alternative

B-Departure. Contrasting this alternative with Alternative A-Current Direction (No Action) provides some useful insights. The primary objective of Alternative B-Departure is "maximize timber production," while that of Alternative A is "maximize PNV." In Alternative B-Departure, the primary objective leads to the allocation to timber production of areas in which timber management costs exceed returns. It also results in the selection of timber management prescriptions which entail considerable use of intensive management practices. Such practices often involve lower return per unit of investment cost, on a per-acre basis, than more extensive management strategies. The principal objective of Alternative A, on the other hand, leads to allocations and prescription selection patterns that are guided by contribution to PNV. The result is a lower timber harvest level, combined with a higher PNV, for Alternative A than for Alternative B-Departure.

The remaining variations among alternatives in PNV and total costs and benefits are due primarily to differences in land allocation. Alternative B-Departure (Modified) has timber production as its primary objective and entails allocation of a high proportion of the available land base to timber harvest (including areas where timber management costs exceed returns). For the remaining alternatives (which include few areas where timber management costs exceed returns in the harvest base), both costs and PNV decrease as more acreages of land from which harvest would contribute to PNV are allocated to the production of outputs incompatible with timber harvest.

Many of the priced outputs included in the calculation of PNV are essentially competitive with timber harvest. Fisheries outputs (both recreational and commercial) and recreation opportunities decrease as harvest increases. This relationship is made especially clear by comparing the discounted nontimber benefits of Alternatives B-Departure (Modified) and I. Alternative B-Departure produces total discounted nontimber benefits of $387 million. In Alternative I, the most amenity-oriented of the alternatives, this figure climbs to $439 million.

While the effect of recreation and fisheries outputs on PNV is small relative to the effect of timber harvest, the competitive nature of their relationship with harvest tends to moderate differences in PNV among alternatives. Alternatives with low timber harvest levels (e.g., Alternative I) have relatively high fisheries and recreation benefits. As a result, differences in PNV between low-timber alternatives and high-timber alternatives are somewhat smaller than would be the case considering timber alone.

Some priced outputs remain fairly stable across all alternatives, having little effect on differences in PNV. Included in this category are on-Forest commercial fishery outputs and fish and wildlife-related recreation. Fishery outputs vary only slightly from alternative to alternative because the total potential productivity of the on-Forest fishery is somewhat insensitive to changes in management. Large changes in acreage allocated to timber production result in relatively small changes in fishery outputs. The lack of variation in wildlife-related recreation benefits results from the use of estimated big game (deer and elk) populations as the principal variable in the calculation of these values. Since these populations are expected to be quite similar in all alternatives, there is little variation in the projected benefits associated with them. Costs which remain stable across alternatives include administrative and support costs (see "Other," Table II-17).

In addition to the priced outputs discussed above, there are several outputs associated with the alternatives to which no monetary value can be reasonably assigned. While these outputs have no effect on the calculation of PNV, they are an important component of issue resolution and, therefore, net public benefits. These outputs, and the relationship of each to priced outputs and PNV, are as follows:

Maintenance of Scenic Quality: As this output increases, PNV decreases due to restrictions on timber harvest. Scenic quality maintenance is complementary to other priced outputs (i.e., recreation, fisheries outputs).

Unroaded Area Acreage: Since unroaded area retention and timber harvest are mutually exclusive, increases in this output can lead to reductions in PNV. Maintenance of unroaded areas is compatible with increases in PNV in many cases, as many of the Forest's unroaded areas are located in areas where timber management costs exceed returns. This output is complementary to other priced outputs.

Wild and Scenic Rivers and River Corridors: These outputs have essentially the same relationship with other outputs as scenic quality, and are particularly compatible with increased fisheries outputs.

Old-Growth Retention: Increasing this output has substantial effects on both timber harvest and PNV. Because old-growth distribution goals often dictate that highly productive and readily accessible areas remain unharvested, increases in this nonpriced output can lead to relatively large reductions in PNV. Old-growth retention is complementary to other priced outputs.

Employment: Of all the Forest outputs, timber harvest has the greatest effect on employment. Therefore, there is generally a close link between PNV and employment level. This linkage does not prevail, however, when incremental harvest investments exceed incremental harvest returns. When this occurs, employment rises while PNV drops. Production of other outputs (both priced and nonpriced), involving reduced timber harvest, generally leads to reduced employment.

Of the above nonpriced outputs, the two which bear the strongest relationship to PNV are old-growth retention and employment. Alternatives involving high old-growth retention targets are low in PNV due to the high per-acre cost of precluding harvest on timberland having high potential to contribute to PNV. Alternatives involving high timber harvest levels, resulting in high employment levels, provide the greatest returns in terms of PNV, although increasing timber production beyond the breakeven point reduces PNV while still generating additional employment.

The economic values displayed do not include those associated with possible future production of locatable minerals, oil and gas, or hydroelectric power. The possibility of future development of these outputs does exist on the Forest, but the timing of their development and the magnitude of their production are both highly speculative. It is possible that the economic values of these activities, if they are undertaken, will vary from alternative to alternative (see Chapter III, "Minerals" and "Energy").

The economic values also do not include the value of changes in fishery outputs projected to result from the effects of Forest activities on off-Forest fish habitat. While these effects have been estimated to facilitate comparison of alternatives, including them in the economic calculations seems inappropriate. Both the procedures used to estimate such effects and the degree to which available off-Forest habitat will actually be utilized (which determines actual output level as opposed to theoretical output level) are highly speculative. Therefore, quantified economic values for these effects are not included in the PNV analysis. In general, the productivity of off-Forest fisheries is expected to be inversely proportional to timber harvest level.

DIFFERENCES IN COSTS

The discounted costs shown in Tables II-16 and II-17 have two separate components: costs to the Forest Service (budget costs) and costs to others. The principal component of "costs to others" is the logging cost associated with harvest of National Forest timber. This cost alone constitutes about 60 percent of the total cost of each alternative. The remaining 40 percent covers anticipated budget expenditures. These are specifically identified in the "Total Costs" column of Table II-18. Refer to Appendix B for a more detailed discussion of costs, both non-Forest Service and budgetary.

The budget costs associated with each alternative fall into two categories: capital investments and operations/maintenance costs. Capital investments are expenditures on the Forest's physical plant which are designed to provide long-term returns. Examples include road construction, tree planting, and fish habitat improvement structures. Operations/maintenance costs cover those activities which are necessary to conduct the day-to-day business of the Forest. Such things as road maintenance, timber sale administration, and habitat condition monitoring fall into this category.

On the Olympic National Forest, virtually all capital investment costs are for either road construction or the numerous activities associated with continued timber production. These form a substantial proportion of the projected budget of each alternative. Projected annual budget costs for Alternatives NC-No Change and B-Departure (Modified) are well above the current (1989) level of $20.5 million in the first decade. This is because of the high first decade harvest levels of these alternatives combined with relatively high levels of harvest from National Forest land within the Shelton CSYU. The projected budget for Alternative A-Current Direction (No Action) is very close to the 1989 level, while those of the remaining alternatives are well below the current budget. These reduced budget levels result from lower first decade harvest levels overall, in combination with the general shift of harvest from National Forest land to Simpson Timber Company land within the Shelton CSYU.

In all alternatives, $8.1 million in budget costs are "fixed" and do not vary from alternative to alternative. Included in this category are basic overhead and administrative costs, as well as costs associated with programs which will be essentially the same in all alternatives. Examples of such programs include management of Dennie Ahl Seed Orchard and the base level of road maintenance needed to keep the existing road system serviceable.

All remaining costs change as the objectives of the alternatives change. Since timber harvest and the associated road construction are the primary factors contributing to variable budget costs, the projected budgets of alternatives increase as harvest level increases, and vice versa. The unit costs of harvest-related activities vary considerably, depending on the characteristics of the area where they occur. For example, the costs of timber sale preparation, fuel treatment, and silvicultural treatments all increase as difficulty of access increases. Road construction cost varies with slope, soil stability, and average rainfall (expense increases as the need for drainage structures increases).

DIFFERENCES IN ECONOMIC BENEFITS AND CASH FLOWS

Tables II-16 and II-17 compare alternatives in terms of PNV, which is based on consideration of all values and costs. There are three categories of "value" and two of "cost." Value can be disaggregated into nonmarket value, market value, and Forest Service receipts (which are a part of total market value). Costs can be disaggregated into Forest Service (budget) costs and costs to others (see also "Differences in Costs" above).

Market resources include timber, that portion of total developed recreation which is covered by campground use fees, commercial fish production, minerals, and special uses for which fees are collected. Nonmarket resource values are dollar values assigned to roaded and unroaded non-Wilderness dispersed recreation, Wilderness recreation, forms of developed recreation for which no fee is charged, and recreation generated by fish and wildlife outputs. The purpose of assigning dollar values to these is to reflect full economic value, even though none or only part of the value associated with particular resources is actually collected as fees under current laws and policies.

Comparison of total benefit to total cost measures the overall PNV of each alternative. Another important consideration is the flow of dollars to and from the U.S. Treasury and taxpayers of the United States. In this regard, the important variables are receipts (the portion of total market output collected as fees or payments) and budget costs. The difference between the two is the net cash flow to or from the Treasury. Net cash flows for the first and fifth decades for each alternative are displayed in Table II-18. The major differences among both economic values and cash receipts are due to differing levels of timber production.

The columns labeled "Noncash Benefits to Users" in Table II-18 represent the total estimated dollar value of nonmarket resources to which values have been assigned. They are presented to give the reader an idea of the relationship between the actual receipts generated by the alternatives and the value of the (valued) nonmarket outputs which occur in addition to market goods. Included in the calculation of noncash benefits is the value of commercial fish generated by on-Forest habitat. This is included (even though it is technically a market product) because it represents a benefit provided by the Forest which does not generate cash flow to the Treasury. Because no direct revenue is received by the Forest as a result of commercial fishery outputs, this item is viewed as a noncash benefit by the U. S. Treasury.

Table II-18. Average Annual Cash Flow and Noncash Benefits in the First and Fifth Decades (Million 1982 Dollars) 1/

	Decade 1				Decade 5			
Alternatives	Net Receipts	Total Costs	Total Receipts	Noncash Benefits to Users	Net Receipts	Total Costs	Total Receipts	Noncash Benefits to Users
No Change	22.4	31.0	53.4	2/	22.6	28.7	51.3	2/
B-Dep (Modified)	15.9	28.3	44.2	13.0	-1.8	16.4	14.6	20.8
A-Current Direction	8.1	20.4	28.5	14.1	3.6	18.7	22.3	20.5
C-Pref (Modified)	2.2	15.7	17.9	14.9	5.0	17.6	22.6	20.7
H (Modified)	-1.3	13.1	11.8	15.2	5.2	17.0	22.2	20.6
I	-6.4	8.9	2.5	15.9	3.6	15.3	18.9	20.8

1/ Costs include only Forest Service costs. Payments to counties have not been deducted from receipts.
2/ Noncash benefits are not estimated for Alternative NC. Data necessary to estimate these not available in timber management plans. It is expected that noncash benefits of this alternative would be close to those of Alternative B-Departure (Modified).

The entries in Table II-18 are arranged in order of decreasing net receipts in the first decade. These depend primarily on two variables: first decade harvest level in total and harvest from National Forest land within the Shelton CSYU in the first decade in particular. The second factor is important because Shelton CSYU harvest from National Forest land generates income to the federal treasury while harvest from Simpson Timber Company land does not. The high degree of variation among alternatives (from 0 to 116 million board feet per year) in the first decade harvest from National Forest land makes this factor significant in determining federal cash flows. Its effect on PNV, however, is small because high first decade harvests from National Forest lands within the Shelton CSYU are balanced by low harvest in succeeding decades and vice versa. Refer to "Returns to Government" in Table II-14 to see how the net receipts of the different alternatives vary from the first to the second decade.

Alternative NC is highest in first decade net receipts because it involves the highest level of total harvest from National Forest land. This includes a substantial difference (59 million board feet per year) between this alternative and the next highest (Alternative B) in harvest from National Forest land within the Shelton CSYU. Fifth decade net receipts of Alternative NC remain high due to sustained high harvest levels.

Alternative B-Departure (Modified) is next highest in first decade net receipts because its initial Forest-wide harvest level is substantially higher than that of any of the remaining alternatives. Alternative A-Current

Direction (No Action) has a moderately high level of net receipts because of its moderate overall harvest level and a relatively high level of first decade harvest from National Forest land within the Shelton CSYU.

For the group of three alternatives below Alternative A, with net receipts ranging from $2.2 million to -$6.4 million, successively significant reductions in overall first decade harvest and virtual elimination of first decade harvest from National Forest land within the Shelton CSYU interact to create the pattern of cash flows shown in Table II-18. Alternative C-Preferred (Modified) has the highest first decade harvest level (both within and outside the Shelton CSYU) of this group, and the highest net receipts. The declines in harvest from Alternative C to Alternative H (Modified) and from Alternative H to Alternative I result in declining cash flows. Alternatives H and I, having very little first decade harvest, still require substantial expenditures for the overall management of the Forest, and show a negative cash flow in the first decade.

Cash flows in the fifth decade primarily reflect overall timber harvest level. Alternatives B-Departure (Modified) and I show dramatic turnarounds in cash flow between the first and fifth decades. In Alternative B, the departure of the first two decades results in low availability of harvest-age timber (and a low harvest level) in the fifth decade. In Alternative I, in which harvest of existing old-growth is precluded, the development of younger stands results in a significant increase in harvest by the fifth decade.

Differences in noncash benefits to users in the first decade are a result of the same variables that affect first decade net receipts. The principal factors causing variation in noncash benefits are the productivity of fish habitat and the availability and quality of recreation opportunities. These vary inversely with overall National Forest harvest level. Therefore, for all alternatives, noncash benefits increase as net receipts decrease.

Fifth decade noncash benefits reflect anticipated increases in recreation use, accounting for the general rise in benefits. The general relationship that alternatives with relatively high harvest levels have relatively low noncash benefits continues to hold in the fifth decade. However, the sediment outputs and resultant fisheries effects of the fifth decade are strongly influenced by the timing and location of the activities of the previous forty years. Therefore, the correlation between timber harvest and noncash benefits in the fifth decade, taken by itself, is less reliable than for the preceding decades.

MAJOR TRADEOFFS AMONG ALTERNATIVES

This section summarizes the relationships among economic values, community effects, and the differing responses of the alternatives to selected issues, concerns, and opportunities (ICOs). The purpose is to highlight major economic and noneconomic tradeoffs that can be quantified, through use of indicators of responsiveness to ICOs, as a means of comparing alternatives. Keep in mind that a complete understanding of the differences among alternatives requires reading all of this chapter and Chapter IV. The ICOs are discussed in detail in Chapter I and Appendix A.

To provide a partial framework for assessing tradeoffs, the long-term resource demands of the national, regional, and local communities are summarized below. Selected economic values and quantified indicators of responsiveness to ICOs are then tabulated. Differences and similarities among the individual alternatives are summarized in terms of the major tradeoffs among competing objectives or responses to ICOs.

NATIONAL, REGIONAL, AND LOCAL OVERVIEW

The Draft Environmental Impact Statement for the 1985 Resources Planning Act Program estimates that total national demands will rise for all National Forest outputs. At the same time, there is a strong demand to protect and enhance the quality of the environment.

The Regional Guide for the Pacific Northwest Region estimates that demands for all outputs of National Forests will rise in Oregon and Washington. Recreation use is expected to increase as the population increases and its characteristics change, with the bulk of recreation use coming from residents of the region. Demand for Wilderness recreation is expected to exceed the available supply within the region's Wilderness Preservation System. Demand could be met, in the near future at least, by utilization of undeveloped lands outside Wilderness. Development of these lands would intensify pressure on the formally designated Wilderness areas.

Demand for hunting and sport fishing is expected to increase considerably between 1990 and 2000. Nonconsumptive uses of wildlife and fish are also expected to increase.

The National Forests of the Pacific Northwest Region have been the National Forest System's primary timber producer, contributing almost one-half of the historic National Forest harvest level. The quantity of timber demanded regionally in 2000 is expected to be about one percent greater than the 1976 demand level. The stumpage price of timber, however, is expected to rise substantially.

The local situation is similar to that of the Region, with a few important exceptions. The opportunity to meet expected additional demand for Wilderness recreation in currently undeveloped non-Wilderness areas does not presently exist on the Forest. Both Wilderness and non-Wilderness areas providing recreation opportunities in the Primitive and Semi-Primitive ROS classes are currently being used at levels which exceed their capacity to provide high quality experiences. Since demand for such recreation opportunity on the Olympic Peninsula is expected to increase approximately 20 percent over the next 20 years, this condition is likely to intensify in the future. The Forest will have the capacity to meet projected demand for developed and dispersed roaded recreation throughout the 50-year planning horizon in all alternatives.

Demand for Forest timber is expected to be stronger in the year 2000 than is anticipated for the Region as a whole. Anticipated reductions in the supply of non-Forest Service stumpage on the Olympic Peninsula are expected to result in a sharp increase in demand for Forest timber. None of the alternatives can provide enough stumpage to completely compensate for these expected declines in non-Forest Service harvest.

The combined effect of current timber demand and anticipated timber supply on local communities is expected to be a long-term shift in employment patterns as timber-based employment opportunities decrease. Increased emphasis on tourism and recreation as a significant component of the economic base is expected. The timber industry is still likely to continue as a major employer on the Peninsula. Refer to the "Vegetation--Future Trends" and "Local Economy" sections of Chapter III of this FEIS for thorough discussions of these anticipated trends.

ECONOMIC VALUES AND RESPONSES TO MAJOR ISSUES, CONCERNS, AND RESOURCE USE AND DEVELOPMENT OPPORTUNITIES

The major reason that alternatives differ is that each responds in different ways to the issues, concerns, and resource use and development opportunities (ICOs) identified for this Forest. This section summarizes many of these differences in response by defining, where possible, quantifiable indicators of responsiveness and displaying in Table II-19 the mix of responses in each alternative. It also discusses indicators of central concern to the nation as a whole (the owner of this Forest). The ICOs and indicators of responsiveness found in Table II-19 are:

- Maintenance of Scenic Quality

  Indicator: Acres to be managed to meet Preservation, Retention, and Partial Retention Visual Quality Objectives (VQOs).

- Availability of Unroaded Recreation Opportunity and Management of Existing Unroaded Areas Outside Wilderness

  Indicators: Acres outside Wilderness to be managed to retain Primitive and Semi-Primitive (P/SP) ROS classes.

  Proportion of existing unroaded areas to be retained in undeveloped condition.

- Retention of Old-growth and Wildlife Habitat Quality

  Indicator: Acres of old-growth remaining at the end of the fifth decade.

- Timber Harvest Level

  Indicators: Average annual allowable sale quantity (ASQ), million cubic feet, in the first decade.

  Average annual ASQ for the first five decades. Harvest figures include harvest from Simpson land within the Shelton CSYU.

- Transportation System Management

  Indicator: Miles of road system open to public use (both passenger car and high clearance vehicle) in the fifth decade.

- Soil Resource Management and Water Quality

  Indicators: Average annual sediment output (thousand tons) for the first two decades.

  Percent of riparian areas harvested during the first two decades.

- Fish Habitat Quality

  Indicator: Average annual fishery production potential (in millions of anadromous smolts), first five decades. Estimates include productivity of on-Forest habitat only.

- Wild and Scenic Rivers

  Indicator: Number of river corridors to be recommended for inclusion in the Wild and Scenic River System.

- Social and Economic Effects

Indicators: Average annual change from present employment level over the first decade (expressed as percent of total Peninsula labor force).

Average annual change in personal income over the first decade (in millions of 1982 dollars).

In addition to local issues and concerns, the nation as a whole has an interest in ensuring that the Forest is managed in an economically prudent manner concurrent with adequate protection of the quality of the physical environment. Indicators of this national interest are:

Present net value (PNV - million 1982 dollars).
First and fifth decade net receipts (cash flows - million 1982 dollars).
First and fifth decade noncash benefits to users (million 1982 dollars).

It should be noted that for two of the indicators of responsiveness displayed in Table II-19, there are base output levels below which none of the alternatives may drop. All alternatives meet 89,700 acres of the "Preservation" Visual Quality Objective, as this is the objective which applies in Wildernesses and the Quinault Research Natural Area. In addition, all alternatives provide at least 97,000 acres of old-growth habitat in all decades, as this is the acreage of old-growth currently in areas classified as unsuitable or unavailable for timber harvest (including Wilderness). These base output levels are included in the output totals shown in the table. The 97,000-acre old-growth habitat base mentioned above does not apply to Alternative NC, since the suitability classification of this alternative is based on determinations made in developing the timber management plans rather than the most current suitability assessment.

Table II-19. Indicators of Responsiveness of Alternatives to Major Issues and National Concerns
(Alternatives Presented in Order of Decreasing PNV)

Indicators	A - Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I	No Change
PNV ,Million 1982 $	568.5	547.2	520.3	452.6	351.2	2/
ASQ, Million Cubic Feet						
1st Decade	70.3	89.7	60.2	44.0	33.9	81.5
50 Year Ave.	70.3	78.2	65.3	56.8	48.7	77.7
Net Receipts, Million 1982 $						
1st Decade	8.1	15.9	2.2	-1.3	-6.4	22.4
5th Decade	3.6	-1.8	5.0	5.2	3.6	22.6
Noncash Benefits, Million 1982 $						
1st Decade	14.1	13.0	14.9	15.2	15.9	2/
5th Decade	20.5	20.8	20.7	20.6	20.8	2/
Visual Quality Objectives Met 1/						
1,000 Acres	114.1	89.7	179.8	179.8	179.8	114.1
Primitive/Semi-Primitive ROS						
1,000 Acres	35.8	20.6	41.9	55.2	60.6	17.5
Unroaded Retained % of Exist.	58.8	35.7	67.0	93.2	100.0	29.6
Wild & Scenic Rivers	1	0	3	10	10	1
Old-Growth, 5th Decade, 1,000 Acres	173.7	151.5	185.0	218.9	266.8	126.8
Open Road Miles	2,110	2,336	2,003	1,792	1,528	2,237
Sediment, 20 yr. Ave., 1,000 Tons	153.6	225.0	122.8	97.5	62.8	191.2
Riparian Areas Harvested, % 1st 20 years	10.9	19.2	7.9	5.1	1.4	17.1
Fishery Poten. Million Smolts (50 year average)	11.2	11.0	11.3	11.4	11.5	11.1
Change in Jobs, 1st Decade % of Peninsula Labor Force	-0.4	+1.6	-1.6	-3.5	-4.6	+1.3
Change in Income, 1st Decade Million 1982 $	-5	+18	-17	-38	-50	+14

1/ Includes provision in Alternative C-Preferred (Modified) that Retention and Partial Retention Visual Quality Objectives (VQOs) are to be met in all areas, regardless of Management Area designation. Acreages shown are Preservation, Retention and Partial Retention VQOs only.
2/ Not estimated for Alternative NC. Timber management plans do not provide sufficient data to enable reasonable estimation of these indicators. PNV of Alternative NC expected to fall between those of Alternative B-Departure (Modified) and Alternative C-Preferred (Modified).

DIFFERENCES AND SIMILARITIES OF INDIVIDUAL ALTERNATIVES

The alternatives are displayed in order of decreasing present net value in Table II-19. They are discussed below in the same order. The comparisons of alternatives consist largely of discussions of incremental differences from one alternative to the next. Alternative B-Departure (Modified) is compared to Alternative A-Current Direction (No Action), Alternative C-Preferred (Modified) is compared to Alternative B-Departure, and so on in order of decreasing PNV. The single exception to this ordering system is Alternative NC-No Change, which is presented first in the following discussion.

The comparison of alternatives begins with Alternative NC, because information available in the timber management plans upon which this alternative is based is not sufficient to enable calculation of PNV. Alternative NC is compared to Alternative B-Departure, which has the closest parallel timber harvest level and pattern of timber management strategies. Since Alternative NC is different in structure from the remaining alternatives, and since many of the indicators of responsiveness displayed in Table II-19 could not be quantified for this alternative, the format of the Alternative NC discussion is different from those for the remaining alternatives.

Alternative NC-No Change

This alternative is derived from the provisions contained in existing timber management plans. Assumptions and analysis parameters have not been updated to incorporate more current information regarding resource capabilities or management requirements. As a result, some of the outputs and effects of Alternative NC differ markedly in scope and magnitude from those of the other alternatives, while others could not be reasonably estimated.

While the PNV of Alternative NC could not be estimated quantitatively, it is likely that this alternative would fall slightly below Alternative B-Departure in PNV. This would place it third among the alternatives in this regard. The principal reason for anticipating a slightly lower PNV for Alternative NC is the higher level of early decade harvest from areas in which timber management costs exceed revenues, combined with more extensive early decade use of intensive management practices with low per-acre returns. Both of these practices will be necessary if the timber output objectives of this alternative are to be met. Since Alternatives NC and B-Departure are quite similar in most of the key factors influencing PNV, it is projected that these differences would lead to a slightly lower PNV for Alternative NC.

The high output of National Forest timber associated with Alternative NC is expected to result in first decade net receipts above those of Alternative B-Departure. This would make Alternative NC highest among the alternatives in this area. Noncash benefits to users, while not estimated quantitatively, are expected to be similar to those of Alternative B-Departure and lower than for the remaining alternatives.

The discretionary land allocations of this alternative parallel those of Alternative A-Current Direction (No Action) quite closely. As a result, the level of VQO attainment is the same as in Alternative A, and ranks above Alternative B-Departure and below the remaining alternatives in this area. However, Primitive and Semi-Primitive recreation opportunity and unroaded area retention are at levels well below Alternative A, and fall just below Alternative B-Departure. Alternative NC ranks lowest among the alternatives in these areas. The reason these outputs do not parallel those of Alternative A is the absence of allocations to meet MR specifications in Alternative NC. In Alternative A, MR allocations add substantial unroaded acreage to the discretionary unroaded area allocations of current direction. This does not occur in Alternative NC.

The qualifying characteristics of one potential Wild and Scenic River corridor (the Duckabush) are to be maintained in Alternative NC, as opposed to none in Alternative B-Departure.

The availability of old-growth habitat is lower in Alternative NC than in Alternative B-Departure, primarily due to the lack of old-growth habitat allocations for maintenance of northern spotted owl populations. This places Alternative NC below the others in old-growth retention.

Because of the similarities in harvest levels and expected road development programs, particularly in the first decade, it is likely that the early decade sediment output associated with Alternative NC will be very similar to that of Alternative B-Departure. As a result, fish habitat productivity should be roughly equivalent to that of Alternative B-Departure, ranking below that of all other alternatives. Level of harvest in riparian areas should also be similar to that of Alternative B-Departure, and higher than in the other alternatives.

The effect of Alternative NC on the local economy is similar to that of Alternative B-Departure, but with employment and personal income levels a bit lower in the early decades and substantially higher in later decades. Alternative NC ranks second among the alternatives in first-decade employment and income levels.

Alternative A-Current Direction (No Action)

Of the alternatives for which PNV could be estimated, Alternative A-Current Direction (No Action) has the highest PNV. This is primarily a result of this alternative's relatively high early decade harvest level (third highest among the alternatives), combined with the fact that this harvest comes from areas where returns to timber management exceed costs. Allocation to harvest of areas in which costs exceed returns and use of management intensities with low per-acre returns are both minimal.

Although the allocation of land to timber harvest and the selection of harvest prescriptions are based on contribution to PNV in this alternative, the land allocations of Alternative A still reflect a strong timber production emphasis. There are few discretionary allocations to nontimber uses. As a result, this alternative provides the third highest levels of both first decade harvest and 50-year average harvest. First decade net receipts fall in the middle range of the alternatives (ranking third) because the harvest level is low relative to those of Alternatives B-Departure and NC. Noncash benefits in the first decade are also in the middle range, again essentially a function of harvest level.

Many nontimber outputs are relatively low in Alternative A, due primarily to the emphasis on timber production in the assignment of discretionary allocations. This alternative ranks fourth among the alternatives in VQOs met, Semi-Primitive and Primitive recreation opportunity, unroaded area retention, and old-growth habitat availability. Recommendation for inclusion in the Wild and Scenic River System is prescribed for one river corridor (the Duckabush) in Alternative A, as opposed to as many as ten in other alternatives.

The harvest level of Alternative A also results in a relatively high sediment output (third highest among the alternatives) and a relatively low level of fisheries productivity. The fishery production potential of Alternative A ranks fourth among the alternatives, and this alternative has the third highest level of harvest in riparian areas.

The employment and personal income effects associated with Alternative A project Peninsula economic conditions roughly equivalent to those of today. Employment opportunities and personal income are higher in Alternative A than in the more amenity-oriented alternatives. This alternative ranks third in these categories.

Alternative B-Departure (Modified)

The drop in PNV ($21.3 million) from Alternative A-Current Direction (No Action) to Alternative B-Departure (Modified) is the net result of two factors, one of which increases PNV while the other reduces it. The substantial departure from nondeclining flow of Alternative B-Departure, providing the highest timber harvest level of the alternatives, could be expected to generate a PNV substantially above that of Alternative A. However, the effect of this difference between the two alternatives is more than negated by reductions in PNV associated with Alternative B-Departure's strong emphasis on timber harvest.

Much of Alternative B-Departure's PNV reduction results from the goal of maximizing timber production, as opposed to the emphasis on contribution to PNV associated with harvest management in Alternative A. This goal results in the inclusion in this alternative's harvest base of virtually every acre of tentatively suitable timberland (other than areas needed to meet MR specifications) on which timber management costs exceed returns. In addition, the objective of maximizing early decade harvest (rather than sustainable harvest) is best served by postponing harvest from faster-growing stands (of harvest age) until the third or fourth decade, while concentrating initial harvests in areas of slower growth and greater management cost. These slow-growing stands are less valuable (per thousand cubic feet) than their more rapidly growing counterparts, and require greater levels of investment per unit of harvest. Therefore, harvesting them first results in a lower PNV than would occur if more valuable stands were harvested first.

The high first decade harvest of Alternative B-Departure results in both higher first decade net receipts (second highest among the alternatives) and lower first decade noncash benefits (lowest among the alternatives) than occur with Alternative A. The substantial increase in net receipts (almost twice those of Alternative A) is a result of the large difference between the two alternatives (about 20 million cubic feet) in first decade harvest from National Forest land.

As a result of the strong timber harvest emphasis of Alternative B-Departure, many of the non-timber outputs drop substantially below the levels provided by Alternative A. This alternative ranks lowest in VQOs met, with attainment of VQOs dropping to near zero outside Wilderness. Alternative B-Departure exceeds only Alternative NC in Primitive and Semi-Primitive recreation opportunity, unroaded area retention, and old-growth habitat availability. The qualifying characteristics of potential Wild and Scenic River corridors are not maintained in any corridor.

Alternative B-Departure has the highest level of road mileage available for public use in the fifth decade, and is considerably above Alternative A in this regard. This is a result of the extensive road construction program which will be needed to serve the timber harvest level of this alternative. Harvest level also influences the proportion of the existing road system which will be kept open, since greater harvest volumes require that more of the road system be available for timber haul at any given time.

Another consequence of the harvest emphasis of Alternative B-Departure is its high sediment output (highest among the alternatives) and the resultant effect on fisheries. Fish habitat productivity ranks lowest among the alternatives, with average fishery production potential roughly 200,000 smolts per year below that of Alternative A. Alternative B-Departure has the highest level of harvest in riparian areas among the alternatives.

The principal favorable effect of the increased harvest level of Alternative B-Departure, aside from the higher first decade cash flow mentioned previously, is the effect of the alternative on the local economy. First-decade employment and personal income rank first among the alternatives, and are considerably higher than in Alternative A.

Alternative C-Preferred (Modified)

The PNV of Alternative C-Preferred (Modified) is $26.9 million below that of Alternative B-Departure. This is the result of substantial differences between the two alternatives in the conditions which generate overall PNV. While the timber harvest of Alternative B-Departure is based on a substantial departure from nondeclining flow, Alternative C includes the nondeclining flow limitation. The first decade harvest of Alternative C is almost 30 million cubic feet per year below that of Alternative B-Departure, and ranks fourth among the alternatives in this regard. The switch from departure to nondeclining flow, taken by itself, should result in an extremely large drop in PNV from Alternative B-Departure to Alternative C.

There are two characteristics of Alternative C which counterbalance the effect of lower harvest volume on PNV: the use of harvest regimes based on contribution to PNV, and removal of areas from the harvest base where timber management costs exceed returns. The objectives of Alternative C emphasize basing land allocation and prescription selection on contribution to PNV rather than timber production. For this reason, where land is allocated to timber harvest in Alternative C, the management regimes and harvest schedules which contribute the most to PNV are applied. In addition, the allocation of areas where timber management costs exceed returns to timber production is greatly reduced from Alternative B-Departure.

The final factor influencing the PNV of Alternative C as opposed to Alternative B-Departure is the stronger emphasis on the production of nontimber outputs in Alternative C. In this alternative, selected areas in which full yield timber management would contribute to PNV have been allocated to uses which preclude or limit timber harvest (an example being some of the areas providing Primitive and Semi-Primitive recreation opportunities). The interactions of all these factors (departure vs. nondeclining flow, emphasis on contribution to PNV vs. timber production, and extent of allocation for nontimber outputs) have resulted in a moderate drop in PNV from Alternative B-Departure to Alternative C.

The large drop in net receipts from Alternative B-Departure to Alternative C results from the decrease in overall first decade harvest in Alternative C, combined with a very substantial drop in harvest from National Forest land within the Shelton CSYU in the first decade. The substantial increase in noncash benefits results from the expanded emphasis on nontimber outputs and the removal from the harvest base of areas where timber management costs exceed returns.

Related to Alternative C's increased noncash benefits are the increased levels of VQOs met (equal to Alternatives H (Modified) and I), Primitive and Semi-Primitive recreation opportunity (ranked third among the alternatives), unroaded area retention (also third), and old-growth habitat availability (ranked third). The three river corridors recommended for inclusion in the Wild and Scenic River System in Alternative C reflect a substantial increase in this output relative to Alternative B-Departure.

Road mileage open for public use in the fifth decade decreases from Alternative B-Departure to Alternative C, largely as a result of the reduced harvest program. Road construction needs are lower in Alternative C, as is the proportion of the existing road system which must be kept open and available for timber haul.

The reduced harvest level and changed allocation patterns of Alternative C also result in a much lower sediment output than occurs in Alternative B-Departure. Alternative C has the fourth highest sediment level, while Alternative B-Departure is highest in this regard. Associated with this decrease in sediment is a substantial increase in fisheries outputs, with Alternative C ranking third among the alternatives in this area. Average fishery production potential is roughly 300,000 smolts per year above that of Alternative B-Departure. Alternative C has the fourth highest level of harvest in riparian areas.

An additional consequence of the substantial harvest reduction of Alternative C is the drop in employment opportunity and personal income associated with this alternative. While Alternative B-Departure provides the second highest level of employment opportunity, Alternative C ranks fourth among the alternatives and entails a substantial decrease from the level of employment opportunity currently provided by the Forest.

Alternative H (Modified)

The principal difference between Alternatives C and H (Modified) is the emphasis, in Alternative H, on maintaining old-growth habitat within winter range (below 1,500' elevation). The goals of Alternative H include retaining all such habitat at its present level. This results in the allocation of a large acreage of timberland with a high potential to contribute to PNV to a use which precludes timber harvest. It also explains the bulk of the $67.7 million drop in PNV from Alternative C to Alternative H.

The first decade harvest level of Alternative H is over 15 million cubic feet per year below that of Alternative C, and ranks fifth among the alternatives. In addition to its effect on PNV, the lower harvest level results in a substantial decline in net receipts in Alternative H, which ranks fifth in this regard as well. In fact, the low level of harvest of this alternative, combined with the basic costs involved in operating the Forest at even a substantially reduced output level, result in a negative cash flow (net receipts below zero) in the first decade.

Many of the nontimber outputs are produced at a higher level in Alternative H than in Alternative C. In addition to retention of old-growth in winter range, this alternative places greater emphasis (relative to Alternative C) on allocation of land to nontimber uses. As a result, Semi-Primitive and Primitive recreation opportunity reaches its maximum potential level in Alternative H, and proportion of existing unroaded area retained approaches its potential. Attainment of VQOs reached its potential in Alternative C, and does not change in this alternative.

Potential Wild and Scenic River corridors are also managed at the maximum potential level in Alternative H. All ten of the rivers which are eligible for Wild and Scenic River classification, and have the Forest Service as the lead classification study agency are recommended for inclusion in the Wild and Scenic River System in this alternative.

Availability of old-growth habitat increases substantially from Alternative C to Alternative H, and ranks second among the alternatives in this area. Harvest of existing old-growth within winter range is precluded in Alternative H. This limitation applies throughout the 150-year analysis horizon.

The reduced harvest level of Alternative H results in a substantial decline in road mileage open to public use in the fifth decade relative to Alternative C. Alternative H ranks fifth among the alternatives in road system availability.

Another result of the change in harvest level is the reduced sediment output of Alternative H. Associated with this is increased fish habitat productivity, which ranks second among the alternatives. Average fishery production potential is roughly 100,000 smolts per year above that of Alternative C. The level of harvest within riparian areas in Alternative H is second lowest among the alternatives.

Also related to harvest level are employment opportunities and personal income associated with Alternative H. These fall considerably below the levels provided by Alternative C, and rank fifth among the alternatives.

Alternative I

The principal change from Alternative H to Alternative I is the expansion of old-growth retention to include all National Forest land. The goals of this alternative include maintenance of all currently available old-growth habitat in perpetuity. The effect of this objective is to severely reduce the availability of harvestable timber, especially in the early decades. As a result, both PNV and first decade harvest drop sharply ($101 million and over 10 million cubic feet per year respectively) from Alternative H to Alternative I. This alternative provides the lowest harvest level among the alternatives.

It should be noted that most of the first decade harvest shown for Alternative I in Table II-19 comes from Simpson Timber Company land within the Shelton CSYU. Harvest from National Forest land drops to 2.6 million cubic feet per year. This results in a first decade cash flow substantially less favorable than that of Alternative H (which is itself negative in cash flow), and places Alternative I lowest among the alternatives in this regard. Noncash benefits increase from Alternative H to Alternative I, and rank first among the alternatives.

While the harvest level of Alternative I is low, its production of nontimber outputs ranks first among the alternatives in many areas. This alternative provides the maximum potential levels of VQOs met, Primitive and Semi-Primitive recreation opportunity, unroaded area retention, and old-growth habitat availability. Outputs of these are higher than those of Alternative H in unroaded area retention (a small increase) and old-growth habitat (a large increase). Management of potential Wild and Scenic River corridors is the same as in Alternative H.

Road mileage available for public use in the fifth decade drops substantially from Alternative H to Alternative I. Road construction needs associated with Alternative I are relatively minor, especially in the early decades, and the light timber haul on the existing road system makes reduction of maintenance levels practical. As a result, Alternative I ranks sixth in road system availability.

Alternative I's low harvest level results in a substantial decrease in sediment output relative to Alternative H, giving Alternative I the lowest sediment output among the alternatives. Associated with this is a modest increase in fisheries productivity, which places Alternative I first among the alternatives in this regard. The average fishery production potential of Alternative I is roughly 100,000 smolts per year greater than that of Alternative H. This alternative has the lowest level of harvest within riparian areas.

The principal unfavorable effect of the low harvest level of Alternative I, aside from its low PNV and cash flows, is the effect of the alternative on the local economy. Employment opportunity and personal income are substantially below Alternative H, and represent the lowest levels provided by any of the alternatives.

Chapter III

Affected Environment

Olympic National Forest

CHAPTER III

AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes the existing environment within and around the Olympic National Forest. It provides a framework from which to develop an understanding of the environmental components and relationships each has with the others. It is organized by major components of the environment.

In general, each component is described in terms of its role in the environment and the current situation or condition of that component on the Olympic National Forest and, where relevant, the Olympic Peninsula. Also described are historic and expected future trends associated with the component.

Many of the discussions throughout this document refer to "zones" within the Forest. These were developed by the planning team for analysis purposes because of significant differences in one or more of the environmental components. The "Eastside" zone includes the Quilcene Ranger District as well as the portions of the Hood Canal Ranger District outside both the Shelton Cooperative Sustained Yield Unit (SCSYU) and the "Satsop Block." The "Westside" zone includes the Quinault and Soleduck Ranger Districts plus the "Satsop Block" within the Hood Canal District. The National Forest land within the Shelton CSYU is considered a separate zone. (Refer to Figure III-1 for the relationship of these Districts within the zones and their relationship to the Olympic Peninsula.)

In descriptions of the Forest, two management "entities" are analyzed and discussed: the Shelton CSYU and remaining National Forest land. Several terms are used to distinguish "remaining National Forest land" from the Shelton CSYU. The reader can expect to encounter the following terms: "East-West," "Eastside and Westside zones," "National Forest land outside the Shelton CSYU," and occasional variations of these terms. All of these terms refer to the combination of the Eastside and Westside zones, which between them include all National Forest land that is not within the Shelton CSYU. This terminology was developed because it is often necessary to separate the conditions, outputs, and effects associated with management of the East-West portion of the Forest from those associated with the Shelton CSYU.

CHANGES BETWEEN DRAFT AND FINAL

Changes were made in Chapter III between the November 1986 Draft and Final EIS as the result of new information becoming available and in response to concerns expressed during the public comment period. The following are the major changes:

1. Updated and expanded the water quality, sediment, and streamflow information and analysis.
2. Updated information and discussion on the northern spotted owl.
3. Cumulative effects concerns for water resource values were addressed by adding a Watershed Condition Classification analysis and discussion.
4. Updated vegetation condition information and past timber harvest levels on the Forest.
5. Updated total acreages within the Forest in response to boundary changes.
6. The Olympic Peninsula timber supply analysis, timber demand projections, and estimates of future harvest levels from non-National Forest land have been updated.
7. Analysis of existing conditions within the Olympic Peninsula timber industry has been updated.
8. Inventory information covering the Forest development road system has been updated, as have data regarding road system management and maintenance.
9. Employment and income information for the four Olympic Peninsula counties has been updated to 1989.
10. Population estimates and other demographic data have been updated.
11. The Historical, Cultural and American Indian sections have been expanded.
12. Current RVDs were updated from 1980 use figures to 1986 use figures as a data base for projecting demand.
13. Projected recreation demand was updated using the newer 6th Edition of the Washington Statewide Comprehensive Outdoor Recreation Plan (SCORP).
14. Demand projections of nonwilderness and wilderness areas are shown by Recreation Opportunity Spectrum (ROS) classes.
15. A complete listing of existing and proposed Developed Sites and Trails is included.
16. Information on mountain bike and off-road vehicle use of the Forest was updated or added.
17. Potential Wild and Scenic River candidates have been reevaluated for eligibility and suitability.
18. Many reviewers commented that Chapter III was too lengthy and that some of the information was more appropriate in Chapter IV. The portions of the chapter which discuss interactions among environmental components have been moved, in part, to Chapter IV. Further information is available for review in the Planning Records in the Supervisor's Office.

LOCATION

The descriptions in this section are also presented in the "Overview" section of Chapter I. They are repeated here because of the importance of becoming familiar with the Olympic Peninsula, to better understand the conditions and relationships described in this Chapter.

THE PENINSULA

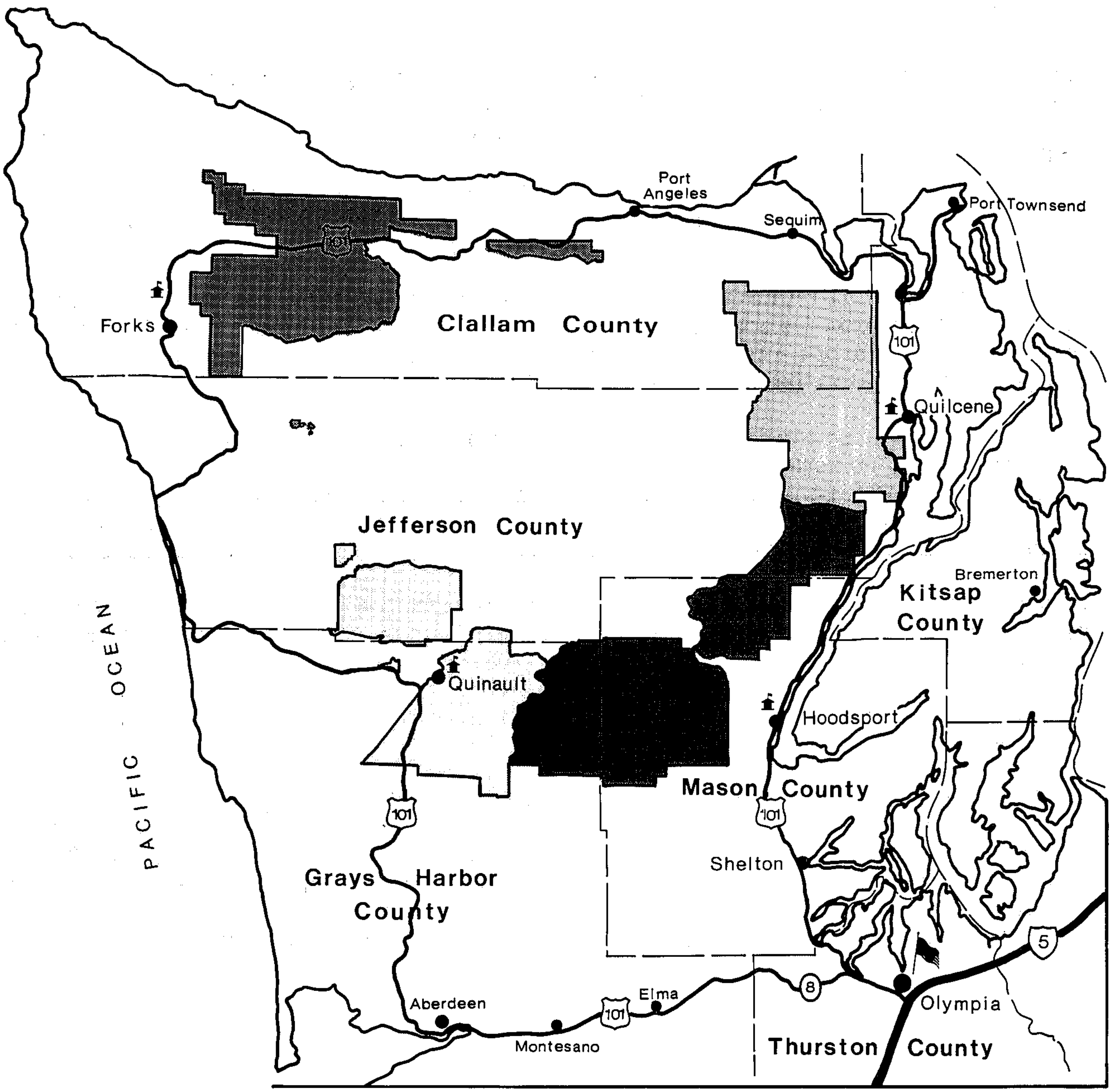
The Forest is located on the Olympic Peninsula in the northwest portion of Washington State. The Peninsula is a distinct and unique geographical area surrounded on three sides by saltwater. U.S. Highway 101 is the main travel route, paralleling the Pacific Ocean on the west, the Strait of Juan de Fuca on the north, and Hood Canal and the inland waters of Puget Sound on the east. This 6,500 square mile area is an association of complex winding ridges, rugged and steep mountains, deep canyons, and tree-covered slopes. Because of the extremely rugged topography, there are no through routes crossing the center of the Peninsula (refer to Figure III-2 for a general vicinity map).

The first people who lived on the Olympic Peninsula were American Indians whose ancestors are believed to have migrated over the ice age land bridge from Asia by way of Alaska. No one knows how long these American Indians were present before European settlers arrived. Archaeological evidence suggests that occupation occurred with the retreat of the continental glaciers some 12,000 to 13,000 years ago.

Early explorers made contact with the coastal region about a century before the interior Olympic Mountains were investigated. The Seattle Press Expedition explored the mountainous core in the 1890's. After early explorations, the inland Peninsula saw little development. Almost all settlement on the Olympic Peninsula is peripheral to the Olympic Mountains and adjacent to saltwater. Most of the Peninsula's population lives in the communities of Aberdeen, Hoquiam, Forks, Port Angeles, Sequim, Port Townsend and Shelton.

An incredible variety of environments occur within short distances on the Peninsula. Within less than 50 miles from the Pacific Ocean to Mt. Olympus, the vegetation changes from the lush, temperate "rain forests" of the Hoh, Queets, and Quinault River valleys to an alpine environment of lichens and mosses. Hundreds of species of plants have been identified on the National Forest alone; twelve are native only to the Olympic Mountains. The major commercial wood-producing tree species are Douglas-fir, western hemlock, western redcedar and Pacific silver fir.

Precipitation is heavy in the fall, reaching a peak in December and decreasing in spring. The driest area is the northeastern corner of the Peninsula, which receives less than 25 inches of precipitation a year. The wettest areas, with more than 220 inches of precipitation annually, are on the windward side of Mt. Olympus and in the upper Clearwater River drainage. Winter snowfall ranges from less than 10 inches in lower valleys to more than 250 inches in the higher mountains. Summers are relatively dry and mild with the warmest temperatures averaging near 75 degrees F. Winters are wet and mild with temperatures in the lowlands seldom dropping below 20 degrees F.



LEGEND

Hood Canal Ranger District

Quilcene Ranger District

Quinault Ranger District

Soleduck Ranger District

Ranger Station

Supervisors Office

County Line Boundaries

Figure III-1. RANGER DISTRICTS

Many recreational opportunities are available throughout the year. Visitors and residents enjoy auto touring, camping, picnicking and backpacking. These activities are most popular during spring and summer. Fishing, hunting, berry picking, and Christmas tree cutting are enjoyed during the fall and winter months.

The Peninsula's Roosevelt elk population is the largest of its kind. It is estimated there are between 5,000 and 7,000 elk in the herds on Federal land. With individual animals often weighing more than 600 pounds, elk are a major attraction for both viewing and hunting. Other common animals are the black-tailed deer, black bear, marmot, and mountain goat. The goat is not a native Peninsula species, having been introduced in the 1920's. Less commonly seen animals are the mountain lion, bobcat, coyote, beaver, marten, otter, mink, raccoon and skunk.

There are over 250 species of birds common to the Olympic Peninsula. Both golden and bald eagles are frequently sighted, although only a few nests have been located.

The many lakes, rivers, and streams, including surrounding bodies of saltwater, offer outstanding fisheries. Anadromous fish include steelhead trout, Pacific salmon, and sea-run cutthroat trout. Resident fish include cutthroat, eastern brook and rainbow trout, as well as Dolly Varden char.

THE FOREST

The Olympic National Forest was designated a Forest Reserve in February 1897. President Cleveland signed the proclamation which included 1,500,000 acres of public land on the Olympic Peninsula. On three separate occasions between 1897 and 1909, lands were added to or eliminated from the Reserve. In 1905, the name Olympic Forest Reserve was changed to Olympic National Forest. The core of the Olympic National Forest was designated as Mt. Olympus National Monument by President Theodore Roosevelt in 1909. The Monument was transferred from the jurisdiction of the Forest Service, Department of Agriculture, to the Park Service, Department of the Interior in 1933 and became Olympic National Park in 1938. Since 1909, there have been several land transfers and boundary adjustments between the Forest and Park.

Lands administered by the Olympic National Forest now occupy 632,324 acres in Clallam, Jefferson, Grays Harbor, and Mason Counties. There are approximately 67,200 acres of private and other government-administered lands within the boundary of the Forest, mostly on the west side.

National Forest lands are administered under the direction of a Forest Supervisor, headquartered in Olympia, Washington. The Supervisor is supported by a headquarters staff and personnel on four Ranger Districts located in the Peninsula communities of Hoodsport, Quilcene, and Forks, and on the south shore of Quinault Lake (see Figure III-1).

Principal forest resources include the vegetation, water, wildlife, fish, recreation and wilderness. These, as well as other resources and attributes, are described in much greater detail later in this chapter.

There are also about 250,000 acres owned by Simpson Timber Company that are directly affected by this plan. Simpson's lands, and approximately 111,000 acres of National Forest land in the Hood Canal Ranger District, are managed as the Shelton Cooperative Sustained Yield Unit (SCSYU). This relationship and that of the Grays Harbor Federal Sustained Yield Unit (FSYU) are explained in greater detail later under the heading of "Sustained Yield Units."

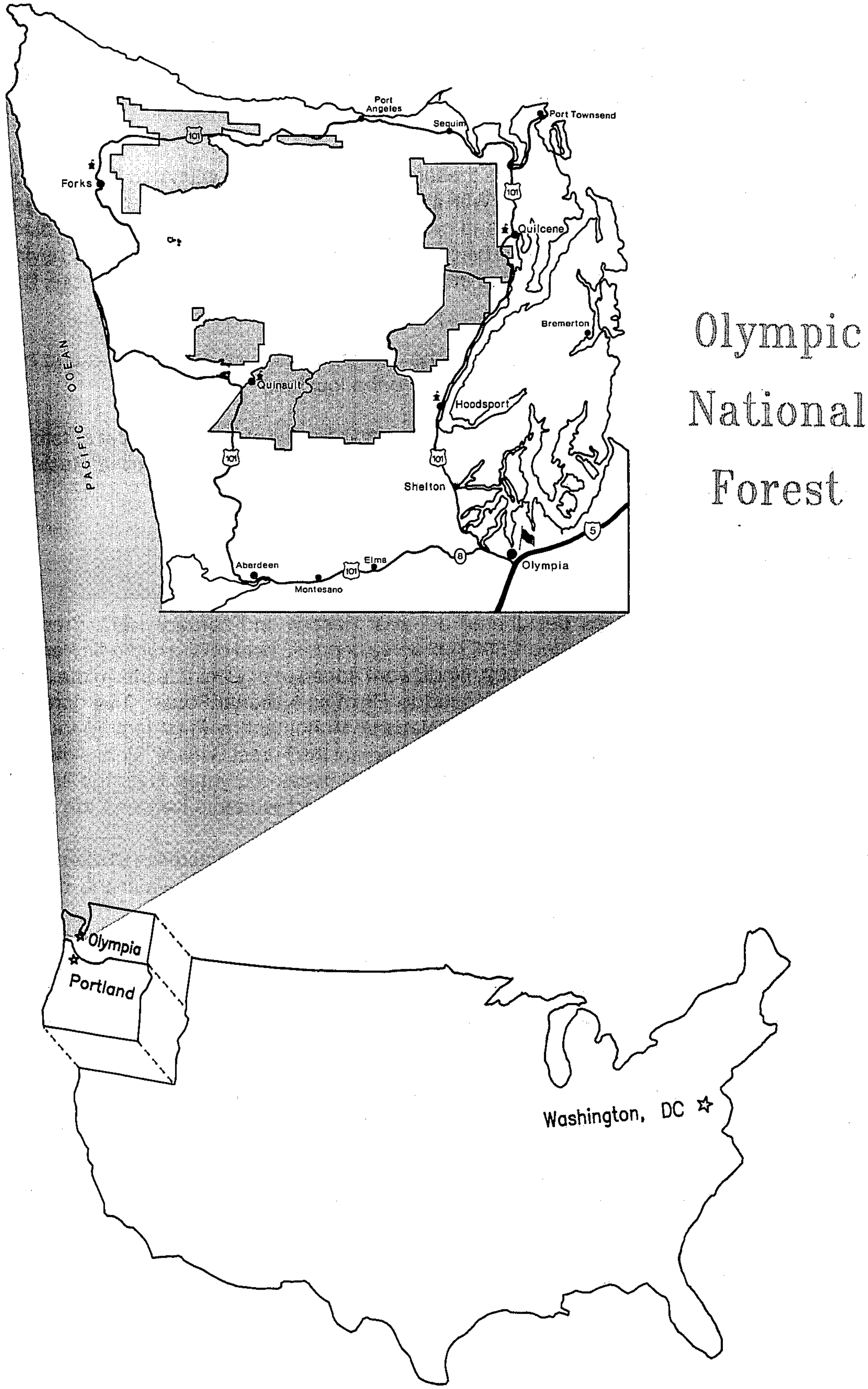


Figure III-2. VICINITY MAP

OTHER LANDS

Other major landownerships of the Olympic Peninsula that have a bearing on the environment and the Forest include the Olympic National Park, Washington State Department of Natural Resources (DNR), several Indian Reservations, and private land (much of which is managed by large timber companies). Refer to Figure III-3 for a display of the relationships of major ownerships.

The Olympic National Park is the largest land management unit, with over 916,100 acres located in the center of the Peninsula and in a narrow strip along the Pacific Ocean. Most of the major Peninsula rivers originate within the Park. No roads traverse the Park, although there are several located within its boundaries. In 1988, over 876,669 acres were legislatively included in the National Wilderness Preservation System. More information about the resource relationships between the Park and Forest are presented throughout Chapter III.

The Washington State DNR manages over 364,700 acres, mostly on the west side of the Peninsula. Timber production is their primary use and current plans call for harvesting of almost all of the overmature forest stands.

The various Indian Reservations include over 235,000 acres, with the Quinault, Makah and Skokomish being the largest. The major activity has been timber harvesting, but management emphasis is changing as the acreage of mature forest declines and more of the management and planning responsibility is assumed by tribal agencies. Their management plans now call for less emphasis on timber harvesting and more emphasis on management for traditional values. Special consideration will be given to multiple-use management, especially fish and wildlife habitat in association with the timber commodity.

Various forest industry corporations manage approximately 915,000 acres (excluding Simpson's SCSYU land) in the four-county Peninsula area. The predominant use is for timber production. Past activities have converted the area to young forests. Expectations are that these lands will continue to be managed primarily for the production of timber commodities.

Numerous landowners hold smaller acreages within and adjacent to the Forest boundary. The trend over the last decade has been toward more subdivision of these and other holdings and the subsequent construction of residences or other facilities, thereby reducing the number of acres being managed for forest products. This is particularly true on the east side of the Forest.

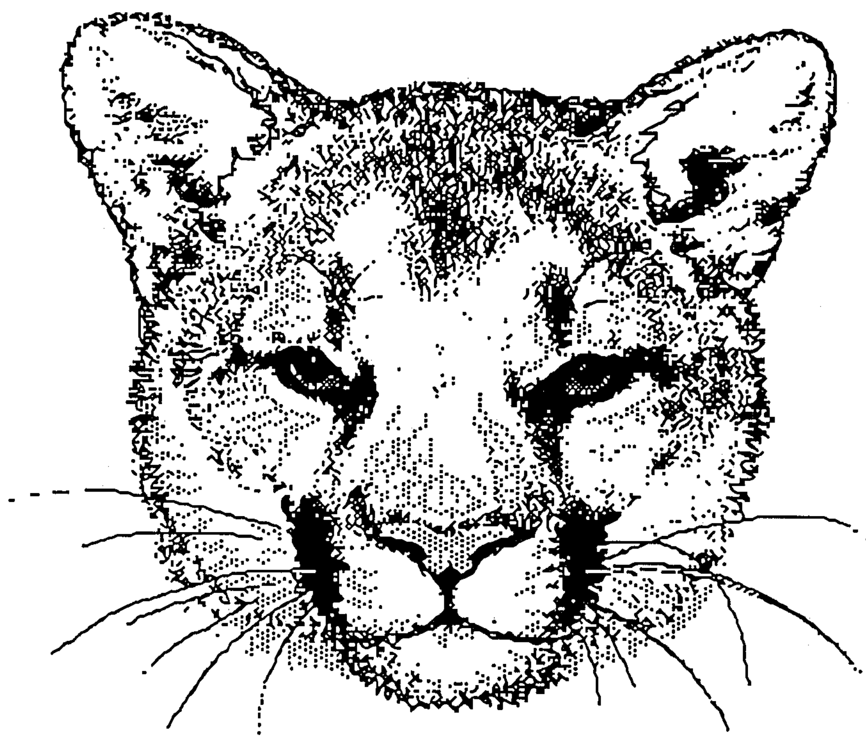
FOR YOUR INFORMATION

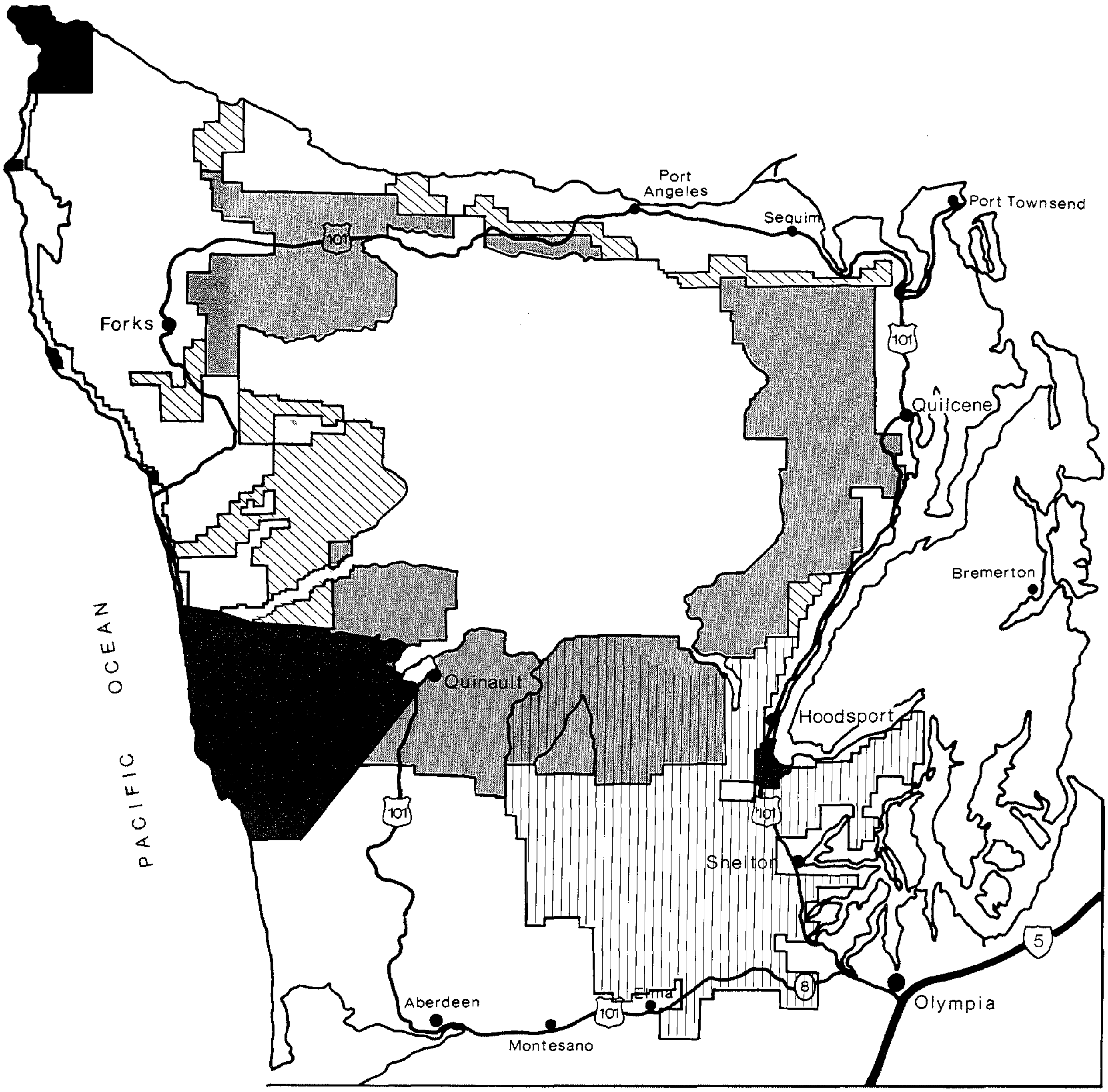
While reviewing this document, it is important to recognize the different areas of responsibility the Forest Service and National Park Service have, and what roles they are expected to play in managing the Nation's resources. One of the most notable differences is explained in the Acts that created the two agencies.

The National Forests, as described in the Organic Administration Act of June 4, 1897, were established "for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of the citizens of the United States." This was reaffirmed in several laws passed later, including the Sustained Yield Forest Management Act of March 29, 1944 and the Multiple-Use Sustained-Yield Act of June 12, 1960.

When the Olympic National Park was established, Congress authorized it to "preserve, protect, and interpret, for the enjoyment and benefit of the American people, the mountain wilderness phenomenon, which contains the finest remnants of the Pacific Northwest rain forest, seacoast, active glaciers, and the Roosevelt elk."

Because of the significant amount of common boundary between the Forest and Park, many of the resources and the interactions described in this chapter are a result of habitat and resource opportunities available from both areas. Many of the activities implemented for management of the Forest affect resources and use opportunities in the Park and vice versa.





LEGEND

Olympic National Forest	State of Washington
Shelton CSYU	Indian Reservation
Olympic National Park	Private Ownership

Figure III-3. LANDOWNERSHIP

TOPOGRAPHY AND GEOLOGY

THE ROLE OF TOPOGRAPHY AND GEOLOGY

The geology of the Forest provides basic information useful in the resource management arena. Data and knowledge about the key terrain characteristics provide the primary framework for identifying land capabilities and limitations, and for predicting the effects of proposed actions on Forest resources. Changes in geologic characteristics reduce or enhance the potential for development of the resources, particularly renewable resources.

OVERVIEW

Two major rock terrains, designated the "Peripheral Rocks" and "Core Rocks" (Tabor and Cady 1978), make up the Olympic Peninsula (see Figure III-4). Crescent Formation and Blue Mountain Unit "Peripheral Rocks" were formed by submarine volcanism and associated sedimentation along a mid-ocean ridge. Sedimentary "Core Rocks" were formed from consolidation and cementation of marine sediments during and subsequent to Crescent volcanism. Intense shearing and folding resulted from thrusting of Core Rocks beneath the Peripheral Rocks along a subduction zone (Calawah, Hurricane Ridge, and Southern Fault Zones). Deposition of sediment continued as the zone of subduction moved seaward, and the area was folded and arched into the present horseshoe-shaped configuration. Continued arching and faulting uplifted rock from the ocean floor to form the Olympic Peninsula.

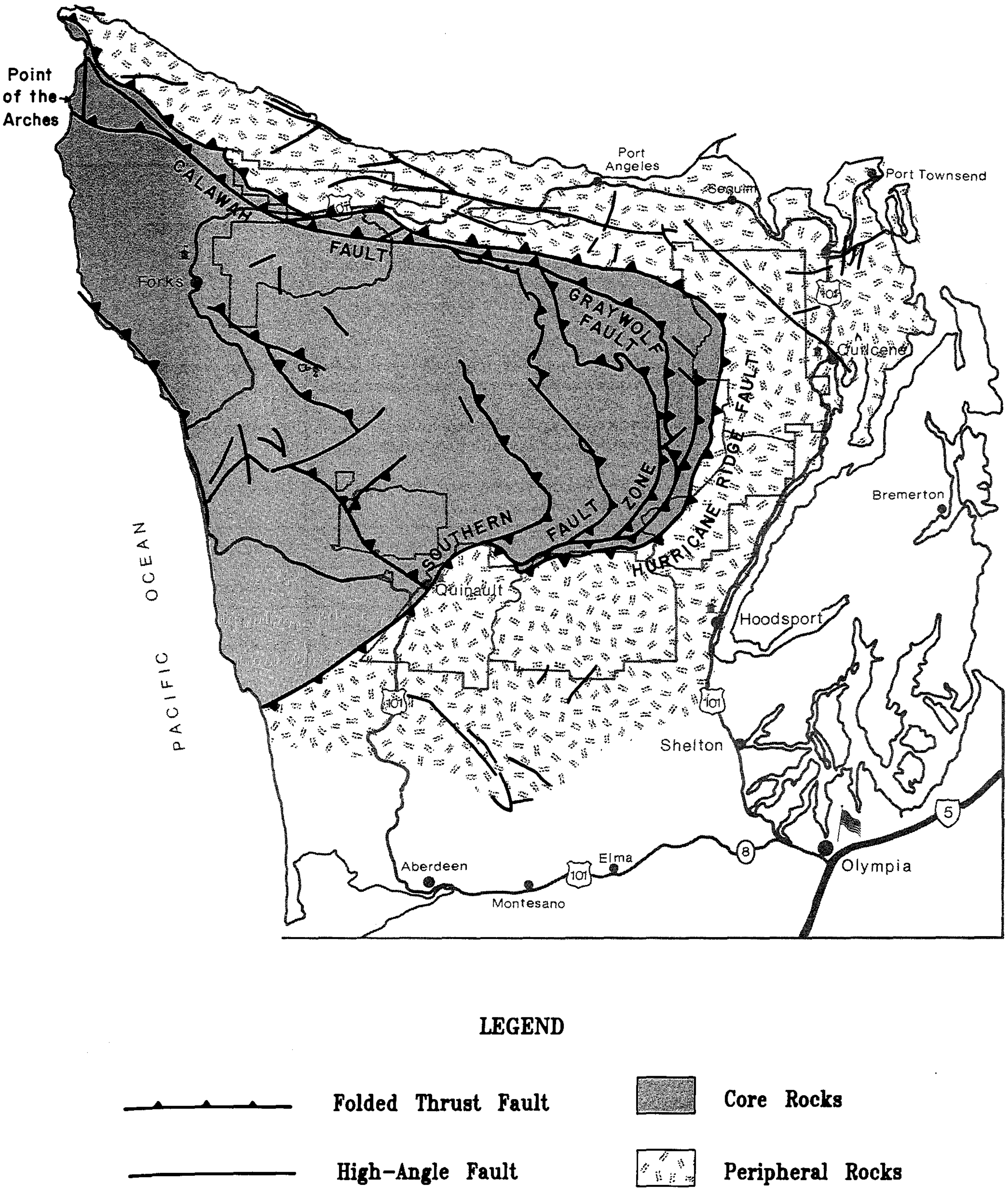


Figure III-4. MAJOR GEOLOGIC TERRAINS

ERA	PERIOD	EPOCH	EVENTS	TIME
	Quaternary	Pleistocene	Human cultures evolve. Olympic Mountains continue to ride as glaciers and water wear them down. Forests dominated by conifers.	Present 2 million years ago
CENOZOIC	Tertiary	Pliocene	Olympic Mountains begin to rise. Subduction zone shifts to the west. Forests dominated by angiosperms, with some conifers.	13 million years ago
		Miocene	More sediments scraped off ocean floor and added to the continental margin. Much folding, faulting and thrusting of the Olympic rock formations.	25 million years ago
		Oligocene	Seamounts scraped off oceanic plate and added to the continental margin at the subduction zone.	36 million years ago
		Eocene	Volcanic island arc forms in ocean. Columbia Embayment accumulates thick beds of sediments.	58 million years ago
		Paleocene	Coastline is approximately along the front of the present day Cascade Mountains	63 million years ago
	Cretaceous			135 million years ago
	Jurassic		North American Plate moves west	190 million years ago
MESOZOIC	Triassic		North American Plate splits from Europe and starts moving west.	225 million years ago

Figure III-5. GEOLOGIC TIME LINE SHOWING THE MAJOR EVENTS IN THE FORMATION OF THE OLYMPIC MOUNTAINS

Weathering and erosion during past and ongoing uplift has exposed rock that had been deeply buried. The differing effects of weathering on highly variable rock materials produced the complex topography found on the Peninsula. Rapid downcutting between each successive valley stage produced landslides and other erosional features that defined the strength characteristics and stress relief history of the various rock layers. The resulting topography closely follows structural patterns in the rock.

Continental glaciation followed major topographic lows around the north and east sides of the Peninsula. Alpine glaciers followed many of the preexisting river valleys. Glaciofluvial and glaciallacustrine materials were deposited in many of the river valleys and over most of the lowland areas on all sides of the Peninsula. Ongoing uplift and erosion have caused downcutting and development of new stream channels related to current base levels. Landslides are occurring on many oversteepened channel walls.

CURRENT SITUATION

The Olympic National Forest is characterized by steep, mountainous terrain dissected by large rivers radiating from the center of the Olympic Peninsula. Elevations range from sea level at the Seal Rock Campground on Hood Canal to 7,134 feet atop Mt. Fricaba on the Quilcene Ranger District. The west half of the Forest (from the Wynoochee to Soleduck Rivers) is somewhat lower in average elevation, with most of the area below 2,000 feet. The east side of the Forest is higher in elevation, with many ridgecrests above 4,000 feet. The major rivers flow through steep-walled valleys with flat valley bottoms.

The Peninsula is still geologically active, and uplift is still occurring. Earthquakes related to this uplift are common, particularly within the northeast and southeast parts of the Forest. Very recent fault traces have been noted in the East Fork Humptulips, Satsop, Hamma Hamma and Duckabush drainages. Ongoing uplift, combined with high runoff, is producing rapid erosional downcutting. This results in steep valley walls on which downslope movement of soil and rock by various processes is occurring. Slope angle and height, rock and soil strength characteristics, and the influence of ground and surface water are combined in complex stress relationships forming a state of dynamic equilibrium on most slopes. Mass movement occurs where dynamic equilibrium is lost due to a change in one or a combination of the key elements affecting stability.

Geologic resources on the Forest include potential geothermal and oil and gas sites, common variety minerals, groundwater, localized manganese, peat, and ceramic clay deposits. These resources are outlined in the section titled "Minerals" which appears later in this chapter. Geologic structure, in combination with other characteristics, also establishes the occurrence on-Forest of potential hydropower development sites.

HISTORIC TRENDS

Past logging and road construction practices have had a significant effect on slope stability and erosion in locations where vegetative root structures, drainage characteristics, and slope angle are key elements. Resulting impacts have ranged from loss of timber production opportunity on small areas to mass failure of soil and rock materials within a drainage area. Other impacts have been loss of vegetative regeneration capabilities, degeneration of channel characteristics and water quality, and at least a short-term loss of fisheries habitat. The occurrence of adverse effects became more frequent as an increasing number of timber sales (and the transportation facilities to serve them) have been located in steep terrain.

At least some of these impacts have been mitigated by use of full-bench road construction techniques, construction of retaining walls and other structures in lieu of large open excavations, and use of long-span skyline, helicopter, and other nontraditional logging systems.

Historic trends regarding geologic resources are discussed later in this chapter in the section titled "Minerals."

FUTURE TRENDS

Instances of mass instability are predicted to continue where clearcut logging occurs on slopes where vegetative root structure is the key stabilizing element. This is predicted to occur regardless of the logging system or mitigation measures applied. The frequency and impact of these failures will be dependent on the accuracy of the timberland suitability stratification process described later in this chapter in the section titled "Vegetation," and the nature of management activities conducted on adjacent slopes.

Glacial deposits and highly altered sedimentary or basalt bedrock are prone to mass instability. Most unstable glacial deposits were large enough to be mapped from aerial photographic interpretation during the Soil Resource Inventory update (Jennings et al. 1982). These areas were withdrawn from timber harvest in the suitability stratification process. Highly altered sedimentary and basalt bedrock commonly occurs as small pockets not apparent from aerial photographs. It is estimated that approximately 10 percent of the Olympic National Forest occurs in this classification and would be susceptible to a high risk of mass instability following tree removal. Most of these unstable areas will be identified during the field review of a timber sale. The areas would be avoided or special mitigation practices would be required in the timber sale contract. However, the risk of mass instability occurring on terrain appearing to be stable increases wherever steep topography is logged.

Mass instability due to road construction has been significantly reduced by selection of road locations in stable terrain, and through selection of road design parameters and road construction techniques suited to actual site conditions. Continued use of appropriate geotechnical investigation and design should result in continued impact reduction.

CLIMATE

THE ROLE OF CLIMATE

The climate of the Olympic Peninsula is probably the most significant component of the environment. It influences the type and amount of vegetation and, to a large extent, the diversity and abundance of other resources. It also plays a significant role in the amount and timing of the uses of resources.

CURRENT SITUATION

The climate is primarily influenced by wind direction, changes in topography relative to the wind direction, and proximity to the Pacific Ocean. These conditions produce a marine climate with heavy winter precipitation and relatively dry summers.

Wide differences in local climatic conditions occur. Annual precipitation is greatest on the windward side of the Peninsula, particularly between Mt. Olympus and Three Peaks and in the upper Clearwater drainage. To the northeast, on the leeward side, precipitation decreases under the influence of the "rain shadow" effect. The driest area is in the upper Dungeness and Gray Wolf drainages. The Quinault area receives about 134 inches of precipitation annually. The headwaters of the Quinault and Wynoochee Rivers receive in excess of 220 inches per year, and Port Angeles averages about 22 inches. These changes occur within an air line distance of less than 50 miles.

For comparison purposes, average temperature and precipitation information for Quinault Ranger Station and Quilcene Ranger Station is provided in Table III-1. Both stations are at low elevations and are at the fringe of the mountainous area. Temperature on the Forest is generally lower than recorded at these stations. Precipitation is generally higher, as much of the Forest is in the mountainous area at higher elevations.

Table III-1. Average Temperature and Precipitation

	Quinault Ranger Station		Quilcene Ranger Station	
Month	Temperature (°F)	Precipitation (inches)	Temperature (°F)	Precipitation (inches)
January	39.4	19.9	36.8	8.1
February	41.4	15.9	39.8	6.5
March	44.2	14.2	43.5	4.4
April	49.8	9.2	49.3	3.1
May	55.3	5.9	55.0	2.5
June	59.0	4.3	59.2	2.4
July	63.3	2.6	63.5	1.0
August	63.3	2.8	62.8	1.0
September	59.8	6.0	58.5	1.5
October	52.6	13.3	50.9	3.8
November	43.9	17.5	42.6	7.3
December	40.8	22.8	39.0	9.4
Annual	51.1	134.4	50.1	51.0

WINTER CONDITIONS

The heaviest precipitation occurs in the fall and winter, reaching a peak in December. This is the result of the prevailing wind direction (from the southwest), which brings in warm, moisture-laden air from the Pacific Ocean. When this air mass meets the steep mountains of the Peninsula it is uplifted, which causes it to cool and drop heavy amounts of precipitation. Periodic high-intensity storms, characterized by high winds and heavy precipitation, are common during winter. The heaviest rainfalls recorded during single storms were 12 inches in 24 hours, 23.5 inches in 48 hours, 28.6 inches in 72 hours, and 35 inches in a single four-day period. This occurred at Quinault Lake from January 21 to 24, 1935.

Most of the winter precipitation falls as rain at elevations below 2,000 feet, as rain and snow between 2,000 and 3,500 feet, and as snow above 3,500 feet. Winter snowfall ranges from 10 to 30 inches in the lower valleys to greater than 250 inches in the higher mountains. Winter snowpacks of more than 10 feet are common above 3,500 feet.

SUMMER CONDITIONS

During late spring and summer, the prevailing winds over the Peninsula are from the northwest. Occasionally, warm, dry winds blow out of the northeast. These "chinook" winds are associated with most of the historic large fires on the Olympic Peninsula. During July and August, two to three weeks may pass without significant precipitation. Heavy thunderstorms are unusual, but there are a few days each summer when thunderstorm activity occurs.

Afternoon temperatures in the warmest months average 62 degrees F. near the water to 75 degrees F. in the lower elevations of the Forest. Night-time temperatures are near 50 degrees F. In the higher elevations, afternoon temperatures range from 60 to 75 degrees F., while night readings are from 40 to 50 degrees F.

Average relative humidity ranges from 90 percent near sunrise to between 50 and 65 percent in the afternoon. During brief periods of dry, easterly winds, relative humidity may drop to between 20 and 30 percent. During the latter part of the summer and early fall, fog banks or low clouds move inland during the night, especially along the west side of the Forest. Although this usually clears by midday, it has a significant influence on vegetative growth and distribution, as well as fire risk.

Although not accurately measured, it is believed that this fog can increase annual precipitation by as much as 40 inches in the lowland areas on the western side of the Peninsula. Fog is a primary reason for the lush rain forest vegetation that exists on the west side of the Peninsula.

WATER

THE ROLE OF WATER

Approximately 2,200 miles of streams are located within the Olympic National Forest. There are 850 miles of Class I and II streams, and 1,350 miles of Class III and IV streams. Class I streams are used by anadromous fish or for municipal water sources. Class II streams are used by resident fish or for municipal/domestic water sources. Class III streams include all other perenniel streams, while Class IV streams are intermittent streams. These streams are a valuable resource on the Olympic Peninsula. High quality water is needed by anadromous and resident fish for spawning and rearing habitat. Water from numerous streams is used for municipal, domestic, industrial, fish hatchery, and agricultural water supplies. Most recreational use on the Forest occurs near streams, lakes or saltwater.

CURRENT SITUATION

WATER YIELD AND RUNOFF TIMING

Water yield (the amount of water runoff from the Forest) is a function of precipitation, and is governed by the physical characteristics of individual watersheds. Vegetative cover, landform, and soil type, as well as type, amount, and timing of precipitation, directly affect the volume and timing of runoff.

Precipitation on Olympic National Forest occurs in two zones: a wet zone (100 to 220 inches per year) on the west side of the Forest and a drier zone (35 to 140 inches per year) on the east side. Approximately 75 to 80 percent of this precipitation is released as streamflow. Above an elevation of 3,500 feet, over 50 percent of the precipitation occurs as snowfall. See the previous section on "Climate" for more information.

Approximately 6.3 million acre-feet of water occurs as runoff from Olympic National Forest annually. Streams generally show two distinctly different flow regimes: one from winter precipitation and the other from snowmelt and spring rains. The former flows are normally higher. The spring runoff peak is more prominent in those watersheds that lie in the "rain shadow" (east and northeast sides) of the Olympic Mountains. On the south and west sides of the Forest, the winter peaks tend to merge into numerous periods of high flows. Maximum monthly flows normally occur during the months of December and January. Rain-on-snow during these months frequently generates peak flows that produce major floods. Mininum flows normally occur during August and September. However, in the northeastern part of the Forest, the minimum flows tend to extend into October.

Over the past 20 years, significant flooding of Peninsula streams has occurred four times (the winters of 1974, 1975, 1979 and 1984). The Satsop and Skokomish Rivers are probably most prone to flooding off-Forest lowland areas. Other flood-prone rivers are the Elwha, Dosewallips, Quinault and Big Quilcene Rivers. The former three rivers drain almost exclusively from Olympic National Park.

WATER QUALITY

Sediment is the water quality parameter most often affected by management activities. The cumulative effect of sediment from nonpoint sources can cause reductions in water quality. Sediment from both natural and activity-related sources is highly variable through time.

A model (USDA Forest Service 1980) was developed in Forest Service Regions 1 and 4 to estimate sediment yields. This model was modified and used to predict sediment indices for all drainages (Stephens 1984). The modified procedure estimates sediment production based on amount of road use (log truck traffic), miles of existing and newly constructed roads, and acres of timber harvest. Local factors used in the model were: soil erosion hazard ratings, land slope, geology and precipitation. Local data, such as the Soil Resource Inventory Update for the Forest (Jennings et al. 1982), research in the Clearwater River drainage (Reid 1981), and other studies in the Pacific Northwest (Larson 1980), were used to generate modeling factors and calibrate the procedure. On the Forest, bedload and suspended sediment are the major water quality parameters affected by road construction and timber harvest activities.

The land base on the Olympic National Forest was subdivided into three groupings: (1) land slope classes, (2) erosion hazard classes, and (3) riparian zone. The first two classes were delineated from soils inventory data, while the third was delineated from USGS topographic maps. The land slope classes were grouped as follows: 0 to 35 percent, 35 to 65 percent, greater than 65 percent. The erosion hazard classes were grouped as follows: low, medium, and high. These three classes were based on soil movement hazards (surface erosion, debris avalanche, and slump). The riparian zone is approximately 200 feet on either side of Class I through IV streams.

The purpose of sediment indices is to show relative differences existing between management alternatives and how these relate to natural and current sediment yields in terms of affected resources and water uses. **The sediment indices are not actual amounts that can be measured, but are indices for making relative comparisons between alternatives and risk assessment.** They are not suitable for determining compliance with State and Federal water quality standards. For project level applications, sediment values would need to be developed from existing data, monitoring, site-specific conditions and proposed activities.

Table III-2 shows the sediment yield indices for major drainages of the Forest. Most streams on the west side of the Forest (Sams, Soleduck, and Calawah Rivers) have relatively high natural sediment levels (90 to 134 cubic yards per square mile per year) due to a predominance of sedimentary bedrock. These drainages are steep with high annual precipitation. They also currently have high sediment levels (140 to 266 cubic yards per square mile per year) related to management activities on the Forest Service. However, the Satsop River drainages have even higher sediment levels (305 cubic yards per square mile per year) due to steep topography, high precipitation, and intensity of past road construction and timber harvest activities. Most streams on the east side of the Forest (Duckabush, Dosewallips and Big Quilcene Rivers) have low natural sediment levels (66 to 89 cubic yards per square mile per year) and low sediment levels from Forest Service activities (26 to 90 cubic yards per square mile per year). The reason for this is that basalt is the predominant bedrock, and the intensity of Forest Service activities is low.

LEGEND

Class I Streams

Class II Streams

Point of Diversion of Municipal Water System

Figure III-6. CLASS I AND II STREAMS AND MUNICIPAL WATERSHEDS

Table III-2. Sediment Yield Indices for National Forest Land in Major Drainages (1988)

Drainage Name	ONF Lands in Drainage (sq.mi.)	Estimated Natural Sediment Yield Indices on NFS Land (Cu Yds/Mi²/yr)*	Sediment Yield Indices from Forest Service Activities (Cu Yds/Mi²/Yr)*
Calawah River	69.8	134	185
Soleduck River	76.1	90	140
East and West Twin Rivers, Deep Creek	23.3	83	185
Dungeness River	89.0	83	72
Jimmy-Come-Lately Creek	14.1	45	82
Snow Creek	8.5	45	125
Little Quilcene River	16.5	65	80
Big Quilcene River	59.2	66	90
Dosewallips River	31.9	81	58
Duckabush River	24.3	89	26
Hamma Hamma River	64.1	94	130
South Fork Skokomish River	85.9	80	152
Middle Fork Satsop River	21.6	118	305
West Fork Satsop River	30.7	118	305
Wynoochee River	59.4	85	163
Humptulips River	88.4	94	180
Salmon River	20.5	113	269
Matheny Creek	34.0	102	239
Sams River	24.3	111	266

* Cubic yards per square mile per year.

Sediment indices have been estimated for entire drainages to determine effects of management from National Forest and off-Forest lands (Table III-3). In general, off-Forest lands in the 19 drainages have lower erosion rates and gentler topography than National Forest land. Thus, National Forest land will usually have higher sediment yield indices.

Aerial photographs were used to determine the amount of timber harvesting that occurred in the previous decade on off-Forest lands. This data was used to estimate sediment indices for off-Forest ownerships in individual drainages, using adjusted values from the sediment yield model for Olympic National Forest. The total sediment from timber harvest activities in these drainages was estimated for both National Forest and non-Forest lands. Natural sediment indices for the drainages were estimated and totaled for all ownerships, including Olympic National Park.

Streams on the west and south sides of the Forest have a high potential for adverse cumulative effects from increased sediment levels. Examples are the Humptulips, Sams and South Fork Skokomish Rivers. These streams show a significant increase in sediment production above the natural level. However, no threshold limit can be cited above which unacceptable resource damage is known to occur. Drainages in the west part of the Forest have soils that are very unstable, and drainages in the south portion of the Forest have had a high level of intensive timber harvest activities. Mitigation on National Forest land may be necessary in the future in those drainages appearing to have a high potential for adverse effects. This mitigation could consist of changes in timber harvest scheduling and distribution to avoid concentrating activities in specific drainages for specific time periods.

Table III-3. Sediment Yield Indices for All Landownerships in Major Drainages (1988)

Drainage Name	Total Acres in Drainage (Mi^2)	Estimated Natural Sediment Yield Indices for Whole Drainage (Cu Yds/Mi^2/yr)	Sediment Yield Indices from Timber Harvest Activities for Whole Drainage (Cu Yds/Mi^2/Yr)*
Calawah River	133.0	155	110
Soleduck River	226.0	80	56
East and West Twin Rivers, Deep Creek	42.3	74	121
Dungeness River	197.0	78	37
Jimmy-Come-Lately Creek	17.7	48	78
Snow Creek	26.8	44	62
Little Quilcene River	35.0	70	60
Big Quilcene River	69.0	67	83
Dosewallips River	116.0	76	19
Duckabush River	71.0	79	12
Hamma Hamma River	84.6	89	105
South Fork Skokomish River	107.0	71	131
Middle Fork Satsop River	59.0	48	119
West Fork Satsop River	95.0	44	107
Wynoochee River	193.0	56	56
Humptulips River	247.0	41	68
Salmon River	32.0	85	184
Matheny Creek	37.8	101	219
Sams River	30.9	108	209

*Cubic yards per square mile per year.

The primary, direct effect of increased sediment on water quality is a reduction in fish habitat. Turbidity, which is related to suspended sediment, affects clarity of the water and is important in municipal and domestic water systems. High turbidity levels make it more difficult and costly to treat the water and easier for it to transmit waterborne diseases.

Most streams on the Forest have water temperatures near or below optimum levels for aquatic organisms. Therefore, stream temperature concerns are normally minimal. Streams on the east side of the Olympic Peninsula have steep gradients and are fast flowing, with little opportunity for solar radiation to heat the water. Streams on the west side have low gradients off-Forest in the broad, flat lands toward the Pacific Ocean. Water temperature data from the U.S. Geological Survey shows that west side stream temperatures are 12 degrees to 18 degrees F. above eastside streams. The maximum temperature on eastside streams is about 57 degrees F. with temperatures usually in the 50 to 55 degree range. Maximum temperatures on westside streams are 75 degrees F., with temperatures usually being in the 65 to 70 degree F. range. Water temperature increase could be of concern in the case of a hot summer with low stream flows on the west or east side of the Peninsula.

For the past 22 years, daily stream temperature data have been collected by the U.S. Geological Survey at the U.S. 101 Highway bridge over the Skokomish River. The maximum desirable temperature for anadromous fish habitat is 65 degrees F. Higher temperatures stress the fish and make them more susceptible to diseases. There were only seven periods of up to five days when water temperatures were over 60 degrees F. During two of these periods, temperature was above 65 degrees F. Both occurred in 1961. Stream temperature measurements taken during the summers of 1978 and 1979 in small streams in the South Fork Skokomish River drainage were normally 55 degrees F. or less. Approximately 45 percent of National Forest lands in this drainage had been clearcut as of 1983. This drainage should be one of the Forest streams most susceptible to water temperature increases. The data collected shows that water temperature increases are not a problem in the South Fork Skokomish River drainage and should not adversely affect fisheries.

The west and east sides of the Olympic Peninsula have different air temperature regimes. West side weather stations show lower summer air temperatures than the east side (approximately a 4-degree difference). This effect is due to the marine influence and higher incidence of cloud cover. Lower air temperature and solar radiation on the west side helps to reduce opportunity for increased water temperatures. Stream temperatures would probably be higher on the west side without this factor.

Bacteriological and chemical water quality of streams on the Peninsula has been very good. Low coliform counts and dissolved chemical constituents have been found in periodic water samples collected by the U.S. Geological Survey in the past 20 years. However, in the last decade, the number of cases of Giardiasis, a waterborne disease, has shown a marked increase. The disease is not life threatening, but causes intestinal discomfort up to several months unless treated with medication.

WATERSHED CONDITION CLASSIFICATION

The National Environmental Policy Act (NEPA) requires an analysis to determine if there will be significant cumulative effects from management activities in watersheds on the Forest and the downstream influence area. The "state of the art" in assessing the risk of cumulative effects on beneficial uses of water is being developed by researchers. The cumulative effects concept is based on the assumption that individual minor actions may have additive impacts when viewed from a drainage basin perspective. An important assumption is that current channel condition, sediment levels, and slope stability can be used to predict the continuation of current effects, or the likelihood of a watershed to experience effects in the future.

A watershed condition classification was made for each of the 19 major watersheds on the Olympic National Forest to use as the basis for assessing cumulative effects on water resource values. Past and present physical factors of the watersheds plus beneficial uses of water were used by an Interdisciplinary Team (IDT) (composed of a hydrologist, fisheries biologist, soil scientist, and geological engineer) to evaluate watershed condition classification of the watersheds.

The risk that management activities on the Forest will have an adverse impact on the watersheds increases as its sensitivity to change increases. Watersheds are not equal in their ability to absorb ground-disturbing activities without reductions on beneficial uses such as water quality and fisheries production. The watershed condition classification was designed to estimate the susceptibility of a watershed to disturbance and the likelihood of that disturbance resulting in an effect on beneficial uses of water in the watershed. Five factors were used to evaluate whether or not there will be significant effects from management activities in these watersheds. The five factors used were: (1) slope stability, (2) sedimentation, (3) water uses, (4) fisheries uses, and (5) public sensitivity. On-the-ground experience and professional knowledge of IDT specialists formed the basis of their assessment of the factors. High rates or amounts of any of the five parameters indicates greater watershed sensitivity. Table III-4 shows the watershed condition classifications.

1. **Slope stability.** This rating is subjective and based on relative numbers and size of slope-movement events. It estimates probability that materials from slope-movement events would produce sediment in the watersheds.

2. **Sedimentation.** Sediment yield estimates were calculated for each watershed. Sediment from natural sources and timber harvest activities were determined. Sediment yields from management

activities used past and present timber harvest, road usage, and road density as factors in the calculations.

3. **Water uses.** Factors used in this evaluation included: for use as a municipal water supply, or water for use for a fish hatchery.

4. **Fisheries uses.** Factors used for this evaluation were fish habitat quality indices, Indian use, anadromous fish use, and resident fish use.

5. **Public sensitivity.** Factors used for this evaluation were Wild and Scenic River status, off-Forest concerns, and recreational use.

Table III-4. Watershed Condition Classification Evaluation for Drainages on the Olympic National Forest

Drainage Name	Slope Stability	Sedi-mentation	Water Uses	Fisheries	Public Sensitivity	Total Score	Condition Classification 1/
Calawah River	20	8	0	17	5	50	Medium
Soleduck River	18	8	5	17	7	55	Medium
East and West Twin River, Deep Creek	17	11	0	10	4	42	Low
Dungeness River	20	4	15	15	18	72	High
Jimmy-Come-Lately Creek	9	20	0	12	8	48	Medium
Snow Creek	9	16	5	11	9	50	Medium
Little Quilcene River	12	8	10	9	8	47	Medium
Big Quilcene River	14	12	15	11	7	59	Medium
Dosewallips River	13	4	0	13	6	36	Low
Duckabush River	11	4	0	13	12	40	Low
Hamma Hamma River	16	8	0	16	6	46	Medium
Skokomish River	17	20	0	21	12	70	High
Main Fork Satsop River	18	20	0	20	8	66	High
West Fork Satsop River	18	20	0	20	8	66	High
Wynoochee River	19	16	0	19	9	63	High
Humptulips River	20	16	5	20	8	69	High
Salmon River	20	16	0	14	6	56	Medium
Matheny Creek	20	20	0	16	5	61	High
Sams River	19	16	0	18	5	58	Medium
Total Score Possible	(20)	(20)	(15)	(25)	(20)	(100)	

1/ **Watershed Condition Classification**	**Total Score**
Low Sensitivity	30-45
Medium Sensitivity	46-60
High Sensitivity	61-75

Although no known threshold exists beyond which damage to downstream uses occurs, low sediment yield is considered to indicate the best water quality. Sediment values used in this analysis are not actual amounts which can be measured, but are indices used to make relative comparisons.

Using the five factors, each of the 19 watersheds were rated. The factors for each watershed were then added to obtain an overall watershed condition classification score for each. These composite watershed sensitivity condition scores were categorized into three groups based on the overall scores. The three watershed sensitivity classes are low, medium, and high. Below are descriptions of the sensitivity classes:

1. **Low sensitivity classification.** Includes those watersheds where existing natural and geomorphic features produce stable watershed conditions within the watershed. Three of the Forest's watersheds were rated as a low condition classification.

2. **Medium sensitivity classification.** Includes those watersheds which have had management activities that resulted in some adverse impacts to water values within the watershed. Nine of the Forest's watersheds were rated as a medium condition classification.

3. **High sensitivity classification.** Includes those watersheds that have been highly impacted by management activities. The magnitude of these activities within the watershed has been significant. Existing and natural geomorphic features have, and can continue, to produce highly unstable watershed conditions within the watershed. There is a high risk of downstream effects on water quality, physical stream characteristics, and fish habitat. A watershed with a high rating would still support beneficial uses, but the amount and relative long-term stability of these uses would be lessened. Seven of the Forest's watersheds were rated as a high condition classification.

The watershed condition classification for Forest Planning purposes is not meant for, nor is it sufficient for, a cumulative effects analysis at a project level. It highlights watersheds where it is important that a cumulative effects analysis be done when there will be activities within the watershed. The analysis on the 19 Forest watersheds as displayed here is best looked upon as a method to identify watersheds which should receive intensive scrutiny at the subdrainage level during project planning. When a drainage has a condition classification rating of medium or high, there should be a site-specific analysis of cumulative effects from management activities (see Plan, Chapter IV, "Forest-wide Standards and Guidelines: Water, Soil, and Air"). In addition, it should highlight which watersheds should receive the most conservative blend of management practices and mitigation or enhancement measures. Conservative management practices could mean: (1) rescheduling management activities into less sensitive drainages, and (2) using special management practices to minimize impacts. To be of value for future management of the Forest, the analysis must be evaluated to see if the effects predicted actually occur. For proposed future monitoring of cumulative effects see Plan, Chapter V.

USES OF WATER

As displayed in Table III-5 there are nine municipal watersheds on the Olympic National Forest. To be classified as a municipal watershed, one or both of the following criteria must be met: (1) serve at least 25 individuals at least 60 days per year, and (2) provide at least 15 service connections.

Three of these watersheds, the Big Quilcene, Little Quilcene, and Wishkah Rivers, serve major Peninsula cities. The Little Quilcene is used periodically as a backup system to the Big Quilcene by Port Townsend. A letter of intent by the U.S.D.A. Forest Service establishes cooperation with the city in regard to activities within the Quilcene drainages. The Wishkah River serves Aberdeen. A Memorandum of Understanding between the U.S.D.A. Forest Service and the city establishes policies for protecting water quality of the water supply system.

Direction for management of municipal watersheds is provided in the Standards and Guidelines in Chapter IV of the Plan. The primary goal is to provide high quality water by minimizing soil erosion and introduction of chemicals or bacteria.

Management activities in these watersheds will have some activity restrictions (such as overnight camping prohibited in the Wishkah Watershed and herbicide and pesticide use prohibited in these watersheds except to control roadside vegetation).

Water quality data from the U.S. Geological Survey for the Big Quilcene River show it has excellent chemical quality. Physical water quality has also been excellent. Turbidity levels are normally below 1 Nephelometric Turbidity Unit (NTU), and occasionally above 10 NTU during high runoff periods. Coliform counts have been very low. Table III-6 shows maximum, mean, and minimum values for important constituents.

Table III-5. Municipal Surface Water Systems (1988)

Water System Name	Water Source	Population Served	Average Daily Use (gal/day)	NF Acreage in Drainage (acres)	Total Acres in Drainage
City of Sequim	Dungeness River	3,400	750,000	56,960	115,840
City of Port Townsend	Little Quilcene River	7,500	1,000,000	6,790	6,790
City of Port Townsend	Big Quilcene River	7,500	1,000,000	30,571	30,571
Falls Creek - Lake Sutherland Home Sites	Falls Creek	75	4,000	642	642
Black Diamond Water System	South Branch Little River	225	58,500	221	6,941
City of Aberdeen	Wishkah River	20,000	5,500,000	1,420	7,300
Meadowland Water Service	Hathaway Creek	95	23,750	374	374
Neilton Water Cooperative	McCall Creek	120	30,000	315	315
Iskra Bros. Logging Co. Water System	Twin Culvert	35	8,750	194	194

Other municipal watersheds should have similar water quality. The City of Sequim obtains its municipal water from infiltration galleries adjacent to the Dungeness River. Port Townsend and Aberdeen water systems have reservoirs that retain water for at least a week or two before it is distributed to users. These three systems and most of the others chlorinate their water. No waterborne diseases are known to have occurred in any of the nine municipal water systems. Timber harvest activities have occurred in all municipal watersheds in the past and are planned for the future. The City of Aberdeen municipal watershed is gated to limit public access.

Table III-6. Water Quality Data for Big Quilcene River

	Hardness (mg/l)	Dissolved Solids (mg/l)	Oxygen (mg/l)	Dissolved Phosphate (mg/l)	Nitrate (mg/l)	Water Temp. (O° C)	Turbidity (NTU)	Coliform (MPN) *
Maximum	52	94	13.5	.32	1.0	15.6	5	430
Mean	45	62	11.4	.03	.3	8.9	>1	42
Minimum	36	43	9.8	.00	0.0	3.6	0	0

*MPN - Most Probable Number

There are three diversions for municipal water supplies on the Forest. They are listed as follows, with the amount of the water right in parentheses: (1) Little Quilcene River (9.56 cfs); (2) Big Quilcene River (30 cfs);

and (3) South Branch Little River (.25 cfs). There is one, small hydropower diversion (up to 30 cfs) located on Rocky Brook Creek with 380 feet of pipeline on the Forest.

There are approximately 113 appropriated Washington State Surface Water Rights for on and off-Forest water withdrawals. Many of these water rights are not being utilized. There are 30 special use permits for surface water intakes on National Forest lands. Most of these uses are for individual homes. Off-Forest uses include fish propagation, irrigation, and other municipal or domestic uses.

There are two reservoirs on the Forest. The Wynoochee Reservoir (1,170 acres) is located wholly within the Forest except for the dam and adjacent area, which are administered by the Corps of Engineers. The purpose of the reservoir is for flood control and industrial water supply for Aberdeen. The Federal Energy Regulatory Commission has licensed the dam to be retrofitted as a hydroelectric power plant. The Lake Cushman Reservoir (4,200 acres) has approximately 20 acres of National Forest land on the upper end of the Lake that become inundated when the reservoir is full. The project was developed by Tacoma City Light for hydroelectric power generators in the 1930's.

GROUND WATER

The distribution and characteristics of ground water and subsurface aquifers are complex. An aquifer is any geologic formation that holds water or permits subsurface water to pass through it. Research findings indicate that timber harvest activities generally will be expected to have a negligible, unmeasurable effect on downstream aquifers. This assumes that management practices are conducted in a manner which reasonably maintains water infiltration characteristics of Forest soils. Best Management Practices (see Appendix J, FEIS) will ensure adequate infiltration characteristics are maintained.

HISTORIC TRENDS

Extensive timber harvest activities began on the Forest in the early 1950's. Initial road construction and maintenance practices consisted of sidecasting waste material. This resulted in extensive mass wasting of unstable road-fill slopes into stream courses. In the early 1970's, end hauling of all waste material to stable areas was required. This practice, along with reduction of miles of newly constructed roads and stabilization of existing roads, has resulted in less sediment entering stream courses.

Improved timber harvesting and slash burning practices in the last decade have resulted in less soil erosion and sedimentation of stream courses. More sophisticated logging systems, such as skyline and helicopter yarding, have reduced soil disturbance and the mileage of new road construction. Within the last 5 years, the Forest has started an active program of closing and/or rehabilitating existing roads which are no longer needed. In the past decade, the Forest has burned slash in the late spring or early summer, when soil moistures are high.

The Olympic National Forest has inventoried a number of watershed projects needed to protect soil and water resource values. These projects consist of erosion control, mass movement stabilization, stream channel stabilization, and log jam removal. Need for such projects has originated from both past management activity and natural events. The northwest portion of the Forest is an area in need of restoration projects due to naturally occurring unstable soils (see Table III-7).

Table III-7. Watershed Improvement Needs

Type of Treatment	Number of Projects	Acres	Costs ($)
Seed and fertilizer	14	101	$60,000
Mass movement stabilization other than roads (material removal and rip-rap)	8	10	55,000
Gully erosion	1	1	4,000
Channel stabilization (rip-rap)	13	30	71,000
Road stabilization (drainage, cut and fill slope stabilization, and revegetation)	32	71	288,000
Channel debris removal	46	16	117,000
Totals	114	229	$595,000

FUTURE TRENDS

Comparison of average annual water usage and average discharge shows there is currently a large excess supply of water from most Forest drainages. The Dungeness and Big Quilcene drainages, however, are nearly overappropriated for off-Forest uses. Water supply demands will continue to increase in these streams for municipal, industrial and agricultural uses. In the future, the cities of Port Townsend or Bremerton may try to utilize the Dosewallips River as a municipal water source. Small water yield increases will have insignificant effect on increasing water quantities. Potential hydroelectric projects could result in low flow conflicts affecting fish habitat requirements.

PLANS OF OTHERS

Water quality standards for waters of the State of Washington are met through application of Best Management Practices (BMPs). The key beneficial uses BMPs are designed to protect are fish habitat and water for domestic use. A Best Management Practice is a practice, or combination of practices, that prevents or reduces the amount of pollution generated by nonpoint sources to a level compatible with water quality goals. An assessment is made of both the effectiveness and the practicality of BMPs, including technological, economic and institutional considerations. This determination is made by the State of Washington or a designated area-wide planning agency after problem assessment, examination of alternative practices, and appropriate public participation (Federal Register, Volume 40, No. 230, November 28, 1975).

A process was established to compare the forest management practices of the Forest Service in Region 6 with the Best Management Practices of the State of Washington (Section 208 PL 95-217). BMPs in the Forest Service are the protection requirements built into the process for implementing any specific land management activity. These protection requirements are found in Forest Service Manual direction, contract provisions, environmental assessments, and Forest Plan Standards and Guidelines and management strategies.

The process is, and has been, used to implement the State Water Quality Plan on lands administered by the Forest Service (Implementation Plan for Water Quality Planning on National Forest Lands in the Pacific Northwest, December 1978). This process is described in a Memorandum of Understanding between the Washington State Department of Ecology and Forest Service (July 1979), and in "Attachment A" of the State Water Quality Plan. The Memorandum of Understanding and Water Quality Plan provide the basis for an interagency agreement whereby the Governor of the State of Washington designates the Forest Service as the implementing agency for nonpoint source control on lands under its jurisdiction.

The Agreement provides for annual meetings between the Forest Service in Region 6 and the Washington State Department of Ecology to evaluate the program and progress being made. Available monitoring information is reviewed, revisions or additions to Best Management Practices are addressed, and reports are written and submitted by the State to the Environmental Protection Agency (EPA).

SOILS

THE ROLE OF SOILS

To mention soils brings forth diverse concepts to different people, such as a possible source of construction material to the engineer and a medium for plant growth to the farmer. We are concerned with naturally occurring soils in a forest environment, unless specified otherwise.

Soils as a natural resource fill a unique role. With rare exception, soils are not used directly, only indirectly. Our basic concept is to treat soil as a capital item for the production of goods and services useful to mankind. An additional concept is that a soil resource should be used, but not abused. To degrade soil results in a future reduction in the soil's capital for production.

CURRENT SITUATION

Soils on the Olympic National Forest have formed from a variety of geologic materials: marine basalt, hard sandstone and conglomerate, interbedded sandstone, siltstone and mudstone, metamorphosed sediments and volcanics, continental glacial drift, Olympic glacial drift, and alluvium. There is also an overall surficial influence of volcanic ash and loess from nearby strato-volcanos. In general, soils developed from marine basalt predominate in the south and west portions of the Forest, while sedimentary-derived soils dominate to the north and east. Metamorphosed sediments and volcanics are generally found at higher elevations toward the interior of the Forest. Soils derived from continental glacial drift are located at lower elevations along the northern and eastern flanks. The Olympic source glacial drift soils are found throughout, but the major soil areas are on the west side at lower elevations. Alluvial soils are restricted to small areas along major stream courses. The addition of ash and loess to the soil surface is considered a minor factor in soil formation.

The Olympic Soil Resource Management Survey Report (SRI) (Snyder 1969), and the Olympic Soil Resource Inventory Update Soil Survey (Jennings 1982) are recommended references for detailed soil descriptions. There are, however, a few important generalizations that can be made about the soils resource. The apparent field texture of surface soils typically varies within the range of gravelly or very gravelly loams, silt loams, or silty clay loams. These soils generally have low bulk densities and often have a "smeary" feel. These properties are indicative of the presence of amorphous (structureless) clays. The exception to this trend would be the soils developing from continental glacial drift, which typically are gravelly or very gravelly sandy loams.

Upland soils are well drained, with low to moderate water retention and very high water infiltration rates. They have thin surface soils. Subsoils strongly resemble original bedrock materials. Soil depth and gravel contents vary widely, relating strongly to past soil erosional processes. Glacial and alluvial bottomland soils are generally more highly developed. Surface soils are thicker. Subsoils are typically deep with moderate to high water holding capacities. Surface infiltration rates remain very high. Soils are generally moderately well to well drained, but significant areas of more restrictive drainage classes are present.

Soil temperatures are mesic (warm) below approximately 1,500 feet elevation, progressing through frigid (cool) and cryic (cold) temperature classes at a more rapid rate on the west side than the east side of the Forest. Temperature and snowpack depth interact to limit the elevational extent of commercial forest land at approximately 3,500 feet (west side) and 4,500 feet (east side). Soils remain moist except for a one- to four-month period during the summer. Soils with a xeric soil moisture regime (at least a 45-day summer dry period) are restricted to the dry, northeastern corner of the Forest.

Sensitive soils are scattered throughout the Forest. These are generally correlated with: (1) steep slopes, (2) incised stream channels, (3) unstable bedrock, and (4) water seepage areas. Soils erode primarily via mass movement (landslide) mechanisms.

HISTORIC TRENDS

Soils change with time. They may be improved or reduced in quality (degraded) under both natural and managed conditions. Natural soils in stable locations will be improved directly by the weathering process and by surface soil enrichment from organic matter additions. These naturally favorable soils are the Forest's most productive sites. In some instances, these soils have been significantly degraded by past wildfires and management practices.

In some areas, natural soils also have been in a degradation process. These soil areas typically have high mass movement processes. Also, the erosional activity is usually sporadically accelerated by unfavorable events such as wildfires and severe winter storms. The direction of soil change over time, however, is negative. The end results are shallower, more gravelly soils or exposed bedrock.

Within the past 50 years, Forest soils have been exposed to management activity. Historically, initial entries into new forest areas have resulted in significant soil degradation. Soil degradation has resulted in accelerated mass movement activity due to road access through unstable areas, and soil compaction on high site land from uncontrolled tractor yarding. A limited amount of this type of degradation has occurred on National Forest lands.

FUTURE TRENDS

What has occurred in the past on this Forest, when combined with what has occurred in the long term elsewhere, can help to project what may occur in the future. Long-term trends from two sources are useful: (1) trends from forest management in Europe, and (2) trends from the related field of general agriculture.

Prudent forest land management strategies can be classed as extensive and intensive. Following extensive soil management strategies, the basic intent is to conserve the soil resource by avoiding soil degradation. Forest products utilization is a secondary consideration. Under intensive soil management strategies, emphasis is placed on maximizing forest yields and the economic return on investments. Therefore, positive measures can be undertaken to enhance soil productivity. In Europe, extensive and intensive management strategies are well developed. This separation has generally not been made in forest management in this country. In the future, soil management strategies will be better defined. Forest managers will design their own extensive and intensive strategies, following general principles developed primarily from European forest land management and U.S. agricultural practices.

Within intensive soil management areas, measures will be undertaken to enhance forest productivity, but within an economic setting. Current agricultural practices will be adapted to forestry when economic returns justify them. Tillage with fertilizer and organic treatments will eventually occur. Irrigation, to ensure tree establishment, will be another future practice. Many of the concepts and practices that will be applied in the future are currently available.

VEGETATION

THE ROLE OF VEGETATION

Vegetation includes all forms of plant life, from the smallest moss to the largest tree. On the Olympic National Forest, it provides habitat for 61 species of mammals, 226 species of birds, 7 species of reptiles and 15 species of amphibians. Vegetation provides protection for over 2,200 miles of stream and shoreline, enhancing water quality, fish habitat and 10 municipal watersheds. It provides a recreation setting for over 1.2 million recreation visitor days, as well as a scenic backdrop for the urban areas of Puget Sound. Vegetation also currently supports a timber harvest of over 293 million board feet per year. Compared to the other 18 National Forests in Oregon and Washington, the Olympic ranks sixth in total timber harvest. Considering both timber and recreation, the Forest provides the basis for about 6,000 jobs on the Olympic Peninsula. This is about 12 percent of the Peninsula's total work force.

CURRENT SITUATION

The vegetation of the Olympic Peninsula is strongly influenced by a maritime climate, as it is surrounded by large bodies of saltwater to the west, north and east. Temperatures are mild and drought is usually not severe. Because of the prevailing storm-track winds from the southwest, Forest lands receive in excess of 200 inches of precipitation on the windward side, and as little as 30 inches in the "rain shadow" area to the northeast. As a result, the Olympic Peninsula represents one of the most floristically rich and vegetationally diverse areas in North America. Over 1,300 species and varieties of plants are known. Of these, 271 are introduced, 12 are found only in this area (endemics), and 44 are rare enough to be potentially threatened, either by man's activities or the forces of nature. Most of these plant species occur somewhere on the Olympic National Forest. Timber productivity is among the highest in the world. The dominant climax tree species are western hemlock and silver fir. The dominant seral tree species and the most important commercial species at lower elevations is Douglas-fir. The upper elevational limit of forests (timberline) occurs at about 5,300 feet in the wetter climatic areas to over 6,200 feet in the rain shadow of the Olympic Mountains.

VEGETATION ZONES

Six vegetation zones are recognized which represent forested types: Western Hemlock, Sitka Spruce, Douglas-fir, Silver Fir, Mountain Hemlock and the Subalpine Fir Zones. The Subalpine and Alpine zones occur at the upper limit of treeline and include non-forest or Olympic National Park areas. Figure III-7 shows the generalized distribution pattern of the major vegetation zones on the Olympic National Forest. (See Henderson et al. 1989, "Forested Plant Associations of the Olympic National Forest," for a more complete discussion of vegetation zones and plant associations on the Olympic National Forest.)

1. **The Western Hemlock Zone** occurs around the Peninsula from very wet to moderately dry habitats. It usually extends up in elevation to where the Silver Fir Zone begins, unless the precipitation is very low as in rainshadow areas, where it is often replaced by the Subalpine Fir Zone. In the wetter parts of the Peninsula, it may extend up to only about 2,000 feet, but in drier areas it may go to about 4,000 feet. Forest fires have been common in the Western Hemlock Zone, with large fires occurring at intervals of about 200 years for most places. Stands throughout most of the Western Hemlock Zone are dominated by Douglas-fir. In the wetter parts of the zone western hemlock may be dominant, even in young stands. In very old stands the composition shifts to dominance by western hemlock and western redcedar. Common shrubs include salal, vine maple, Oregongrape, red huckleberry,

Alaska huckleberry, salmonberry and rhododendron. Herbs include swordfern, deerfern, oxalis, beargrass, twinflower, prince's pine, evergreen violet, vanillaleaf, trillium and foamflower.

2. **The Sitka Spruce Zone** is limited to the area of strong maritime influence along the western side of the Peninsula. It generally occurs where precipitation exceeds 100 inches and there is a summer fog effect. It also appears to be limited above 600 feet elevation. It is characterized by such species as Sitka spruce, western hemlock, western redcedar, salmonberry, salal, vine maple, red huckleberry and Alaska huckleberry. Herbs include oxalis, swordfern, ladyfern, deerfern and foamflower. Timber productivity is very high.

3. **The Silver Fir Zone** is also very common on the Peninsula, occurring in all but the driest climatic areas. It is generally the mid- to upper-slope forest, occurring above the Western Hemlock Zone and below the Mountain Hemlock Zone. The dominant trees are silver fir and western hemlock. Douglas-fir can occur as relicts from earlier climatic periods on many sites in this zone, or it may occur as a component of young-growth stands in drier sites or at lower elevations in the Silver Fir Zone. Western redcedar, Alaska yellowcedar, mountain hemlock and Pacific yew can also occur. Common shrubs include Alaska huckleberry, red huckleberry, salmonberry, fool's huckleberry, salal and Oregongrape. Herbs include queen's cup, bunchberry, rosy twisted-stalk, vanillaleaf, false lily-of-the-valley, deerfern, swordfern, five-leaved bramble, foamflower and trillium.

4. **The Mountain Hemlock Zone** occurs at upper elevations in all but the driest parts of the Olympic Peninsula, where it is replaced by the Subalpine Fir Zone. It occurs above the Silver Fir Zone and grades into subalpine parkland at upper elevations. It is a cold, snowy zone where winter snowpacks usually exceed 10 feet. It is dominated by silver fir and mountain hemlock, and sometimes Alaska yellowcedar. Common shrubs include Alaska huckleberry, oval-leaf huckleberry, big huckleberry, white rhododendron, mountain-ash, fool's huckleberry and red heather. Herbs include five-leaved bramble, trailing bramble, avalanche lily, deerfern, queen's cup, beargrass and sidebells pyrola.

5. **The Douglas-fir Zone** is limited in distribution and occurs sporadically on dry microsites, primarily in the northeastern Olympics, and is most common in the Dungeness River drainage. Douglas-fir is the dominant tree, while grand fir, lodgepole pine, Rocky Mountain juniper, madrone and western hemlock can occur in small amounts. Common shrubs include kinnikinnick, Oregongrape, serviceberry, oceanspray, baldhip rose, creeping snowberry and salal. Herbs can include western fescue, vanillaleaf, white hawkweed, prince's pine, Scouler's harebell, bigleaf sandwort and starflower.

6. **The Subalpine Zone** occurs in a mosaic with the Mountain Hemlock and Subalpine Fir Zones at the higher elevations, generally above 4,500 feet and up to about 6,000 feet. Trees occur as sporadic individuals or clumps, or at the transition from subalpine to alpine, as nearly prostrate shrubs (krummholz). Meadows provide many of the scenic vistas and recreational opportunities at the high elevations. Common shrubs include red and white heather, common juniper, and mountain huckleberry. Many conspicuous and showy flowering herbs occur here. They include daisy, arnica, lupine, monkey flower, valerian, avalanche and glacier lily, mountain bistort, phlox, Indian paintbrush, buttercups, cinquefoil, sedges and grasses.

The Subalpine Fir Zone occurs in the drier, northeastern part of the Olympic Peninsula, at elevations generally above 4,000 feet. Snow accumulations are less than 10 feet. Dominant trees are subalpine fir and/or lodgepole pine. Shrubs include big huckleberry, white rhododendron, common juniper and pachistima. Herbs include subalpine lupine, Sitka valerian, sidebells pyrola, trailing bramble, Martindale's lomatium and white hawkweed.

The Alpine Zone occurs rarely and sporadically on the highest peaks, generally above 6,000 feet. Well-developed alpine communities occur on peaks and ridgetops that have escaped glaciation for thousands of years. Often they occur on exposed areas with a shallow, windswept snowpack that melts off early in the summer. Soils typically freeze in the winter, and freeze and thaw throughout much of the year. This is the most rigorous environment on the Forest. Plants (and animals) that survive here have special adaptations for coping with the harsh and unforgiving environment. Many of the Olympic's rarest plants occur in this zone. "Trees" may occur as dwarf or stunted forms of subalpine fir, whitebark pine, mountain hemlock, lodgepole pine, or Alaska yellowcedar. Shrubs include shrubby cinquefoil, alpine willow, red and white heather, and spreading phlox. Herbs include many endemic species such as Piper's harebell, Olympic mountain daisy, Flett's violet, Webster's senecio, mountain wallflower, Olympic paintbrush, Olympic rockcress, and wandering daisy, plus many other plants such as white pussy-toes, eriogonum, penstemon, Tolmie saxifrage, many mustards, sedges, grasses, mosses and lichens.

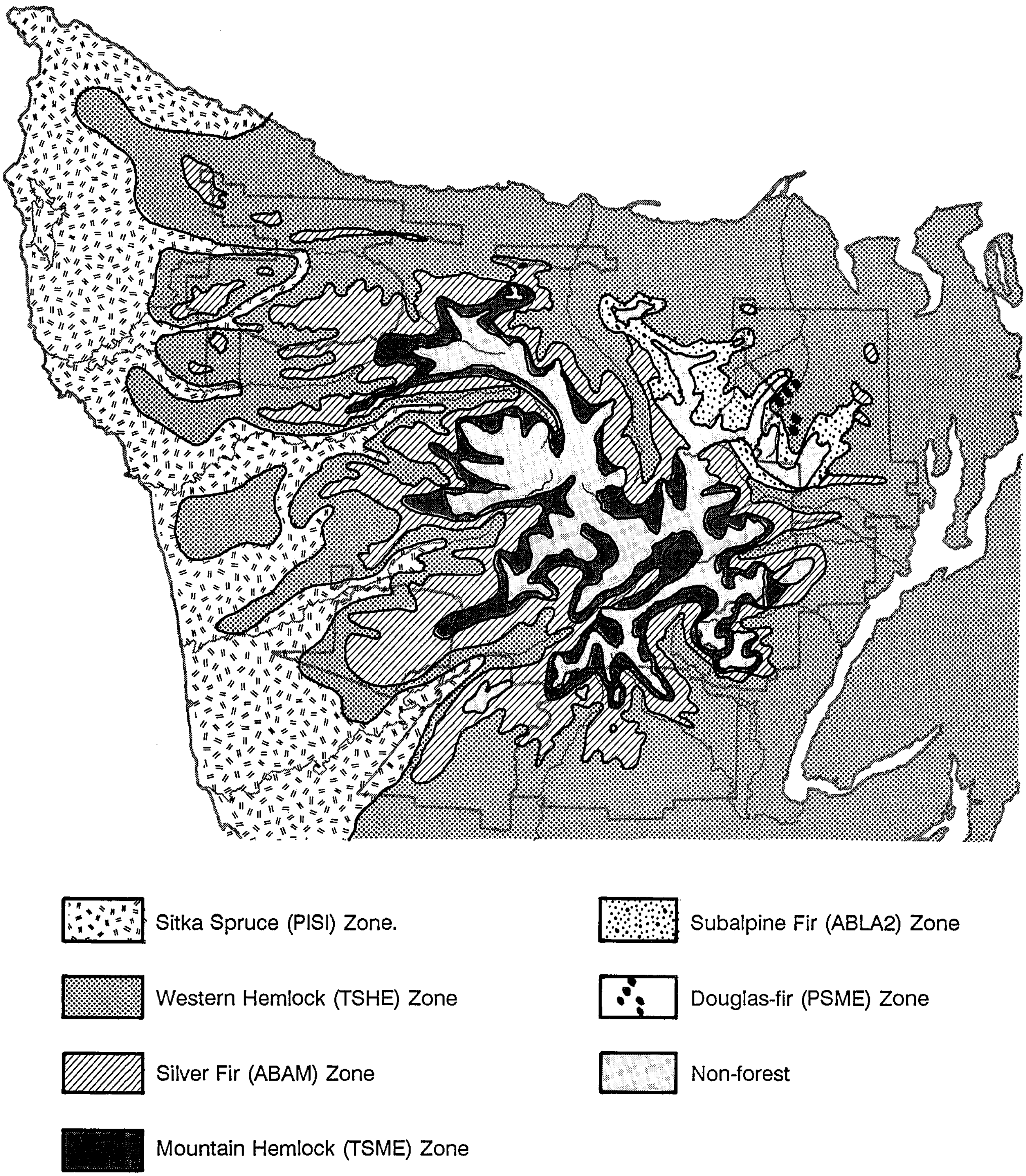


Figure III-7. MAJOR VEGETATION ZONES

ENDANGERED, THREATENED AND SENSITIVE PLANT SPECIES

According to the U.S. Fish and Wildlife Service (Federal Register Notice of Review 1985), no plants occurring on the Olympic National Forest are currently Federally listed as threatened or endangered. There are, however, two species recommended for endangered or threatened status: *Arenaria paludicola* (swamp sandwort), which the State of Washington believes to be extinct or extirpated, and *Astragalus cottonii* (cotton's milk-vetch).

There are 45 State-listed sensitive vascular plant species known or suspected to occur on the Olympic National Forest. Of these 45 taxa, 23 are documented as occurring on the Forest, and 22 taxa are suspected to occur, as they occur in areas adjacent to the Forest, or in habitats that may be represented on the Forest (Table III-8). Table III-8 is based on the current Region 6 Sensitive Plant List (USDA Forest Service 1989, Washington Natural Heritage Program Data Base 1989, Area Ecology Data Base, and information from Nelsa Buckingham, Botanist, Port Angeles, WA). This list is subject to constant revision. For the current status of any species on this list, consult the current Region 6 Sensitive Plant List (USDA 1989) or Washington Natural Heritage Program List (1990). Although these species do not have the protection of the Endangered Species Act of 1973 (December 28, 1973), Forest Service Policy requires that they be managed to prevent the need for placing them on the Federal List.

Table III-8. Sensitive Plants Documented or Suspected to Occur on the Olympic National Forest

	Occurrence	
Plant Taxa	Documented	Suspected
Arenaria paludicola		x
Aster sibiricus var. meritus	x	
Astragalus cottonii		x
Astragalus microcystis	x	
Botrychium lanceolatum	x	
Botrychium pinnatum	x	
Carex anthoxanthea	x	
Carex circinata	x	
Carex interrupta	x	
Carex obtusata	x	
Carex pauciflora	x	
Carex pluriflora		x
Carex saxatilis var. major		x
Carex stylosa		x
Chrysolepis chrysophylla	x	
Cimicifuga elata		x
Claytonia lanceolata var. pacifica	x	
Coptis asplenifolia		x
Draba lanceolata	x	
Draba longipes	x	
Epipactis gigantea		x
Erigeron aliceae	x	
Erigeron peregrinus ssp. peregrinus var. thompsonii		x
Erythronium revolutum	x	
Galium kamtschaticum	x	
Gentiana douglasiana		x
Lobelia dortmanna		x
Microseris borealis		x
Montia diffusa		x
Ophioglossum vulgatum		x
Orobanche pinorum		x
Oxytropis viscida		x
Parnassia palustris var. neogaea	x	
Pellaea breweri	x	
Plantago macrocarpa		x
Pleuricospora fimbriolata	x	
Poa grayana	x	
Poa laxiflora		x
Polemonium carneum		x
Ranunculus cooleyae	x	
Sanguisorba menziesii		x
Saxifraga debilis	x	
Synthyris pinnatifida var. lanuginosa	x	
Utricularia intermedia		x
Viola renifolia		x

UNUSUAL, RARE, OR SENSITIVE PLANT COMMUNITIES

The Olympic National Forest has a diversity of unusual plant communities. The existence of these unusual and in some cases, unique communities, is a result of various biotic and abiotic factors. Glacial and climatic history have played an important role in the evolution of the Olympic flora. As the alpine and continental glaciers advanced, the Peninsula was isolated from other areas. Glacial refugia existed in localized areas where plant species and communities were able to survive. This isolation enabled plant taxa to evolve and become distinct genetically and geographically from closely related species now known only from other areas. Various climatic, geologic and soil factors also interplay to create specialized habitats for unusual plant communities.

In this planning process, various communities were identified as unique or unusual in terms of presence and diversity of plant species, plant community composition, populations of endemic plants, sensitive species, and disjunct populations of species that are common east of the Cascades or more common to the south. We also identified areas that were unique and important because of their age. These sites represent the end point in a long period of development without disturbance, and are some of the oldest communities known on the Forest. The areas considered in this FEIS are:

Buckhorn Mountain

The Buckhorn Mountain area (approximately 3,000 acres) in the northeastern Olympics, a floristically rich area of high botanical importance, represents some of the most well-developed alpine communities in western Washington. It is likely this area was a botanical refugium during previous glacial periods. These communities contain a diverse and unique assemblage of plants including many Olympic Mountain endemics, mosses and lichens. Eight sensitive plant taxa occur here, as well as 13 monitor taxa, 7 endemics, and 12 disjunct taxa. For many of these species, the nearest location is in eastern Washington. A newly described saxifrage also occurs here, which is a local endemic to the northeastern Olympics, with an outlying population on Vancouver Island. This area has the potential to fill two cell needs as defined in Research Natural Area Needs in the Pacific Northwest (Dyrness et al. 1975): "Subalpine parkland mosaic with subalpine fir and grass-forb dominance, eastern Olympic Mountains," and "Alpine community mosaic, including krummholz, northeastern Olympic Mountains."

Wet Weather Creek

Wet Weather Creek, an area of approximately 1,100 acres, represents typical vegetation of the northeastern Olympics. Western Hemlock/Rhododendron-Salal communities occur in lower Wet Weather Creek, including some doghair stands, and rocky balds. At higher elevations Subalpine Fir/Common Juniper and Subalpine Fir/White Rhododendron communities occur which are dominated by lodgepole pine. Subalpine fir krummholz, and subalpine communities occur along the ridgetops. The area would fill two cell needs as identified in Research Natural Area Needs in the Pacific Northwest (Dyrness et al. 1975): "Typical Douglas-fir/Western Hemlock forest on slopes, east side of peninsula," and "Subalpine fir forest in northeastern portion of Olympic Peninsula."

Pat's Prairie

Pat's Prairie, a cold pocket wetland, is located in the northern part of the Quilcene District. This area was overrun by a continental glacier of the Juan de Fuca lobe, creating a shallow lake basin which subsequently filled in. It has a unique assemblage of plants, and a diversity of communities, including wet meadow, bog and forest communities. Species include Douglas spiraea, sphagnum, several sedge species, bluejoint reedgrass, labrador tea, elephant's head, northern daisy, and northern starflower. The adjacent forest stand contains a possible hybrid swarm of Engelmann and Sitka spruce. This is a fairly young stand, with some evidence of charcoal. The bog and area surrounding it, include approximately 400 acres, with twelve coniferous and nine deciduous tree species, and over 30 species of shrubs.

Cranberry Lake

Cranberry Lake is a wetland area of approximately 60 acres. This lake is in transition to a bog habitat, with open water, extensive sphagnum mats and bog plants, aquatic and semi-aquatic vegetation along the lake margin, and adjacent stands of shrubs and stunted trees. This area is also habitat for the only known Olympic Peninsula population of a sensitive species.

Three O'Clock Ridge

This area of approximately 350 acres lies in the extreme rain shadow of the Olympic Mountains, where Douglas-fir is the climax tree species on dry, south-facing slopes. The Douglas-fir Zone is very limited in its distribution on the Olympic National Forest, with the majority of it occurring in the Dungeness drainage. Rocky Mountain juniper occurs sporadically in this area, most likely representing the most western occurrence of this species in Washington. This area has a diverse assemblage of plant species, many of which are restricted on the Forest to the northeastern Olympics. Various herbaceus species that occur here have affinities with prairie habitats of the Puget lowland, or steppe habitats east of the Cascades.

Tyler Peak

This area of approximately 300 acres lies in the extreme rain shadow of the Olympic Mountains, where Douglas-fir is the climax tree species on dry, south-facing slopes. The Douglas-fir Zone is very limited in its distribution on the Olympic National Forest, with the majority of it occurring in the Dungeness drainage. Rocky Mountain juniper occurs sporadically in this area, most likely representing the most western occurrence of this species in Washington. This area has a diverse assemblage of plant species, many of which are restricted on the Forest to the northeastern Olympics. This site complements the Three O'clock Ridge Area, with similar vegetation and habitats.

Three Peaks, Old Alaska Yellowcedar

This area on the Hood Canal District occupies approximately 800 acres of higher elevation, montane forest and parkland habitats, with scattered wetland communities. Alaska yellowcedar, mountain hemlock and silver fir dominate the forest communities, with Alaska huckleberry, white rhododendron and avalanche lily as common understory species. This area is of particular importance because of the occurrence of Alaska yellowcedar trees believed to be some of the oldest on the Forest. These forest stands have developed for over 1,000 years without apparent disturbance, and have important biological, scientific and educational values. This area also provides habitat for a known population of a sensitive species.

Matheny Prairie, Old Western Redcedar Grove

The Matheny Prairie stand is very old and patchy; it appears to be in or near the climax stage of succession. This stand has likely existed for over 1,000 years without disturbance, and is of important biological, scientific and educational value. There are scattered western redcedar, deerfern, avalanche lily and salal, and a small wetland community. This area also supports populations of two sensitive species. The area occupies about 100 acres on the Quinault District.

Matheny Ridge, Old Alaska Yellowcedar

This area on the Quinault District occupies approximately 140 acres of higher elevation, montane forest dominated by Alaska yellowcedar, mountain hemlock, silver fir, with Pacific yew Alaska huckleberry and avalanche lily. There are several scattered, small wetland communities. This area is of particular importance because of the occurrence of Alaska yellowcedar trees believed to be some of the oldest on the Forest. These forest stands have developed for over 1,000 years without disturbance, and have important biological, scientific and educational values.

North Fork Matheny Ponds, Old Alaska Yellowcedar

This proposed botanical area on the Quinault District occupies approximately 75 acres of higher elevation montane forest communities, dominated by Alaska yellowcedar and mountain hemlock with occasional silver fir, western hemlock and western redcedar. Common understory species include Alaska huckleberry, avalanche lily, beargrass and deerfern. Wetland communities occur in seeps and around natural ponds. This area provides habitat for elk, with evidence of their wallows and browsing. It is of particular importance because of the occurrence of Alaska yellowcedar trees believed to be some of the oldest on the Forest. These forest stands have developed for over 1,000 years without disturbance and have important biological, scientific and educational values.

Bill's Bog

This 49-acre area is located on the Quinault District. This mid-elevation cedar "swamp" is a unique area, both for its age and the extraordinary diversity and abundance of fungi, as well as providing habitat for a sensitive species. This stand is very old, and possibly represents a climax forest, as it has existed for hundreds of years without disturbance. The stand is patchy with scattered wet pockets and seeps. Western redcedar and western hemlock are the dominant trees, with occasional silver fir and Pacific yew, and a diverse assemblage of understory species and ground mosses. Bill's Bog has been used for recreation and scientific purposes for over 25 years and represents a valuable resource.

Pine Mountain, Old Alaska Yellowcedar

This area occupies approximately 420 acres in the vicinity of Pine Mountain on the Soleduck Ranger District. Montane forest communities are dominated by Alaska yellowcedar, mountain hemlock and silver fir, with occasional western redcedar and scattered wet pockets. This stand is of particular importance because of the abundance of large, old Alaska yellowcedar, including some of the oldest known trees on the Forest. These forest stands have developed for over 1,000 years without disturbance and have important biological, scientific and educational values.

South Fork Calawah River

This area of more than 100 acres on the Soleduck District represents a "rain forest" habitat not usually found within the Forest. This riparian corridor along the South Fork Calawah River and adjacent forest communities are dominated by deciduous trees, generally bigleaf maple, with some scattered, large Sitka spruce. Epiphytic mosses and ferns are abundant.

RESEARCH NATURAL AREAS

Research Natural Areas (RNAs) are part of a Federal system of such tracts established for non-manipulative research and educational purposes. Each RNA is a site where some features are preserved for scientific purposes and natural processes are allowed to dominate. Their main purposes are to provide: (1) baseline areas against which effects of human activities can be measured; (2) sites for study of natural processes in undisturbed ecosystems; and (3) gene pool preserves for all types of organisms, especially those which are classified as rare and endangered types.

Prior to establishment, a comprehensive formal report is made. For RNAs proposed on National Forest System lands, the report is submitted to the Chief of the Forest Service for approval.

Steps in Establishment of RNAs

1. R-6 Research Natural Area Committee working in conjunction with the Washington Natural Heritage Plan (Department of Natural Resources, 1989) identifies the need for a site representing a specific natural ecosystem.

2. This committee then works with the area ecologist and Ranger District personnel to identify several potential representative sites.

3. The committee visits and evaluates the sites and narrows the list down to the most representative site.

4. This site is then recommended through the Forest Plan for establishment as an RNA.

5. If the area is allocated as a proposed RNA by the alternative in the Forest Plan which is implemented, then an establishment report is developed. In the past, Ranger District and Pacific Northwest Forest and Range Experiment Station personnel have worked together in the development of this report.

6. The approval procedure for an RNA Establishment Report is as follows:

   - District Ranger - Review and Recommend
   - Forest Supervisor - Review and Recommend
   - Pacific Northwest Station Director - Review and Recommend
   - Regional Forester - Review and Recommend
   - Director of Division of Recreation - Review and Recommend
   - Deputy Chief of Research - Review and Recommend
   - Chief, U.S. Forest Service - Approve

7. Upon approval by the Chief, the area is designated as a Research Natural Area and will be managed accordingly.

Existing Quinault Research Natural Area

The Quinault RNA was established in 1932 and occupies 1,468 acres. This RNA fills four cell needs as identified in "Research Natural Area Needs in the Pacific Northwest" (Dyrness et al. 1975). Federal Research Natural Areas in Oregon and Washington (Franklin et al. 1972) provides a description of the Quinault RNA. The climate is maritime, with mild temperatures and an average annual rainfall of 132 inches. The topography is primarily a broad gentle plain composed of marine terrace deposits overlain by glacial outwash, which were probably reworked by saltwater following retreat of the glaciers. Other topographic features include a basalt knob, the lower slope of Quinault Ridge, and drainages of Willaby and Boulder Creeks. Western hemlock is the dominant tree throughout most the RNA, although there are some large Sitka spruce, and occasional Douglas-fir and western redcedar. Most of the stand is about 290 years, with some older trees about 370 years. Dominant understory vegetation includes salmonberry, Alaska huckleberry, red huckleberry, vine maple, fool's huckleberry, oxalis, swordfern, deerfern, five-leaved bramble and foamflower. Large down logs are common, and epiphytic and ground mosses are abundant. The area is occupied by a population of Roosevelt elk, which have had some effect on the composition of the vegetation.

NOXIOUS WEEDS

There are at least two weeds on Olympic National Forest that are considered noxious: tansy ragwort and Canada thistle. Both of these occur along roadsides at low elevation (under 1,500 feet) where the soil has been disturbed. They also occur at the edge of clearcuts adjacent to roads. Both tansy ragwort and Canada thistle have migrated into the clearcuts. While no specific control of these weeds has been practiced, some are killed by normal roadside maintenance.

INTRODUCED SPECIES

There are many introduced plants (over 270) on the Olympic Peninsula (Buckingham and Tisch 1979) that may be found on the Forest. Generally, they occur along roads and trails, where they have been brought in, either accidentally or purposely, by man's activities. They include many different species of grasses, herbs, shrubs, and trees.

DEAD AND DOWN WOODY MATERIAL

From the standpoint of commodity uses of trees for timber, dead and down material is considered as waste. However, a growing body of evidence indicates that dead and down wood is necessary to the efficient, long-term functioning of a healthy forest.

Dead and down material, in the form of stumps, root wads, bark, limbs, and logs in various stages of decay, is needed in both managed and unmanaged stands. This material is important for nutrient cycling, soil protection, wildlife (both as food and habitat), and maintenance of microclimate effect (Sollins 1982). The amount existing in managed stands is largely dependent on the characteristics of the previous stand, type of harvest method used and type of fuel treatment applied (if any). Dead and down material in unmanaged stands is a result of natural tree mortality, usually from insects, disease, weather or competition. In both managed and unmanaged conditions, the dead and down material can be in the form of standing, dead trees or dead, woody material lying on the ground.

DIVERSITY

The National Forest Management Act of 1976 provides statutory direction for managing the National Forest System to provide for diversity of plant and animal communities. Section 6(g)(3)(B) of the NFMA, the diversity provision, states:

The [planning] regulations shall include, but not be limited to . . . (3) specifying guidelines for land management plans developed to achieve the goals of the [RPA] Program which . . . (B) provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives of a land management plan adopted pursuant to this section, provide, where appropriate, to the degree practicable, for steps to be taken to preserve the diversity of tree species similar to that existing in the region controlled by the plan.

The regulations call for diversity to be considered throughout the planning process (36 CFR 219.26). The diversity provided by a Forest Plan is evaluated by determining how that Plan has considered the distribution and abundance of plant and animal species and communities to meet its overall multiple-use objectives. Several of these objectives are clarified by 36 CFR 219.

Specifically, forest planning shall provide that:

1. Management direction contributes to recovery and conservation of Federally listed threatened or endangered species (Endangered Species Act and 36 CFR 219.19).

2. Management of habitat provides for the maintenance of viable populations of existing native and desired nonnative, wildlife, fish (36 CFR 219.19), and plant species (USDA Regulation 9500-4) well distributed throughout their current geographic range within the National Forest System. As interpreted by the Secretary, this means that land and resource management plans (LRMPs) should identify or be amended to identify known sensitive species and provide Forest Standards and Guidelines that ensure conservation when an activity or project is proposed that would affect the habitat of a sensitive species.

3. Management of plant and animal communities identified in Regional Guides, or Forest Plans as issues that warrant special measures achieves overall multiple-use objectives (36 CFR 219.8, 219.12(b), 219.27).

4. Management direction includes objectives for selected management indicator species (36 CFR 219.19). The Forest Plan should specify for plant and animal species and/or communities identified as major Forest Plan issues or management indicators:

   -Standards and guidelines for protection, viability, recovery or restoration as appropriate to meet overall multiple-use objectives (36 CFR 219.27);

   -The expected future conditions in terms of distribution and abundance of populations or habitats to meet overall multiple-use objectives (36 CFR 219.11, 219.26);

   -The schedule for monitoring and evaluation of standards, guidelines, and objectives for plant and animal species and communities (36 CFR 219.27); and

   -A discussion of any proposed type conversions. If any conversion results in a reduction in diversity, explanation must be provided to show why the conversion is necessary to achieve multiple use objectives (36 CFR 219.27).

Plant and animal diversity is the diversity of life. There are 3 general levels of diversity: genetic, species, and ecosystem. Genetic diversity is the variation within a species, the genes which allow a population of a given species to adapt to changes in the environment. Species and ecosystem diversity, for planning purposes, are expressed by the number of species and seral stages present, often called "richness," and by their relative proportion and distribution over some land area, often called "evenness." Because the Olympic Peninsula receives from 30 to 200 inches of rain per year on land from sea level to over 7,900 feet, it has a very large number of plant species. Over 1,300 species have been recorded (Buckingham and Tisch 1979). Many of these are found on the Olympic National Forest, indicating great on-Forest diversity in plant species. For a general list of species present, see the descriptions under "Vegetation Zones." A potential vegetation classification for forested lands of the Olympic National Forest has been completed and published (Henderson et al. 1989, "Forested Plant Associations of the Olympic National Forest"). This document recognizes and describes 64 forested plant associations with detailed descriptions on species occurrences, timber productivity and soils. There is currently an ongoing project to classify non-Forest lands on the Olympic National Forest, including wetland, riparian, subalpine and alpine communities.

Size class diversity is an indicator of the different developmental stages a plant community goes through after being disturbed. The existing timber stands on the Forest are the result of early wildfires, wind storms and recent harvesting. This combination includes trees ranging from emerging seedlings to trees up to 10 feet in diameter and over 700 years old. For ease in data handling, this wide range in sizes and ages has been compressed into five classes. Table III-9 defines each class, and lists acreage by size class and general location. The proportion of each area in each class is also shown.

Table III-9. Existing Timber Stand Conditions (FY 1989)
Acres in Thousands, Percent is of Total Forested Land

Seral Stage	Eastside	Westside	Shelton	NF Total
Pioneer Stage Trees less than 6 inches tall	8 6%	24 9%	18 20%	50 10%
Early Stage 6 inches tall to 4.9 inches DBH 1/	19 14%	37 14%	30 33%	86 18%
Young Forest Stage 5 inches DBH to 8.9 inches DBH	20 15%	47 18%	11 12%	78 16%
Mature Forest Stage 9 inches DBH to 20.9 inches DBH	58 44%	35 13%	8 9%	101 21%
Old-Growth and Climax Forest Stage 21 inches DBH and larger	28 21%	119 46%	23 26%	170 35%
Total Acres	133	262	90	485

1/ Diameter breast height. Diameter of tree at 4-1/2 feet above the ground.

Much of the Forest supports large trees over 21 inches DBH, with 35 percent of the total land area occupied by stands in this category. Current standing volume on tentatively suitable land (in trees 9 inches DBH or larger) is estimated to be 1.2 billion cubic feet within the Shelton CSYU (including Simpson Timber Company's land) and 1.9 billion cubic feet on remaining National Forest land.

OLD-GROWTH

A great deal of interest exists regarding old-growth stands on the Forest. A considerable volume of old-growth was harvested along with mature stands during the past 50 years. Additional old-growth has been lost to windthrow, insects and disease. Old-growth provides wildlife habitat, gene pools for plants and animals, opportunities for research on natural systems, aesthetics, recreation, fish habitat and timber.

Old-growth forests have a unique character comprised of many vegetative, biological, and ecological characteristics. Old-growth is a late stage of stand development in plant succession. A stand on the Olympic National Forest usually takes at least 160 years to begin to develop the structure, composition and ecological characteristics (function) indicative of old-growth. There are different types of old-growth, depending on the geographic location, elevation and vegetation zone. There are few species which are totally dependent on old-growth forests for survival, although many species may attain their optimal development in old-growth. Epiphytic mosses and lichens are particularly important in old-growth, and the diversity and abundance of species are seldom found in younger stands. Nitrogen-fixing lichens, and those that provide food for small mammals, as well as mosses which provide nesting sites and materials for birds such as the marbled murrelet, are important features of old-growth. Some structural attributes of old-growth forests include diversity of size and age of trees, multi-layered canopy, presence of snags and standing dead trees, and large logs on the forest floor and in streams (Franklin et al. 1981). Ecological or functional characteristics include nutrient cycling, hydrologic cycle, food webs and interaction of organisms. Old-growth forests are an important contribution to the landscape and habitat diversity. They function as gene pool reserves for a diversity of plant and animal species which can aid in the reestablishment of populations in adjacent managed areas, and are important for scientific, educational and recreational values.

The most complete ecologically based definition of Douglas-fir old-growth is contained in Franklin et al. (1986) and describes stands containing the following characteristics:

- Low elevation forests, with Douglas-fir as the principal successional tree species.
- Two or more species with wide range of ages and tree sizes.
- Eight or more Douglas-fir per acre that are bigger than 32 inches in diameter or over 200 years old. In some environments western redcedar, western hemlock, or Sitka spruce are replacements for Douglas-fir.
- Twelve or more trees per acre of a shade tolerant species bigger than 16 inches in diameter.
- Stands will usually contain a multi-layered canopy.
- Four or more conifer snags per acre that are bigger than 20 inches in diameter and are over 15 feet tall. (Some Coast Range sites exposed to high winds may have fewer than four per acre.)
- Fifteen or more tons per acre of down logs including four pieces per acre that are bigger than 24 inches and 50 feet or longer.

Another commonly used definition of old-growth is contained in the Regional Guide for the Pacific Northwest Region (USDA FS 1984). It defines old-growth as any stand of trees 10 acres or greater generally containing the following characteristics:

- Stands contain at least five overmature trees per acre and additional mature trees in the overstory. At least 60 percent of the canopy is dominated by large individual trees with stem diameters 32 inches or greater.
- Stands usually contain a multi-layered canopy and trees of several age classes; species include shade-tolerant and shade-intolerant species.
- An average of two standing dead trees per acre and 30 tons of down logs per acre are present.
- Stands are well into the mature growth stage. Trees have deeply furrowed bark. Crown height has slowed, giving the tops a more rounded shape; tops may be broken. Limbs are heavy and gnarled, with mosses and lichens present.
- Evidence of human activities may be present, but do not significantly alter the other characteristics and would be a subordinate factor in a description of such a stand.

Neither of these definitions was available when the planning process began in 1979. The old-growth inventory in the Draft EIS was based upon acres of large sawtimber. This simplistic definition did not consider other important criteria of old-growth and it has been modified in the FEIS. For the current planning process, old-growth has been identified and mapped as those stands representing typical, suitable spotted owl habitat, disregarding elevation breaks. The conditions necessary to meet this definition are found in timber stands greater than 160 years of age. On the Olympic Peninsula, this 160-year criterion provides the structural components which are necessary for old-growth. Stands of average age greater than 160 years often contain at least the minimum of 8 trees per acre greater than 200 years prescribed in Franklin et al. (1986). Based on this definition, it is estimated there are currently 266,800 acres of old-growth on the Forest. A map showing the distribution of this old-growth has been included with this FEIS. Of the total old-growth area, about 46,800 acres are located within Wilderness areas. Under existing management plans, an additional 50,200 acres are outside of Wilderness, but on lands which are not suitable or available for timber production. The balance of 169,800 acres are tentatively suitable for timber production. See Chapters II and IV for a discussion of how old-growth is managed under the various alternatives.

A recent study by The Wilderness Society (Morrison 1990) has reported a total of only 94,400 acres of old-growth remaining on the Olympic National Forest. In presenting their data and conclusions, the Wilderness Society used two map categories to depict old-growth. One is purportedly based on the concepts of "The Old-growth Definition Task Force," Franklin et al. (1986). The other is a more broadly conceived concept they call "older forest" of which they reported 189,500 acres. They used both terms throughout the report, but did not make clear the distinction or implication of the differences between these two terms. The Wilderness Society used the term "old-growth" in a very restrictive sense, claiming it was a literal interpretation of the Old-growth Task Force's definition. However, a more widely held interpretation of the Task Force definition would have identified an acreage figure more in line with what they called "older forest" as old-growth.

It is important to note that the Task Force definition was intended to be applied to the western hemlock vegetation series and that to qualify stands should have at least 8 trees greater than 32 inches DBH *or* be at least 200 years old. In interpreting "old-growth," the Wilderness Society acknowledged the 200 year criterion, but always ignored it in favor of the tree size criterion. All stands meeting the age criterion, but lacking the 32 inch size, were apparently relegated to the "older forest" category.

In 1986 a vegetation resource inventory was initiated on the Forest. It consists of three separate surveys:

1. The Vegetation Resource Survey (VRS) which targets natural stands.

2. The Managed Stand Survey (MSS) which was designed for managed stands or plantations.

3. The Mature and Over-mature Survey (MOMS) which was designed to collect information about older stands.

Field work for the MSS was initiated in 1990, with the accompanying map of stand conditions due in the Fall of 1990, and the productivity stratification map due in 1991. Field work involves installing permanent inventory plots, which will subsequently be remeasured. The MOMS is scheduled to be completed in 1991, while the VRS is scheduled for 1993.

When completed, the MOMS plus the vegetation maps based on satellite imagery will provide information about the amount and distribution of old-growth on the Forest. It will not, however, provide enough site-specific information about understory and dead and down logs to allow a direct translation into the definition from the Regional Guide or from Franklin et al. (1986). The exact amount and location of old-growth will be known only after each potential old-growth stand identified by the MOMS is visited and examined more closely.

In addition to the resource inventories, the Ecology Program inventory has been collecting vegetation, stand structure, snags and site information on reconnaissance and permanent plots since 1979. Many of these plots are scheduled for remeasurement in the 1990's.

None of the old-growth inventories to date have addressed minimum stand size necessary for old-growth ecosystems. The distinction between stands that provide limited function or meet limited objectives and stands that are large enough to be considered viable old-growth ecosystems is not yet well defined. This is a topic for further research.

TIMBER - TREES

Trees are single-stemmed, woody plants that commonly exceed 20 feet in height during their lifetime. Almost 583,800 acres, or 92 percent, of the Olympic National Forest support trees. The 1973-74 timber inventory indicated the following proportion of species on the Forest based on acres (Bassett and Oswald 1981): 1/

Western hemlock	42%	Alaska-cedar	*
Douglas-fir	38%	Mountain hemlock	*
Western redcedar	1%	Subalpine fir	*
Pacific silver fir	16%	Red alder	1%
Lodgepole pine	*	Maple	*
Sitka spruce	*	Cottonwood	*

* Less than 1 percent.

1/ The timber inventory plots are biased away from low-productivity sites. Therefore, Pacific silver fir, mountain hemlock, and subalpine fir may be under-represented.

The above-listed species do not occur uniformly throughout the Forest. There are more acres of Douglas-fir type and more Douglas-fir volume on the east side of the Forest than the west and more Pacific silver fir and western hemlock type and volume on the west side than on the east. The following summary shows this relationship:

Location	Douglas-fir	Western hemlock	Pacific silver fir	Western redcedar	Other Species
Eastside	85%	10%	2%	*	3%
Westside	26%	50%	19%	2%	3%
Shelton	47%	41%	8%	1%	3%

* Less than 1 percent.

TIMBER - VOLUME

Of the nearly 583,800 acres of Forest land supporting tree growth, about 446,939 acres, are classified as tentatively suitable for timber production. The productivity of these lands ranges from 20 to over 200 cubic feet per acre per year, with an average productivity of 120 cubic feet per acre per year. See Table III-10 for a more detailed display of timberland suitability. Existing timber management plans are based on timber being managed on 484,426 acres of suitable land.

Biological potential is estimated at 69.4 million cubic feet per year. This is the approximate maximum potential from all land that can support trees (nearly 583,800 acres), regardless of other conditions. "Support trees" means that trees have grown, or would be able to grow, on the area and that their crowns cover (or would cover) 10 percent or more of the area.

Table III-10. Tentative Suitability Stratification

Category	Acres
National Forest Area	632,324
Lands not forested	48,535
Water	1,752
Non-Forest	28,108
Roads	16,764
Other uses (campgrounds, etc.)	1,911
Forested Land	583,789
Legislatively Withdrawn from timber production	69,501
Lands irreversibly damaged if logged or roaded	27,761
Lands not capable of being reforested within 5 years	41,034
Tentatively Suitable Forested Land	446,939
Lands that can be planted	439,849
Lands that must be reforested naturally	7,090

Suitable potential is estimated at 53.6 million cubic feet per year. This is about the maximum potential supply, given existing laws, regulations, and policies, and the implementation of intensive management practices. All tentatively suitable land (446,939 acres) is included in this calculation.

The current timber output from the Olympic National Forest based on existing timber management plans is 59.8 million cubic feet per year (330.5 million board feet), with an estimated value of $43.6 million (based on the average stumpage value for Olympic National Forest timber between 1977 and 1983 ($132.00 per thousand board feet)). If harvest from Simpson Timber Company land within the Shelton CSYU is added, the total output becomes 441.8 million board feet per year. This figure represents the volume that meets the current utilization specifications. If green material that does not meet current utilization specifications (dead trees, cull material, and firewood material) is included, the total fiber output level reaches approximately 469 million board feet in an average year.

Timber output from the Forest is influenced by a wide range of existing plans and legal entities. Annual harvest volumes are established by three separate timber management plans. Four land-use plans dictate harvest locations through allocation of lands to resource uses. Two established sustained yield units limit the location of mills that can process the trees removed from 46 percent of the lands suitable for timber production. The relationships among these interacting timber management guides, and the harvest volumes associated therewith, are displayed in Table III-11.

Table III-11. Current Chargeable Annual Allowable Sale Quantity

Management Plans				
Timber	Land	Ranger District	Annual Volume	Area Covered and General Comments
Quinault 1969	Quinault 1976	Quinault	86.9 MMBF 14.5 MMCF	Grays Harbor Federal Sustained Yield Unit. Control is sold volume.
Shelton 1977	Incorporated within the Timber Resource Plan	Hood Canal Simpson Timber Co. Total Unit	115.7 MMBF 21.6 MMCF 113.3 MMBF 21.7 MMCF 227.0 MMBF 43.3 MMCF	Shelton Cooperative Sustained Yield Unit jointly managed by the Forest Service and Simpson Timber Company. The unit was established by an agreement that terminates in 2046. Control is harvested volume.
Peninsula 1968	Soleduck 1975 Canal Front 1979 Satsop Block 1979	Soleduck Hood Canal Quilcene Hood Canal	127.9 MMBF 23.7 MMCF	Includes all remaining National Forest land. The Satsop Block originally was not part of any Timber Plan, but subsequently has been added to the Peninsula Plan. Control is sold volume.
Total Volume meeting utilization specifications all NF lands.			330.5 MMBF 59.8 MMCF	
Total Volume meeting NF and Simpson Timber Co. utilization specifications.			441.8 MMBF 81.5 MMCF	

TIMBER - SILVICULTURAL TREATMENTS

Silvicultural treatments and management practices currently applied to timber include the following:

1. Precommercial thinning in seedling/sapling stands as needed to achieve desired stocking levels.
2. Commercial thinning in accessible small sawtimber (DBH 9 to 21 inches) stands.
3. Clearcutting in large saw (over 21 inches DBH) and larger small sawtimber stands.
4. Fertilization of selected Eastside zone stands (one application).
5. Treatment of slash resulting from regeneration harvest, generally by broadcast burning and site preparation.
6. Reforestation, usually by planting one- or two-year-old Douglas-fir, Pacific silver fir, western hemlock, western redcedar, or Sitka spruce seedlings.

7. Reforestation with genetically superior Douglas-fir stock (from Dennie Ahl Seed Orchard--see below) where appropriate.

8. Removal of noncommercial tree species in plantations (generally with hand-held power tools) to allow commercial species to grow at faster rates.

Genetically superior Douglas-fir seedlings are planted on lands located in the Douglas-fir management zone between 1,500 and 3,000 feet elevation on the Quinault and Soleduck Districts, and on the west side of the Hood Canal District. These seedlings are grown (at Wind River Nursery and other suitable locations) from seed harvested at the Dennie Ahl Seed Orchard. The Orchard was established in 1957 to produce frequent, abundant, and easily harvested crops of genetically improved Douglas-fir seeds. Parent trees were phenotypically selected for increased volume and form characteristics. Although out-planting tests have been completed, the present orchard block has not been rogued (culled) due to the limited nature of the tests and low number of parents in one block. The Orchard is currently being expanded, and will soon produce Douglas-fir seed for all elevations and zones on the Forest. It will also produce western hemlock, Pacific silver fir, and western white pine seed.

Successful reforestation is, as a rule, readily attainable. Abundant rainfall and a general lack of competing vegetation are the key factors facilitating reforestation. Nonetheless, there are approximately 7,000 acres, generally on shallow, rocky soils, which cannot be planted. These areas must rely on seed sources from adjacent stands, advanced regeneration, and/or shelterwood regeneration techniques.

OVERSTOCKED STANDS - DOGHAIR

The Forest also has approximately 12,000 acres of excessively overstocked, stagnated (doghair) stands. These stands are a mixture of Douglas-fir and western hemlock that seeded in after early wildfires. Many stands have in excess of 10,000 stems per acre, averaging less than 12 inches DBH. Approximately 3,000 acres of stands have been harvested (at about 600 acres per year) on an experimental basis, to test the economic feasibility of converting these areas into productive timber stands. As of April 1990, 2,437 acres have been logged with 283 acres to be harvested under the contract. The material was sold as hog fuel (scrap material), low-grade and high-grade pulping material, and a minor amount, lumber. This experimental program is scheduled to end in 1990.

OTHER FOREST PRODUCTS

The Forest's vegetation provides opportunities for gathering forest products other than those that are timber-related. These products include berries, mushrooms, ferns and salal, boughs, plants for landscaping, Christmas trees, and cedar products used by American Indians. The amounts of such materials being removed from the Forest at present are not known.

Although many of the above products have commercial value, most collecting or harvesting is for personal use. A fee policy has recently been adopted by the Forest for these products both for personal and commercial use. Permits are required for gathering.

HISTORIC TRENDS

VEGETATION

Climate, vegetation and soils have changed continually since the last ice age. The forests and soils of today bear little resemblance to those of 10,000 years ago. Even 300 years ago, during the Little Ice Age, climate and vegetation are known to be significantly different than today. The forces that cause these changes are still in effect today. The dynamic nature of climate, vegetation, and soils join to make up one of the basic properties of ecosystems.

THREATENED, ENDANGERED, OR SENSITIVE PLANTS

There are currently no documented sightings of recognized threatened or endangered plants on the Olympic National Forest. Since sensitive plants occur mostly in harsh or unusual habitats (generally nonforested areas or lands of low productivity), it is unlikely that logging practices will harm any sensitive plants. Possible exceptions include *Erythronium revolutum* (pink fawnlily), *Poa marcida* (withered blue-grass), and *Synthyris schizantha* (fringed synthyris), which occur on forested areas. Generally, fire is not a concern either, since most sensitive plants occur in areas that have insufficient fuel to carry wildfire.

UNUSUAL PLANT COMMUNITIES

While it is possible that unusual vegetation associations that no longer exist occurred on this Forest at one time, no records of such occurrences have been found. Generally, the characteristics that have resulted in the currently identified unusual areas have also made them uneconomical to harvest or develop.

NOXIOUS WEEDS

It has only been recently (perhaps in the last 20 years) that tansy ragwort and Canada thistle have been found on the Forest. These weeds migrated from adjacent lands as new roads were built. Recreation and commercial traffic undoubtedly helped spread these plants.

INTRODUCED SPECIES

The number of introduced species, and the quantity of each species on the Forest, have undoubtedly increased over the last 20 years due to better access. As man's activities reached farther and more frequently into the Forest, so did the potential for the introduction of new species.

DEAD AND DOWN WOODY MATERIAL

Because vegetation grows and dies, there probably has always been dead and down material in the Forest. Wildfires could have consumed most or all of this material at times. These same fires also added more fuel by killing some of the trees. The dead, standing stems would eventually fall, adding more material to the ground. On the west side of the Forest, where fires were less frequent, wind was the primary agent causing dead and down material.

Logging activities have removed some of the existing dead and down material, and most of the vegetation that would replace this material. Burning the material that remains after logging has further reduced the amount of dead and down material.

DIVERSITY

The Forest has always had a large number of plant species present and all of the seral stages represented. Their proportion and distribution, however, has been affected by catastrophic events such as large wildfires and high winds that disturbed or destroyed existing communities. As species started to recolonize these areas, the process of succession began again. Generally, this resulted in large areas of similar species and seral stages. Those species associated with older stands (western redcedar, western hemlock, and Sitka spruce) were reduced by these phenomena. Glaciation also had a major effect on the distribution and diversity of species. Some areas in the northeastern Olympics are believed to have been refugia for plants during glacial events.

The combined effects of increased access to the Forest and better fire-fighting methods and equipment have reduced the likelihood of large fires. Logging activities, however, have continued the process of disturbance and succession. Generally, this has caused a more even, spatial distribution of size classes and the continued decline of species associated with older stands. In the last 20 years, there has been a shift in the proportion of the Forest in each size class. The 1963 timber inventory did not separate the east side of the Forest from the west. However, totals from this inventory show this shift when compared to the current situation.

	East-West		Shelton		Total National Forest	
Size Class	1963	1989	1963	1989	1963	1989
Less than 6" tall	4%	7%	3%	9%	4%	8%
6" tall - 4.9" DBH	16%	17%	17%	25%	16%	18%
5" DBH - 8.9" DBH	12%	12%	5%	18%	11%	13%
9" DBH - 20.9" DBH	12%	29%	6%	15%	11%	26%
21" DBH +	56%	35%	69%	33%	58%	35%

OLD-GROWTH

Old-growth stands have changed in structure, amount, and distribution over time. Old-growth on the Forest ranges from multi-aged stands to near uniform stands of older trees. These differences reflect the natural succession of vegetation as plants grow, die and are replaced by other plants. Wildfires and wind have been the major forces affecting the amount of old-growth in the past. Within a stand, insects and disease can create openings and initiate succession on a smaller scale. More recently, logging activities have been the principal cause of the reduction of old-growth. Old-growth includes stands over 160 years of age meeting the criteria of typical and suitable spotted owl habitat, disregarding elevation. According to the 1963 inventory, old-growth was estimated at approximately 316,500 acres. It decreased to about 266,800 acres in 1989.

TIMBER - TREES

The volume by individual tree species has changed over time. The normal succession of trees is to climax species such as western hemlock. Wildfires and wind have often interrupted that process, allowing the species associated with earlier successional stages to grow, i.e., Douglas-fir. More recently, logging activities have had similar effects. The following comparison between the 1963 inventory and the current situation shows this shift:

	East-West		Shelton		Total National Forest	
Species	1963	1989	1963	1989	1963	1989
Douglas-fir	35%	37%	39%	47%	36%	38%
Western hemlock	47%	42%	38%	41%	45%	42%
Pacific silver fir	10%	17%	10%	8%	10%	16%
Western redcedar	5%	2%	9%	1%	6%	1%
Other	3%	2%	4%	3%	3%	3%

Changes in species percentages between inventories are the result of harvesting one species in greater quantities than another, as well as differences in inventory procedures.

TIMBER - VOLUME

Early records indicate harvest of timber from National Forest land began in 1906. Table III-12 shows the steady increase in annual timber harvest since that time, to a peak in 1980. Since 1980, there has been a general decline in annual timber harvested.

Table III-12. Annual Volume Harvested (in Million Board Feet)

Year	Volume
1920	17
1930	19
1940	108
1950	242
1960	254
1970	260
1980 *	328*

* This is an average for 9 years (1981-1989).

Multiple-use plans completed in 1960 (one for each District) established a commercial forest land base of about 498,000 acres, with a potential harvest level of 326 million board feet (210 from National Forest lands not in the Shelton CSYU, and 116 from lands within the Shelton CSYU). Due in part to the timber inventory of 1963, the area defined as commercial forest land increased to a high of about 524,800 acres in 1969. The total potential harvest level also peaked in 1969 at 370.9 mmbf as a result of the inventory and subsequent timber management plans.

Since 1969, there has been a gradual reduction in both the number of acres identified as "commercial forest land" and the potential harvest level. This is due to areas set aside from timber harvest, land exchanges and redefined direction in timber management plans. The commercial forest land base defined in current plans is 484,426 acres, with a potential harvest level of 330.5 million board feet (214.8 from National Forest lands not in the Shelton CSYU and 115.7 from National Forest lands within the Shelton CSYU).

TIMBER - SILVICULTURAL TREATMENTS

Silvicultural treatments prior to the late 1960's were generally limited to clearcutting and reforestation. Early records indicate that about 2,600 acres were reforested annually by planting, and another 1,000 acres by artificial seeding, on National Forest lands outside the Shelton CSYU. On National Forest lands within the Shelton CSYU, about 1,500 acres per year were reforested by planting.

The current timber management plans for the Forest, written from 1968 to 1978, established commercial thinning objectives for the first time. The objective was to harvest 57.5 mmbf annually from about 8,000 acres on National Forest land outside the Shelton CSYU. Commercial thinning on National Forest land within the Shelton CSYU, while allowed, was never established as a firm objective. These plans also established goals for precommercial thinning of about 4,200 acres per year. Prior to these plans, less than 1,000 acres had received this treatment.

While the 1968 and 1969 plans did not establish goals for pruning, they did indicate that about 250 acres had been pruned in the past. The limbs from about 50 trees per acre were removed, from the base of the tree up to about 18 feet. The purpose of this treatment is to obtain clear lumber from the growth which follows pruning when the tree is harvested.

OVERSTOCKED STANDS - DOGHAIR

The Forest has often tried to bring its doghair stands under management. The 1968-1969 plans indicate that several commercial thinning sales had been made in these stands. These plans scheduled, for the first time, regular commercial thinning harvests from these areas.

OTHER FOREST PRODUCTS

Removal of miscellaneous forest products has historically been low. However, as the population continues to grow and more people become aware of these goods, their use is increasing. Of greatest recent concern is the number of people harvesting mushrooms and the amount being removed. Concern has been expressed that mushrooms are being overharvested, to the point that they are no longer regenerating in some areas. Increases in mushroom harvest are attributed to increased awareness of the commercial value of this resource. Although permits are required to gather mushrooms commercially on-Forest, this requirement is often ignored. This makes control of use difficult. Recent Forest policy regarding the gathering of miscellaneous forest products specifies that charge permits are required for many products. This charge policy applies to both personal and commercial use.

FUTURE TRENDS

VEGETATION

Because climate, vegetation and soils have changed continually for thousands of years, they should be expected to continue to change in the future. The extent or direction of change may not be predictable, especially since the world population is beginning to alter the natural patterns of change. How carbon dioxide enrichment, sulfur dioxide or nitrous oxide pollution, for example, will affect these trends, is largely unknown.

THREATENED, ENDANGERED, OR SENSITIVE PLANTS

The list of these plants may continue to change in the future. As management activities continue toward the higher elevations and harsher sites, new species could be discovered and added to these lists. Some species may be removed from the lists, as new areas are found where these plants live and reproduce in sufficient numbers.

UNUSUAL VEGETATION ASSOCIATION

It is reasonable to assume that as more is known about the Forest, more unusual vegetation associations will be found. As each new area is found, it will be evaluated and appropriately managed.

NOXIOUS WEEDS

The spread of both tansy ragwort and Canada thistle will continue as new roads and clearcuts are developed. Some control of these weeds may be needed. Although no new threats from noxious weeds have been identified, the possibility exists.

INTRODUCED SPECIES

It is reasonable to assume that the number of introduced species, and the quantity of each such species on the Forest, will continue to increase due to man's activities. Most of the increase in the number of species will be due to accidental or natural expansion, but some will be intentional (e.g., noble fir experimental plantings). Other species will possibly be introduced for erosion control purposes.

DEAD AND DOWN WOODY MATERIAL

The amount and type of dead and down woody material in unmanaged stands will be maintained as the result of natural tree mortality. In managed stands, the amount and type of material is dependent on the rotation lengths, thinning regimes, harvest methods and fuel treatment methods applied. The amounts of very old, large material (old-growth) found in unmanaged stands will generally not exist in managed stands, except where rotations are over 200 years in length. Such material will continue to exist in areas not scheduled for timber harvest or consumed by fire. Desired levels of dead, down and defective materials necessary for its nutrient cycling and other values will be identified and managed for in future stands.

DIVERSITY

The diversity of seral stages should continue to increase for a time, particularly in evenness (relative proportion and distribution), with man's activities. The likelihood of large fires that reverse this trend will continue to decrease as access into the Forest increases and methods of fire detection and suppression improve. The diversity of species, and the amount of area associated with old-growth and older stands, will continue to decline.

Seral stages in unmanaged stands will continue to evolve through the natural process. Fire, wind, insects and disease will continue to be the primary causes for changes that occur. It is anticipated, however, that these agents will have a minor effect in reducing the amount of old-growth forest. In managed stands, the trend will be toward an even distribution of seral stages. The even distribution for normal rotations is about 10 percent pioneer stage, 10 percent early stage, 30 percent young forest stage, and 50 percent mature forest stage.

OLD-GROWTH

The number of acres of old-growth in its natural (unmanaged) state will continue to decline in the near future as a result of timber harvest activities. As the amount of old-growth in the landscape decreases, its importance as a biological and ecological reserve increases. These old-growth stands will become increasingly important as gene pool reserves, providing species to reestablish the adjacent managed areas and contributing to the diversity in the landscape and ecosystem. The composition and structure of such stands will also change over time as trees die and are replaced. There may be opportunities to manage for old-growth for wildlife species or other values. Depending on the management objectives, these stands will probably not duplicate original old-growth in all the composition, structure and functional attributes.

TIMBER - TREES

The relative proportions of individual tree species within managed areas will continue to change over time, but at a slower rate. Planting harvested areas with the tree species best suited to the site, or with a mixture of species and natural seeding, will all serve to provide balance. Succession will continue toward climax species in unmanaged areas.

TIMBER - VOLUME

Regional Timber Supply and Projection: The principal projections used in developing long-range plans and programs for management of the National Forests are contained in the Forest and Rangeland Renewable Resources Planning Act (RPA) Assessment and 1984 Update. These projections focus on the long-term situation (50 years), and do not necessarily recognize current short-term regional fluctuations. A summary of projected national RPA trends (to year 2030) for timber supplies follows:

Hardwoods: The current balance between the growth of wood and its removal shows that the hardwood forests and eastern softwood forests can support additional timber harvests. However, this balance will change, and future harvests, particularly past the year 2000, could vary over a wide range. Nonetheless, if commercial timber landowners continue to respond to price and inventory changes, then timber harvests can be increased substantially in most geographic regions during the next few decades. The largest hardwood increases will be in the South, which is expected to rise from about 3.4 billion cubic feet in 1980 to 9.4 billion cubic feet in 2030.

Softwoods: Total projected softwood roundwood harvests would rise 24 percent, from 9.6 billion cubic feet in 1980 to 11.9 billion cubic feet in 2030. Though the outlook is for increased softwood harvests nationally, there are important differences among the major softwood producing regions. In the Douglas-fir subregion, projected annual harvest from 1980 to 1990 is about 2.3 billion cubic feet. It then declines slightly, to about 2 billion cubic feet per year. This level is roughly maintained through the rest of the 50-year projection period. In contrast, in the other major source of softwood timber (the South), harvest is projected to rise from about 4.1 billion cubic feet in 1980 to 7.3 billion in 2030. Much of the expansion in the South, in both softwood and hardwood harvest, is due to the fact that production of its wood products has become diversified relative to other regions of the country.

Short-Term and Long-Term Demand Trends: Over the next 10 years, timber demand from the Pacific Northwest geographic region will grow slowly. Although there is a backlog of unfilled housing demand, the future will depend primarily on continuing strength in personal income and the availability of affordable housing and financing. In addition, projections of exports to the Pacific Rim countries show a continuing, slow economic growth. The analysis acknowledges that there will be a declining trend in the construction sector. Structure replacement, rather than new construction, will characterize the market. The projections for increases in demand may be described as considerably restrained and cautious (Nomura 1981).

The long-term outlook for the solid wood products industries contains a number of challenges. Evaluation of recent data and information indicates that the demand for timber is changing to a moderate rate of increase, as compared to the slowdown that occurred in the early 1980's.

The ability to sustain this increase on a long-run basis is linked to the critical issue of costs. The short-term future of timber and wood products demand is clouded by factors such as the severity and length of the housing and wood products recession that began in 1980. The long-term trends in housing demand, the growing popularity of construction methods that use less wood, availability of wood substitutes, and a shift in business management strategies and methods all contribute to a potential shift in future demand (Adams and Haynes 1985).

Wood supply will continue to be an issue, in the sense that it will be highly dependent on the ability of producers to lower costs to be competitive with wood substitutes (Schallau 1986).

Although overall current timber supply levels in the Pacific Northwest region may be capable of meeting future demand, there are some problems within the subregional market areas. Many of these are adversely affected by the shifting emphasis within the region on the types of wood products which are to be produced. Several subregions may not have the ability to supply the kinds of wood needed to meet demands for new products.

Concerted efforts by the wood products industry will be needed in order to broaden the economic base. Such efforts could bring about a transition enabling the Pacific Northwest to regain much of the previous strength of one of its larger revenue-generating basic industries. Nevertheless, this will take time.

A broader vision of the future includes developing a flexible regional basis for stabilizing wood supplies and a forward-looking perspective on wood fiber management. This will allow the Pacific Northwest region to better utilize the opportunity to increase exports to international markets. To achieve this, the forest products industry will need to learn the workings of a different market system, and provide more products in the forms demanded (Campbell 1983). In addition, actions by industry, such as modernizing facilities, adopting state-of-the-art technology, reducing costs, and diversifying into other sectors of production (similar to what the Southern region has done), could help to rebuild and stabilize the wood-based sectors of the region (Schallau 1985).

Private and Public Land Interrelationships: Currently, part of the timber formerly supplied by the Pacific Northwest region is being supplied by the South and Canada. However, the supply situation with Canada can be expected to change as soon as about 6 years, or at least within 15 years. The projected change indicates a drop in supply capability of 30 to 50 percent from the current relatively high levels. At about the same time as this drop in Canadian supply capability begins to occur, the growth of wood fiber on private lands in the Pacific Northwest would again be reaching its capability. The private lands in the Pacific Northwest could then become a major source of supply for softwoods to meet national and international demand. Further, during the period before the private lands in the region regain their full supply potential, the public forests would be looked upon as a major source for a relatively stable supply of wood fiber (Schallau 1985).

Local Timber Supply and Projections: Theoretical supply levels have been calculated for the Forest. These were presented earlier in the section covering the current situation for timber volume. These levels include the following assumptions regarding intensive management: genetically improved seedlings will be planted within Douglas-fir areas between 1,500 and 3,000 feet elevation on the west side of the Forest; all managed stands achieve optimum stocking; all stands within Douglas-fir areas will receive commercial thinnings at appropriate ages and intervals (depending on productivity class); and all managed Douglas-fir stands on the east side of the Forest below 1,500 feet elevation will receive fertilization.

There are three major influences on the potential supply level: the number of acres available for harvest, the intensity of management on those acres, and the harvest flow schedule (nondeclining flow or departure). Acreage available is the most significant influence, since large changes in standing timber volume are directly related to land allocation. Departure from nondeclining flow can increase harvest level temporarily, but entails a decrease at some time in the future. Intensive management practices influence the supply level by affecting the growth rate of trees. The most effective practices for increasing growth are planting of improved stock (genetics), stocking level control (planting and precommercial thinning), and fertilization.

In order to put Forest supply potential in the context of its relationship to the Peninsula timber industry, it is necessary to consider the timber supply picture for the Peninsula as a whole. In the past, demand for wood products has been the primary determinant of the health of the local timber industry; raw material supply has been abundant and, therefore, not an immediate concern. However, this picture is changing substantially, and a continued supply of readily available raw material is no longer assured. Enough is known about current stand conditions to draw some general conclusions about future supply trends. Table III-13 summarizes current conditions on Peninsula timberlands.

Table III-13. Timber Stand Conditions, Olympic Peninsula 1/

Ownership Class	% of Total Forest Land	Stand Conditions
National Forest	19.3	Relative abundance of large sawtimber stands (31 percent of tentatively suitable timberland); over 50 percent of remaining Peninsula large sawtimber is in NF ownership.
State of Washington	16.5	Rapidly diminishing base of harvest-age timber. State DNR projects substantially lower harvest levels over the next 50 years (compared to average harvests of the 1980's).
Other Public and American Indian Reservations	8.0	Rapidly diminishing base of harvest-age timber; large proportion in seedling and sapling stands. Old-growth removal is approaching completion on acreage to be harvested.
Forest Industry	40.8	Small holdings of large sawtimber. Large area in small (9-20" DBH) sawtimber stands, characterized by a fairly even distribution of age and diameter classes (with the exception that the proportion in larger diameter classes is somewhat below average).
Other Private (small holdings)	15.3	Approximately the same as forest industry. Management practices are highly variable.

1/ Consolidated from several unpublished State of Washington DNR and Forest Service supply studies.

As a result of present stand conditions, it is expected that timber supply from non-National Forest sources will drop significantly below recently experienced levels through the next 50 years. Table III-14 presents an estimate of future potential harvest levels. The figures displayed are based on DNR and Bureau of Indian Affairs harvest projections (State, Other Public, and American Indian land), as well as data obtained from a 1981 inventory of Olympic Peninsula timber supply (Bassett and Oswald 1981). Recently completed timber supply analyses (Fox 1989, Columbia Consulting Group, Inc. 1989) were also used in deriving future supply projections.

Information from these sources was used to project harvest levels from private timberland. Stand conditions on private land are such that a relatively even flow of timber harvest could be both possible and economically practical over the next 50 years. The average annual harvest under such a scenario is estimated at roughly 800 million board feet. This approximates the estimated long-term sustained yield capacity for Peninsula private timberland and is considerably below the 1100 million board feet experienced in the 1985 to 1988 period (when demand for timber was high and harvest accelerated in response to market conditions).

Current projections indicate a strong potential for private timberland harvest to be above the long-term average in the 1990's (in response to continued demand). If this occurs, harvest in later decades (most likely the 2010 to 2020 period) will necessarily be somewhat below the long-term average due to reduced availability of harvest-age timber. This possibility is reflected in the ranges presented for private and total "non-National Forest" harvest in Table III-14 Calculations and procedures from which harvest projection estimates were derived are on file in the Forest Supervisor's Office. Keep in mind that the estimates are quite uncertain, and that actual harvest in any given decade could differ substantially from the projected level.

Table III-14. Projected Potential Timber Harvest, Olympic Peninsula (Harvest in Million Board Feet per Year)

Period	State and Other Public	Private 1/	Total "Non-National Forest"	National Forest 2/	Total
1970-1979	610	780	1,390	395	1,785
1980-1984	370	740	1,110	355	1,465
1985-1989	470	1,100	1,570	410	1,980
1990-1999	340	800-880	1,140-1,220		
2000-2009	345	800	1,145		
2010-2019	350	720-800	1,070-1,150		
2020-2029	365	800	1,165		
2030-2039	355	800	1,155		

1/ Does not include Simpson Timber Company land within the Shelton CSYU.
2/ Includes Simpson land within the SCSYU. Harvest levels after 1990 will depend on alternative selected. Figures based on actual harvest rather than planned sale quantity.

The supply picture alone does not dictate the future condition of the Peninsula timber industry or the role of Olympic National Forest timber in relation to this industry. It is the interactions of supply and demand that establish the framework for future possibilities. As is the case for Pacific Northwest region demand as a whole, demand for western Washington timber (and thus Forest timber) is presently high relative to historic levels. The combined effects of the influx of inexpensive timber from western Canada and the expansion of the market area of timber from the South precipitated a major slump in western Washington's timber industry in the early 1980's. Over the past five years, however, there has been a strong resurgence of demand for western Washington timber, and recent harvest has been considerably above historic levels. It is expected that the current high level of demand will moderate in the 1990's and beyond, although continuing peaks and valleys will occur in response to market cycles. It is further expected that the long-term average demand for Peninsula timber will fall between the average level experienced in the 1980 to 1988 period and the average harvest of the 1970's.

If demand for Peninsula timber approximates the projected level, supply availability will soon become the critical factor limiting the vigor of the local timber industry. The projections in Table III-14 indicate a substantial drop in timber availability, beginning in the 1990's and extending throughout the next 50 years. Thus, the upcoming decades could entail difficulties for the Peninsula industry due to reduced supply. Lack of raw material availability may make it impossible for Peninsula mills to take advantage of anticipated levels of demand.

The projected supply picture on the Peninsula could be influenced to some extent by future conditions in neighboring timber-producing zones (southwest Washington and the Puget Sound counties). Over the last 10 years, the volume of logs flowing from Peninsula suppliers to these areas has been roughly equal to the flow of logs from neighboring areas to the Peninsula timber economy. While changes in market conditions and relative stumpage availability have the potential to modify this balance, there are no clear indications that any substantial changes in net log flow are likely. Therefore, for the purpose of this analysis, it is assumed that the interchange of raw material between the Peninsula and adjacent areas will remain essentially balanced in the future.

An additional factor affecting supply conditions for Peninsula mills is the proportion of local harvest which is exported. At present, 35 to 45 percent of Peninsula harvest is exported (in log form) to Japan and other Pacific Rim nations. Indications are that demand for logs will increase throughout the Pacific Rim nations, especially China. Whether this will in fact occur, and how it will interact with such things as supply availability from non-Peninsula sources and changes in trade agreements and trade barriers, is highly uncertain. If Peninsula log exports increase, the supply shortage for Peninsula mills will be heightened, while a decrease in exports would serve to relax the supply pinch.

In the context of this scenario, what is the likely demand pattern for Olympic National Forest timber? There should be a continuation of strong demand, although this may be dampened to some extent if private landowners concentrate initially on their own harvest-age stumpage. Such a situation is quite possible, and is reflected in the "high" end of the range of projected private harvest in the 1990's (880 million board feet). Once any "backlog" private timber has been harvested, the demand for Forest timber should increase.

The overall timber supply situation on the Peninsula should soon become the dominant factor in determining demand for National Forest timber. With timber availability from non-National Forest sources declining, this demand is expected to be quite strong. While attempting to quantify the future demand for Forest timber is a highly uncertain undertaking, such an estimate is useful in relating alternative National Forest harvest levels to the overall Peninsula timber supply/demand situation. Therefore, projections have been made of the possible range into which demand for National Forest timber could fall in future decades. These projections are presented in Table III-15. They are based on the following assumptions:

1. The average annual Peninsula-wide harvest level of the 1980 to 1988 period represents the lower limit of future demand for Peninsula wood products, while the 1970 to 1979 level represents the upper limit. Under this assumption, future demand for Peninsula wood products will fall between 1,695 and 1,785 million board feet per year, a range of 90 million board feet. In this context, "demand" is defined as the volume of Peninsula harvest that would be consumed in final product form (lumber, pulp and paper products, plywood, and logs for export) in the wood products market, given that Peninsula forests are able to supply the amount demanded.

2. Demand for National Forest timber can be projected by subtracting estimated non-National Forest harvest from estimated demand for final products. In this context, "demand" (for National Forest timber) is defined as the volume of Forest timber that would be purchased (if available) by Peninsula mills in response to the combination of demand for final products and supply of timber from other sources. This assumes that the demand for exportable logs is fully filled from non-National Forest sources, with National Forest timber helping to fill the needs of local mills.

Table III-15. Projected Demand for National Forest Timber

(Million Board Feet per Year)

Period	Estimated Total Demand	Non-National Forest Harvest	Demand for National Forest Timber
1990-1999	1,695-1,785	1,140-1,220	475-645
2000-2009	1,695-1,785	1,145	550-640
2010-2019	1,695-1,785	1,070-1,150	545-715
2020-2029	1,695-1,785	1,165	530-620
2030-2039	1,695-1,785	1,155	540-630

The above projections of demand for National Forest timber represent estimates of the volume that would be purchased if it were available. Actually, it is not possible for National Forest timber to be supplied at the levels necessary to satisfy projected demand over the next 50 years (see "Cumulative Effects of Alternatives on Vegetation" section in Chapter IV). It is therefore necessary to conclude that the expected reductions in non-National Forest timber supply are quite likely to limit any long-term demand-induced recovery of the Peninsula timber industry. Assuming a relatively stable flow of harvest volume from National Forest sources, the combined effects of current demand and anticipated future supply conditions on the Peninsula timber industry are expected to be as follows:

1. A steady decline in timber harvest and mill output from 1990 through 2020 is likely to occur due to lack of supply. A similar decline took place in the 1980 to 1984 period due to lack of demand. This decline, however, represented a temporary response to market conditions rather than a long-term consequence of reduced supply.

2. A shrinkage of mill capacity and employment opportunity will occur as harvest declines. The period 1990 to 2020 will be a time of transition as the Peninsula economy adjusts to reduced supply conditions.

3. Continued high demand combined with declining supply will result in some increase in stumpage prices for the timber industry. Higher prices may bring increases in timber availability from small tract owners, but these sources are relatively limited.

4. Stabilization of the Peninsula timber industry will occur at a lower level of output and employment. It is expected that this will occur by the year 2020.

TIMBER - SILVICULTURAL TREATMENTS

It is anticipated that new silvicultural treatments, such as reproduction of trees by tissue culture, will be developed for general field use, while some existing treatments will be modified or deleted. Specialized crossing of trees to produce desired characteristics will probably continue. The number of applications of fertilizer may increase, or the area treated may be expanded to include other soil types and tree species. The timing and number of commercial thinnings may change. The age of precommercial thinning and number of trees left, or the need for the treatment itself, may change. The relationship of new developments or changes to management of the Forest will be reviewed and evaluated as the need arises or new technologies are developed.

OVERSTOCKED STANDS - DOGHAIR

The acres of doghair stands will continue to decline, due to the experimental program. If economical, doghair will continue to be converted into new stands. Some of these areas will grow out of the stagnated condition and produce future commercial-size logs for lumber. Some areas may never be economical for timber production or reach commercial size. It is anticipated that, as a result of careful site preparation, planting and precommercial thinning, no new areas will be added to the doghair category.

OTHER FOREST PRODUCTS

Use increases are expected to continue. It is likely that State laws will be passed to help control mushroom harvesting. Additional controls will also be necessary to avoid overuse of other products.

PLANS OF OTHERS

The Forest Land Management Program, Draft Environmental Impact Statement, Washington State Department of Natural Resources issued in 1979, projects the sustainable harvest level from State-owned or administered lands for the next 100 years. The Statewide goal for timber to be sold for the years 1980 to 1989 was 805 million board feet annually. This amount increases to a high of 896 million for the years 2000 to 2009, then declines to 762 million board feet by the years 2020 to 2029. The Olympic Area (generally Olympic Peninsula) shows a different harvest rate as indicated in Table III-16.

Table III-16. Washington State Timber Flow - Olympic Area

Decade	Timber Volume (MMBF)	Percent Change
1980-1989	338	-31
1990-1999	232	-30
2000-2009	162	-2
2010-2019	159	+9
2020-2029	173	

Since publication of the draft statement, there have been numerous changes in the management objectives applicable to DNR timberland on the Peninsula. A new Forest Land Management Program is currently being developed to incorporate these changes. At present, tentative projections of future DNR harvest levels from the Olympic Area indicate a fairly stable harvest flow, averaging roughly 225 million board feet per year, over the next five decades.

The draft statement also includes an insect and disease program with objectives to protect and preserve the forest resources of Washington State against destructive forest insects and diseases. The goal is to reduce damage and loss to tolerable levels as determined by the resource values involved. The State has an agreement with the Forest Service (not just the Olympic National Forest) to share the cost of prevention, protection, evaluation and technical assistance in detecting insects and diseases.

The Washington Forest Resource Plan, Washington State Department of Natural Resources issued in 1985, provides the framework for the State to cooperate with nonindustrial private forest landowners. The goals are: to increase productivity of nonindustrial private forest land and encourage retention of these lands in forestry; to expand public education about forest resource management; and to improve harvest efficiency for increased wood fiber recovery. No projected timber harvest flow was presented, but the potential is thought to be great. Nonindustrial private forest land is 26.2 percent of the total commercial forest land in Washington State. As a comparison, the total National Forest land in the Washington State is 26.3 percent.

The Olympic National Park Proposed Master Plan and Final Environmental Statement, published in 1976, does not display a timber harvest level. Several research projects are proposed. One would provide a baseline data survey of Park ecological resources, including vegetation maps.

Botanical Areas and Research Natural Areas are intended to be part of a regional network of preserves and protected areas involving Federal (RNA and Special Interest Areas), State (Natural Area Preserves) and private holdings (The Nature Conservancy). The primary objective of this system is to preserve natural ecosystems and gene pools of typical or rare and endangered plants and animals. The Forest works in cooperation with the Pacific Northwest Research Natural Area Committee (comprised of several Federal agencies), the Washington State Department of Natural Resources, under direction of the Natural Heritage Plan (DNR 1989), and The Nature Conservancy to ensure that regional needs are met and that duplication of effort is avoided.

RIPARIAN AREAS, WETLANDS, AND FLOOD PLAINS

THE ROLE OF RIPARIAN AREAS, WETLANDS, AND FLOOD PLAINS

Riparian areas, wetlands and flood plains play a significant role in: (1) providing fish and wildlife habitat, (2) protecting water quality, and (3) providing recreational opportunities. Riparian areas help maintain water quality by acting as filter zones for overland water flows. Also, these areas can be a significant source of sediment to a stream, and serve a critical function as habitat for fish and wildlife. Flood plains play a role similar to riparian areas. Wetlands provide habitat for numerous wildlife species.

Riparian areas occupy a limited amount of space in the forest environment, but receive heavy use by a great number of wildlife species. Vegetation near water creates an important habitat component for most wildlife. The gentle slopes near major streams at low elevations provide winter habitat for many species. Riparian areas have a greater diversity of plant composition and structure than uplands. They are natural migration routes, and serve as travel corridors for many wildlife species.

Because of their influence on the aquatic environment, the riparian areas along Class I and II streams are essential to fish populations. They provide the supply of large, woody debris necessary for maintenance of proper spawning and rearing habitat. In some streams, up to 50 percent of rearing pools are created or enhanced by large, woody debris. It also provides instream hiding cover for fish.

CURRENT SITUATION

RIPARIAN AREAS

Approximately 28 percent (177,044 acres) of the Forest land base is within riparian areas, or Water Influence Zones (WIZ). 1/ These areas include the water and adjacent lands which can directly influence the aquatic ecosystem by contributing shade and organic or soil material. The WIZ, or riparian area, generally extends 200 feet on each side of all streams.

The majority of the streams on the Forest were surveyed in the late 1970's. Information on channel stability, as well as biological and other physical parameters, was collected. These surveys showed that the streambank stability of the smaller streams (Class III and IV) is, generally, moderately unstable to unstable in the natural condition. The large streams (Class I and II) are normally moderately unstable to stable. Smaller streams tend to have steeper side slopes than larger, more established streams. The small streams have an average side slope of 62 percent, while the larger streams average 35 percent.

WETLANDS

There are approximately 5,970 acres of wetlands delineated on the Forest Soil Resource Inventory maps. The majority of these wetlands are located throughout the Forest as pockets in flat areas; however, there is a concentration of wet soils in the Cook Creek area of the Quinault District. Executive Order 11990 directs Federal agencies to take those actions necessary to minimize the destruction or degradation of wetlands, and to ensure their survival and quality.

1/ Stream classes are described in Forest Service Manual (FSM) 2526-Riparian Areas (R-6 Supp. 51).

FLOOD PLAINS

There are approximately 2,500 acres and 74 river miles of flood plains on the Olympic National Forest. The totals for the three zones on the Forest are: Westside--1,400 acres and 41.3 river miles, Eastside--300 acres and 8.2 river miles, and CSYU--800 acres and 24.8 river miles. These flood plains generally extend for 200 feet or more from the water's edge, and are inundated by high water at least once every 100 years. Executive Order 11988 requires Federal agencies to avoid, to the extent possible, the long and short-term adverse effects associated with the occupancy and modification of flood plains. This Order also requires Federal agencies to avoid the direct or indirect support of flood plain development whenever there is a practical alternative. In a few instances, roads and campgrounds are adjacent to, or within, major flood plain zones.

HISTORIC TRENDS

Because the amount of riparian area is basically fixed, the primary concern with supply is the quality of available habitat, rather than its extent. Access, occupancy, vegetative change, and the timing of activities have the greatest influences on the quality of this resource.

Until the last decade, management of riparian areas was primarily concerned with maintaining water quality and streambank stability. Riparian areas are now recognized as providing key wildlife habitat and maintaining quality fish habitat and recreational opportunities. In the late 1970's, the importance of woody debris in streams for fish habitat was recognized.

Wetlands in the Cook Creek area have increased in size (up to 100 and 200 acres) due to disruption of drainage patterns by railroad grades and logging roads. Past timber harvest activities have also contributed to creating more wetlands in the area by reducing evapotranspiration. Other small wetlands scattered throughout the Forest have not been significantly increased in size or affected by management activities.

Relatively few activities have occurred within major flood plains, though several of our major campgrounds are located in these areas. Roads that are located within flood plains occasionally are damaged by flood waters and need repair. Little timber harvesting has occurred in these situations. Hardwoods usually predominate in the stands, along with some large cedar. The major exception is a stretch of the South Fork Skokomish River. This area was cleared in the early 1960's in anticipation of construction of a reservoir for electric power generation by Tacoma City Light. The project was later shelved and will probably not be developed.

FUTURE TRENDS

The riparian areas will continue to be in increasing demand for numerous uses. They receive high levels of fish, wildlife, and recreational use relative to their small portion of the total land base. Demands for these uses will continue to compete with demand for use of riparian areas as a source of timber. Fish and wildlife habitat and water quality will continue to be the primary management concerns in riparian areas.

There is a critical need to provide for a future supply of large woody material along stream channels for fish habitat, particularly on Class I and II streams.

It is anticipated that few, if any, activities will occur in flood plains. Timber harvest activities are likely to continue adjacent to some wetland areas.

No future changes are anticipated in cliff and cave environments. Demand for road construction material available from talus will increase.

PLANS OF OTHERS

The Department of Natural Resources is responsible for administering the Forest Practices Rules and Regulations for the State of Washington. These regulations establish timber harvest practices for areas within or adjacent to riparian zones, flood plains and wetlands. Forest Service direction is to meet or exceed the Forest Practices Rules and Regulations for the State of Washington.

The Shoreline Management Act for Washington addresses protection of areas adjacent to water bodies such as riparian areas and flood plains. The Department of Ecology administers the Act with individual counties having jurisdiction through implementation of their own Shoreline Master Plan. The Department of Ecology along with the counties are in the process of establishing regulations for wetlands.

WILDLIFE

THE ROLE OF WILDLIFE

Wildlife plays an important role in the natural ecosystem and is one measure of the productivity of the land. Game animals and furbearers are considered by many to be a crop from the forest which can yield high returns. Many species are essential for maintaining the productivity of the forest. They play an important ecological role in the environment by transporting pollen and seeds, keeping vegetation browsed back, and keeping insect populations in balance. Wildlife also plays an important part in recreation use of the Forest. It provides for the consumptive uses of hunters as well as nonconsumptive values for the visitor who likes to watch wildlife and the city dwellers who are happy just knowing it is there.

CURRENT SITUATION

Wildlife habitat on the Olympic National Forest is made complex by the Olympic Peninsula's relationship with the sea. The close proximity of saltwater, the area's weather patterns, the extensive river network and flat, stable flood plains giving way to sharp, unstable interior mountains create a wide range of habitats and animal diversity. Prevailing winds and the Peninsula's isolation from the Cascades and the Willapa Hills have generally prevented interbreeding of many nonmigratory wildlife species. The Olympic marmot, Roosevelt elk and Cope's salamander are wildlife subspecies that have been influenced by geographic isolation.

The wildlife resource on the Olympic National Forest is also heavily influenced by the presence of Olympic National Park. The 904,800 acres of the Park provide additional habitat for species that spend a portion of each year on the Forest. This available habitat enables genetic interchange and provides big game summer and winter range, as well as habitat for both game and nongame birds and animals.

HABITAT DIVERSITY

The Eastside, Westside, and Shelton CSYU zones of the Peninsula vary both physically and biologically. Big game winter range comprises approximately 14 percent of the land base on the Eastside zone, approximately 36 percent on the CSYU, and approximately 50 percent on the Westside zone. Natural habitat biological variance is demonstrated by differences in the proportions of vegetation types. Non-forested habitat features form a very small part of the total land base. Particularly unique habitat types include wetlands, cliffs, caves and talus.

ANALYSIS OF STAND CONDITIONS

The relative abundance of the grass-forb, shrub, open sapling-pole, closed sapling-pole/sawtimber, large sawtimber over 21 inches in diameter, and old-growth (with dead and down material and two canopy layers) stand conditions can be translated into a ratio of habitat components (e.g., forage, hiding and thermal cover and old-growth). Each of these habitat components can consist of one or more of the stand conditions. For descriptive purposes, the forage component is composed of the grass-forb, shrub, and open sapling-pole conditions, while hiding and thermal cover are composed of the closed sapling-pole/sawtimber and large sawtimber over 21 inches in diameter stand conditions. Refer to Table III-9 for more information on existing vegetative conditions.

WILDLIFE DIVERSITY

The Forest provides habitat for 61 species of mammals, 226 species of birds, 7 reptiles and 15 amphibian species. A full list of the species and their related habitat needs is contained in "Wildlife of the Pacific Northwest" (Guenther and Kucera 1978). This wildlife resource and the associated on-Forest habitats generate recreation-related use valued at approximately $1,420,000 annually, based on assigned RPA (Resources Planning Act) values.

Although most wildlife species use several or all vegetative age classes, many are oriented to either early or late successional stages. Availability of habitat in either the early or late stages of forest growth strongly influences both the abundance and the diversity of associated wildlife species.

This response to structural habitat components in the environment (ecotype, stand condition and special habitat features) provides a framework to estimate the effects of management activities on wildlife species. Based on their responses to habitat conditions, certain birds and mammals have been identified as indicator species.

INDICATOR SPECIES

Each indicator species represents an association of other animals that respond to the same set of structural components. It is assumed that management which maintains or enhances the habitat of the indicator species will likewise maintain or enhance that of its "association." Seven species, or groups of species, have been selected as indicator species. These are:

Columbian Black-Tailed Deer and Roosevelt Elk: These two species are identified as management indicator species needing a balance of cover and forage dispersed throughout the landscape. They are also an indicator of the level of vehicular harassment to wildlife populations. The Columbian black-tailed deer is the most abundant game species on the Olympic National Forest. The most recent estimate of herd size supported by Forest habitat is 6,500 animals, with over one-third of these in the SCSYU. Peninsula-wide, deer populations appear to be increasing. The average annual deer harvest rate from 1984-88 was 21.6 percent, providing approximately 37,000, 12-hour Wildlife and Fish User Days (WFUDs) of recreation per year. On-Forest populations appear to be increasing as a result of increased forage availability following timber harvest activities.

Roosevelt elk is a popular game species and is also a focus of public concern. The most recent estimate of numbers utilizing the Forest habitat is 3,200 elk, with over 80 percent occurring on the Westside zone. The 1984 to 1988 average annual elk harvest rate was 9 percent, providing a total of 15,000 WFUDs per year. Big game populations suffered large losses during the severe winter of 1968 to 1969 (Taber and Radaeke 1980) with an estimated loss of 30 to 40 percent of the elk on the Olympic Peninsula. Elk populations on the Olympic Peninsula rebounded quite rapidly after the winter of 1968 to 1969. Elk numbers reached their historic peak in the mid to late 1970's and began a slight decline in the early 1980's. This is thought to be the result of the steadily increasing hunting pressure on the Olympic Peninsula.

Pileated Woodpecker and Pine Marten: The pileated woodpecker and the pine marten represent species that inhabit mature conifer habitat. While each requires mature conifer habitat, home range and distribution requirements are different. Habitat exists to support high numbers of both pileated woodpeckers and marten. The marten's solitary and secretive behavior patterns make it very difficult to monitor actual population levels.

Primary Cavity Excavators: This group of species represents snag-dependent cavity nesters. It includes animals dependent on dead or dying trees of varying sizes for the construction of nest sites. Current snag densities are at a level capable of supporting high numbers of these species, but snag density in younger stands are often suboptimal.

Bald Eagles: The bald eagle is a Federally listed Threatened species sensitive to management of riparian areas. Mature timber is needed for nesting and roosting. At present, 16 nest sites are protected as the Olympic National Forest's share of sites determined necessary in the Pacific States Bald Eagle Recovery Plan (1986). Sufficient unoccupied habitat exists to support significantly greater numbers. With decreased harassment and continued food availability, eagle populations can be expected to increase. It has been recently proposed that the bald eagle be removed from the Threatened Species list in Washington State.

Northern Spotted Owl: The spotted owl is a sensitive species in the Forest Service's Pacific Northwest Region. It represents wildlife species associated with mature and older timber stands in the Douglas-fir and other conifer types. Spotted owls also occur in other stands that meet their habitat needs. This habitat is referred to as "atypical" habitat. Although it represents a small portion of the known range of the spotted owl on the Olympic Peninsula, it contains some of the most successful breeding pairs on the Forest.

Because the spotted owl is identified as a sensitive species and has been selected as an indicator species, management of suitable habitat is necessary to ensure the maintenance of a "viable population, well distributed across the Forest" (36 CFR 219.19).

The Pacific Northwest Regional Guide describes suitable spotted owl habitat as mature, timbered stands having multilayered conditions, a canopy closure of 70 percent or greater, and obvious decadence. The Regional Guide also indicates that deviation from this description is possible, based on local research data, habitat models, or other informational sources.

Suitable habitat on the Peninsula has been tentatively defined as consisting of the above conditions as found in the following stands:

A. Stands under 4,000 feet elevation with the following characteristics:

    1. Typical habitat

        a. Stands with timber larger than 21 inches DBH.

        b. Stands with timber of average size larger than 9 inches and less than 21 inches DBH which are more than 160 years old. A number of trees within these stands may be greater than 21" DBH.

    2. Atypical habitat

        a. Stands with a light scattering of timber larger than 21 inches DBH. A light scattering is anything from 1 to 29 trees per acre. Stands of timber which Forest Biologists thought unsuitable for spotted owls were removed from this category.

        b. Stands identified by District biologists as being used by spotted owls which do not meet the above criteriea.

B. Olympic National Park:

A map of potential spotted owl habitat in Olympic National Park was developed in the mid-1970's using LANDSAT data.

C. Washington Department of Natural Resources:

All stands of timber on the west side of the Olympic Peninsula owned by DNR which have a stand origin date before 1921.

Field surveys since the late 1970's have identified 99 occurrences of individuals or pairs of spotted owls on Olympic National Forest. The following table summarizes the spotted owl information for the Olympic Peninsula:

Table III-17. SUMMARY OF OWL OCCURRENCES

	Breeding Pairs	Other Pairs	Total Pairs	Single	Total
Olympic National Forest 1/	41	30	71	28	99
Olympic National Park 2/	5	13	18	27	45
DNR & Other	4	7	11	8	19
TOTAL	50	50	100	63	163

1/ Olympic National Forest spotted owl survey work began in the late 1970's. This was fairly cursory with informal protocols. The ONF surveys in the early 1980's were part of a State-wide effort to take a census of spotted owl populations in Washington State. These surveys were carefully documented and conformed to strict protocols. Survey work conducted during 1983 and 1984 varied between districts and records are often poor. Since 1985 records have improved and with increased effort, more owls have been found.

2/ Approximately 35 percent of the habitat currently identified as suitable for spotted owls in Olympic National Park has been surveyed for owl occurrence. Eighteen pairs of owls have been found. If this rate of occurrence is representative of owl occurrence potential, there could be about 43 pairs of owls in the Park (refer to Chapter IV for further discussion). The R-6 DSEIS and R-6 FSEIS estimated that the Park has the potential to support about 30 pairs of owls. Olympic National Park occurrence numbers are based on surveys done between 1985 and 1989. They may not be indicative of actual owl populations because surveys were confined to roads and trails. These figures also include owls occurring in the coastal strip of the Park.

SOHA SUMMARY-ONF	
SOHAs with: (1985-1989)	
Reproductive pairs	(19 of 30) 63%
Pairs where reproduction is unknown	(12 of 30) 40%
Presence of spotted owls	(28 of 30) 93%
No confirmed occupancy	(2 of 30) 7%
NETWORK SUMMARY	
Breeding pairs in network	(33 of 41) 80%
Total pairs in network	(49 of 71) 69%

The spotted owl population on the Olympic Peninsula may be isolated from that in the Cascade Mountains. Recent surveys have shown the presence of spotted owls using habitat midway between the Olympics and Cascades. Based on the field survey data, coupled with information on the amount and distribution of habitat that appears to be suitable, habitat on the Forest is estimated to be capable of supporting approximately 99 pairs of spotted owls. Field studies on the Olympic National Forest indicate that spotted owls are using approximately 2,750 acres of suitable habitat per pair.

The spotted owl habitat network for Olympic National Forest consists of 30 Spotted Owl Habitat Areas (SOHAs) and all suitable spotted owl habitat in reserved areas. All but two of the SOHAs are occupied by spotted owls. The two SOHAs that are not occupied were established to provide linkages between other SOHAs and the rest of the network.

The SOHAs, averaging 3,000 acres each, are spaced no more than two miles apart. Clusters of three SOHAs are spaced no more than eight miles apart. This is to ensure that the owl population will continue to be well distributed. Individual SOHAs have been established where conditions preclude clusters. To the extent possible, the sites were located on lands not available for timber harvest or on lands already allocated to prescriptions compatible with spotted owl habitat needs.

During 1987, 1988 and 1989, intensive inventories were conducted to document current occupancy and reproductive success in the proposed network of SOHAs. Adjustments in the number, location and size of SOHAs in the network may occur in the future. These changes will be based on spotted owl inventory and monitoring efforts and on definitions of suitable habitat for the Olympic Peninsula. The definition will be updated using information from the Spotted Owl Research, Development and Application Program (which involves a five-year research program begun in 1987) and from other inventories, monitoring, research and administrative studies concerning spotted owls (USDA FS FSEIS 1988).

The following table is a summary of spotted owl habitat for the Olympic Peninsula.

Table III-18. Habitat Acres Currently Suitable on the Olympic Peninsula

	Suitable Habitat Acres
Olympic National Park	403,500
Coastal Strip (34,380 acres total–approx. 2,380 acres nonforested beach)	32,000
Washington DNR and Other	80,800
Olympic National Forest	272,008
TOTAL SUITABLE HABITAT ACRES	788,308

1/ All figures based on Olympic National Forest GIS maps, July 1989.

MOUNTAIN GOAT

Another species of local concern is the mountain goat. This species was introduced to the Peninsula in the 1920's. The concern surrounding the goats is their foraging on native plants. Their wallowing also increases soil erosion. Roughly 200 animals (1987 estimate) are located within established Wildernesses on the Forest. On March 18, 1988, the Olympic National Park signed a Record of Decision and implemented a plan to reduce goat populations in several critical areas of the Park through a live-capture/removal program. At the end of three years, the program is to be evaluated and the decision made to continue it, modify it or adopt a new program for goat control in the Park.

Goats inhabit both the Park and the Forest on a seasonal or other migratory basis. The goats on the Forest are a wildlife resource managed by the State of Washington Department of Wildlife. They represent a unique hunting opportunity not provided by any other species on the Olympic Peninsula. Their potential impact on the Forest resources, including native plant species, will be monitored during implementation of this Forest Plan.

HISTORIC TRENDS

The wildlife resource on the Olympic Peninsula, including that on the Forest, has been affected by settlement patterns and past uses of the land. It is doubtful that the aboriginal tribes were large enough to have had a significant impact on either the wildlife or its habitat.

With the advent of market hunting, following the entry of Europeans into the area, big game population levels dropped until regulatory measures were taken. Not until 1905, when the State legislature started establishing hunting regulations, did populations start to stabilize. These regulations, coupled with changes in habitat (increased logging activity resulting in increased forage availability), allowed populations to begin increasing.

Big game populations suffered large losses during the severe winter of 1968 to 1969 (Taber and Radaeke 1980). The winter of 1968 to 1969 caused an estimated loss of 30 to 40 percent of the elk on the Olympic Peninsula. Elk populations on the Olympic Peninsula rebounded quite rapidly after the winter of 1968 to 1969. Elk numbers reached their historic peak sometime in the mid to late 1970's and began a slight decline in the early 1980's. Other wildlife populations probably remained fairly constant, although changes in habitat composition throughout the Peninsula favors species dependent on younger forested conditions. The shift toward intensive utilization of the available resources through settlement patterns, logging activities and the consumptive use of wildlife, has shaped the current level of availability of the wildlife resource.

FUTURE TRENDS

The assumption was made that the demands of hunters and other "consumers" of wildlife will always exceed the capacity of the land to produce animals. Assuming that all people who are actively hunting expect to be successful, "demand" will never be met. Demand for nongame species (nonconsumptive uses) is assumed to be met if viable populations are maintained. In order to provide a meaningful basis to assess various output levels, the demand indices in Table III-19 were developed. These represent the level of output needed to maintain overall user satisfaction at today's level.

These indices reflect the assumption that outputs must increase at the same rate as the user population in order to continue providing the same degree of user satisfaction.

Table III-19. Relative Demand for Wildlife

Year	1990	2000	2010	2020	2030
Game Species Index	100	109	116	126	134

Response to the demand for limited resources is complicated by the fact that the Forest Service manages habitat, while the Washington Department of Wildlife manages wildlife populations. Because the Forest must provide for other uses on its land, it cannot be managed exclusively for wildlife.

The potential future supply of overall wildlife outputs can be achieved only when an "optimum mix" of habitats for all species is present. If a single species is emphasized through management, its population increases will be at the expense of other species. For example, habitat management aimed at providing older forest conditions favoring species such as the spotted owl and marten, would lower the quality of habitat for deer and elk.

The opposite situation is also true. Management aimed at providing younger forest cover would favor deer, but have adverse effects on the northern spotted owl and marten. One of the major factors affecting the future supply of wildlife is the amount, variety, and distribution of vegetative comunities throughout the Forest.

PLANS OF OTHERS

Plans of other agencies can affect wildlife within the Forest. The Olympic National Park is the largest landholder on the Peninsula. The 904,800 acres of the Park are managed to provide only nonconsumptive use of wildlife. The Park provides security for wildlife by providing undisturbed habitat and prohibiting hunting. The Park's management for nonconsumptive uses places increased hunting demand on the wildlife found on the Forest.

The Washington State Department of Wildlife is primarily responsible for managing wildlife populations, while the Forest Service is responsible for managing the animals' habitat on National Forest lands. The Department of Wildlife has established management goals for game and nongame species within the State (Strategies for Washington's Wildlife, Washington Department of Wildlife (WDW), January 1982). In general, the Department's goal is to maintain or enhance the 1970 to 1979 game population levels, with emphasis on habitat protection and management. The State-wide goal for black-tailed deer is to increase populations, while the goal for Roosevelt elk is to maintain the current level.

The Forest Service consults with the USDI Fish and Wildlife Service when its activities might affect plants or animals listed as threatened or endangered. If necessary, activities are modified or actions deferred when they would adversely affect such species. Olympic National Forest management is in compliance with recovery plans for listed species.

Activities of the Washington Department of Natural Resources (DNR) also affect the wildlife resource, but in a more indirect way. DNR was established to administer State timberlands which generate operating capital for all levels of the educational system in the State of Washington. Under this mandate, State timbered lands on the Peninsula are being harvested and converted to younger stands. Wildlife dependent on an old-growth environment are either being displaced to other areas of suitable habitat or lost. Displaced wildlife can increase the pressure on suitable old-growth habitat on the Forest.

Due to safety considerations, the regulation of logging activities by the Washington Department of Labor and Industries has an effect on dead and defective tree habitat. The ability to leave standing dead trees for primary cavity excavators is hampered by the rules and regulations governing woods workers near these potential safety hazards. Enforcement of these regulations limits the distribution of dead standing trees and affects the recruitment (over time) of these as down material used by cavity-dependent species. The Forest Service has been working with the Washington Department of Labor and Industries to find ways to leave dead and defective trees in areas which do not pose a threat to the safety of workers in the woods.

Management of the forest resources on Indian and private lands have similar effects to those described for DNR lands. Where the landowner's management does not include a priority for providing for wildlife and fish habitat, forest-dependent species may suffer. State Forest Practice Act provisions address some of the wildlife habitat concerns but do not establish it as a requirement on private lands.

FISHERIES

THE ROLE OF FISHERIES

The salmon and trout species produced and/or reared within aquatic habitats of the Forest contribute considerably to the sport and commercial fisheries resources of the Olympic Peninsula. This is especially true of the sea-run or anadromous species that spawn in Forest freshwater habitats, then migrate to the ocean to grow to adults. The majority of these species are captured in the ocean, or in the rivers downstream from the Forest during their return spawning migrations.

The actual portion of Olympic Peninsula anadromous fish produced on the Forest is unknown. However, using river miles of habitat accessible to anadromous fish as a guide, National Forest management directly influences about 43 percent of the total habitat within drainages flowing through or from the Forest. Fifteen percent of the total habitat is within the National Forest boundary, while 28 percent is downstream and can be influenced by the Forest's activities. The remaining 57 percent is upstream, or tributary to downstream reaches and is not directly influenced. The fisheries resource influenced by the Forest is significant. Many coastal communities and Indian Tribes on the Peninsula rely on recreational and commercial fisheries revenues. Additional information about the relationship between National Forest management of the fisheries resource and the Indian Tribes is presented later in this chapter under the heading "American Indians."

In addition to managing on-Forest fisheries habitat, the Forest Service is responsible for maintaining water quality and natural fish passage within all river systems that occur on the Forest. This is important because about 28 percent of the river miles accessible to anadromous fish influenced by on-Forest activities occur downstream on State and private lands. Maintaining fish passage is also important because 20 percent of the river miles accessible to anadromous fish are located upstream from the Forest in Olympic National Park.

Since there is only limited information for Olympic Peninsula streams that do not flow through the Forest, an estimate of total habitat on the Peninsula has not been made.

CURRENT SITUATION

FOREST FISH SPECIES

The suitable surface waters of the Forest provide habitat for significant populations of cold-water fish species. Although there are, at present, no listed endangered or threatened fish species known to utilize habitat located within the Forest boundary, several candidate species do exist on the Olympic Peninsula. The Olympic mud minnow is found on the National Forest, and the bull trout is found in the National Park. Selected management indicators for fisheries habitat include anadromous and resident salmon and trout species groups. These species are collectively referred to as salmonids. These selections were made because the fishes within these groupings are significant sport and/or commercial species, and their populations are sensitive to environmental change. These, as well as nongame fish species, are briefly described as below:

ANADROMOUS SALMON AND TROUT

For discussion purposes, anadromous fish include the migratory species commonly considered to have commercial and/or sport fishing value. The major anadromous fish that utilize accessible on-Forest habitat include chinook, coho, chum, pink and sockeye salmon, steelhead and sea-run cutthroat trout. Collectively, these species contribute to the sport fishery, the commercial fishery, and the American Indian subsistence/ceremonial fishery. Fish produced on-Forest contribute to both on-Forest sport fishery and downstream uses.

RESIDENT SALMON AND TROUT

Resident fish include several species recognized as game fish. Rainbow and nonmigratory cutthroat trout are the primary species occurring in Forest streams. Other, less abundant stream species include Dolly Varden, brook trout, mountain whitefish and Kokanee salmon. The majority of these are found in suitable Forest lakes and reservoirs. Two lakes support introduced populations of Atlantic salmon.

NONGAME FISH SPECIES

Nongame fishes include western brook, river and Pacific lamprey, Olympic mudminnow, carp, redside shiner, longnose dace, large scale sucker, three-spined stickleback, and coastrange, shorthead, torrent, prickly, and reticulate sculpin. Most of these species coexist and are generally distributed with the anadromous and resident species that inhabit Forest streams. Nongame species were not selected as management indicators because the distribution and habitat requirements of the salmonids and nongame fishes generally overlap. Therefore, the assumption was made that if adequate habitat for salmonids is maintained, the requirements for native nongame species will also be met. The one exception is the Olympic mudminnow.

The Olympic mudminnow is found only in the State of Washington, occurring only in the coastal lowlands of the western Olympic Peninsula. On-Forest populations have been found only in the bogs and marshes of the Cook Creek area of the Quinault Ranger District. In general, the species prefers dense aquatic vegetation, mud stream bottoms and brownish, quiet waters associated with bogs and swamps.

SHELLFISH AND MARINE FISH SPECIES

Forest shellfish species include numerous mussels, oysters, cockles, clams, shrimp, and crabs that inhabit the tidal flats near Seal Rock Campground located on Hood Canal. The marine fish species that utilize these tidal flats during high tide include dogfish sharks, herring, smelt, cod, hake, pollock, perch, rockfish, and a host of other species found in the waters of Hood Canal.

FISHERIES HABITAT

Habitat information presented here includes all areas within the Forest boundary. Therefore, some of the habitat included is not managed by the Forest Service, but these amounts are minor.

There are approximately 350 river miles, or 1,507 surface acres, of habitat on the Forest currently accessible to anadromous fish. In addition, there are approximately 424 river miles, or 773 surface acres, of isolated stream habitat that presently support resident fish populations. The types and quantities of habitat located within each planning zone are listed in Table III-20. Current habitat management direction is to maintain or enhance fisheries habitat by preventing or mitigating adverse effects on fisheries resulting from Forest resource management activities. Habitat enhancement projects are implemented as funding becomes available.

In addition to the stream habitat, there are 44 lakes or reservoirs that provide an additional 3,416 surface acres of suitable habitat. Thirty-six of the impoundments, totaling 3,357 surface acres, are located on the Hood Canal Ranger District. The Quilcene District has seven lakes totalling about 20 acres, and Soleduck Ranger District has one impoundment of about 39 acres. Currently, there are no lakes or reservoirs located on the Quinault Ranger District except Quinault Lake which is part of the Quinault Indian Reservation.

Each of these species found on the Forest will tend to thrive in a different type of habitat. Coho Salmon do better in habitat that has a large percentage of pools as opposed to Steelhead, which do better if there is a larger percentage of riffle in a stream. Sockeye usually need a lake for rearing. There are many other factors which can affect fish habitat capability in general. Some of these factors include cover, channel morphology, water temperature, and macro invertebrate production. After carefully considering all of the needs of the fish species, it has been determined that generally summer low flow rearing habitat is the limiting factor for most of the salmonids on the Forest. All of these factors will be considered when individual habitat improvement projects are initiated for specific drainages.

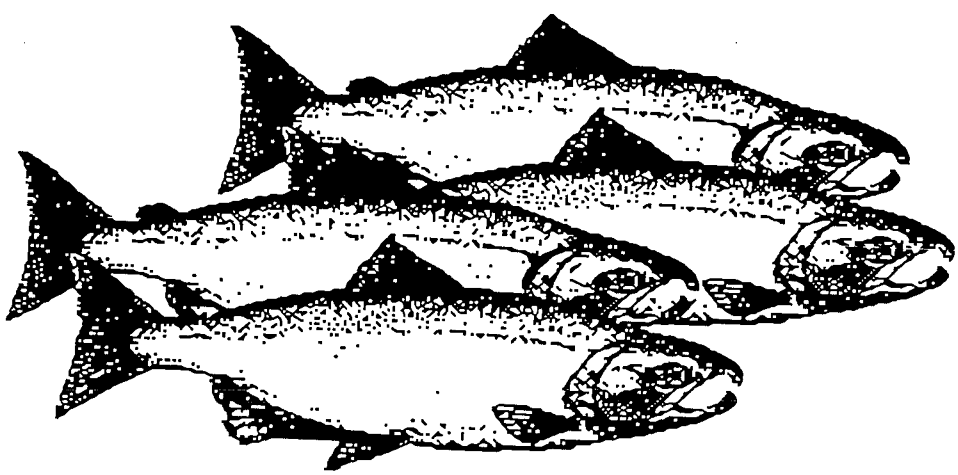


Table III-20. Existing Stream Fisheries Habitat

	On-Forest				Influenced Off-Forest	
	Resident Habitat		Anadromous Habitat		Anadromous Habitat	
Drainage System or Geographical Area	River Miles	Acres	River Miles	Acres	River Miles	Acres
East Straits 1/	20.9	18.3	3.7	4.9	21.1	18.0
Dungeness River	13.4	14.2	24.9	159.5	15.3	71.3
Little Quilcene River	6.8	12.2	0.0	0.0	5.5	7.0
Big Quilcene River	22.4	57.7	2.6	14.8	4.2	4.1
Dosewallips River	2.7	3.6	8.1	88.4	6.0	44.4
Duckabush River	5.7	30.9	4.8	43.1	3.3	12.5
Hamma Hamma River	34.7	102.6	0.0	0.0	2.6	15.2
Hood Canal Independents 2/	9.8	14.0	0.0	0.0	2.7	4.4
N. Fork Skokomish River	7.2	17.5	0.0	0.0	0.0	0.0
S. Fork Skokomish River	46.3	87.8	22.3	90.1	31.0	339.0
W. Fork Satsop River	13.4	24.4	0.0	0.0	0.0	0.0
Satsop River	15.7	28.5	6.9	16.2	103.0	636.0
Wynoochee River	22.0	31.0	27.4	181.2	44.8	717.0
Humptulips River 3/	35.5	73.7	41.9	130.8	83.2	943.0
Quinault River	22.0	31.0	34.4	181.2	54.5	4,181.7
Queets River 4/	16.4	27.0	41.1	123.5	77.9	444.1
Hoh & Bogachiel Rivers	2.7	3.0	8.6	35.8	31.6	244.4
Calawah & N. Fork	25.0	16.2	31.1	88.4	14.3	237.7
S. Fork Calawah & Sitkum	27.1	26.0	18.6	111.2	5.0	285.9
Soleduck River	41.9	35.5	59.7	220.7	72.7	1,069.7
West Straits 5/	33.8	113.4	14.3	16.9	47.7	109.7
FOREST TOTALS	423.7	773.3	350.4	1,506.7	626.4	9,385.1

1/ East Straits drainages include Snow, Salmon, Jimmy-Come-Lately and McDonald Creeks.
2/ Hood Canal Independents include Lilliwaup, Waketickeh, Fulton, Jackson, Marple and Spencer Creeks.
3/ Humptulips River also includes influenced off-Forest anadromous habitat in the Wishkah River.
4/ Queets River also includes influenced off-Forest anadromous habitat in the Raft River.
5/ West Straits drainages include the Elwha, Lyre, East Twin, West Twin, and Pysht Rivers and Deep Creek.

EXISTING HABITAT CAPABILITIES

Actual fish production information for the suitable habitats located on-Forest is not available. Therefore, current production or habitat capability estimates were made based on 1989-1990 data provided by the Washington State Departments of Wildlife and Fisheries. This information was utilized to generate Habitat Capability Indices for each of the major drainages on the Forest. The capability indices for anadromous fish production assumes that the escapement goals provided by the Washington State Departments of Wildlife and Fisheries are adequate to seed the available habitat in the various river systems under the existing environmental conditions. Using information on both escapement goals and survival rates from the State of Washington, we were able to calculate the number of smolts which could be produced on the Forest. Taking the smolt production numbers and applying a smolt to adult survival rate, we are able to determine the total adult production coming from the National Forest. The total adult production coming from the Forest minus the escapement goal will yield the number of fish available for the sport, commercial, and Indian fishery. The number attributed to each fishery was determined by a catch factor provided by the State of Washington. Resident fish capability estimates for streams were developed in a similar manner. Stream Habitat Quality Indices (HQI) were also developed to estimate current habitat conditions. These estimates were primarily derived from predicted effects of current nonnatural sediment outputs. The existing habitat quality and capability estimates (potential outputs) for the major Forest drainages are displayed in Table III-21. The economic values associated with these potential outputs are $1,180 million per year from the commercial fishery and $690,000 per year from the recreational fishery. These figures are based on resource values developed for the 1985 RPA Program. American Indian fisheries subsistence values are included in the commercial values.

Table III-21. Existing Habitat Capabilities (on-Forest)

Drainage Systems	Total Smolt Production Numbers 1/	Commercial Weight (Lbs/Yr)	Anadromous WFUDs/Yr	Resident WFUDs/Yr
Big Quilcene River	105,354	30,197	570	767
Bogachiel River	1,790	395	30	40
Calawah River	191,080	80,376	1,294	561
Deep Creek	14,146	812	23	133
Dosewallips River	3,614,222	263,380	3,177	48
Duckabush River	1,672,138	129,424	1,519	411
Dungeness River	2,381,780	167,880	2,196	189
East Twin River	11,794	2,673	46	234
Hamma Hamma River	25,766	16,198	543	1,365
Hood Canal Independents 2/				186
Humptulips River	105,280	32,283	506	980
Jimmy-Come-Lately Creek	6,886	420	5	16
Little Quilcene River	0	0	0	162
Matheny Creek	65,210	22,893	444	119
Pysht River	31,018	5,837	116	549
Quinault River	398,310	71,511	553	412
Salmon Creek	90,338	7,243	74	228
Salmon River	7,550	2,149	48	119
Sams River	20,330	7,734	106	120
Satsop River	27,820	10,941	181	704
Skokomish River	202,230	96,096	2,229	1,400
Soleduck River	271,950	78,079	1,115	472
West Twin River	31,406	6,255	101	593
Wynoochee River	235,110	89,938	1,408	476
OUTPUT TOTALS	9,411,508	1,122,714	16,286	10,285

1/ Total numbers of adult anadromous fish produced per year including escapement. (Pink salmon runs occur only every other year.)
2/Hood Canal Independents include Lilliwaup, Waketickeh, Fulton, Jackson, Marple and Spencer Creeks.

HISTORIC TRENDS

Fish production from aquatic habitats located on the Forest, from a historic perspective, is believed to have declined. This decline is believed to be primarily attributable to two major factors. First, there has been a decline in resident and anadromous fish production resulting from management of other resources, both on and off the Forest. Logging and roading has increased sediment yields, created barriers to fish migration, and removed or reduced sources of large instream woody debris. Effects such as these have reduced fish habitat quality and quantity and are believed to have led to subsequent reductions in fisheries productivity. The second factor or cause is the adverse effect that overfishing has had on natural or "wild" anadromous fish stocks.

Overfishing of the wild stocks, in conjunction with the harvest of hatchery fish, has resulted in fewer adult fish returning to their natal waters to spawn. Although the magnitude of the decline is unknown, it is assumed that these factors, in combination, have reduced fish production from on-Forest habitats.

FUTURE TRENDS

The three principal sources of demand for fisheries outputs are: commercial fishing, ocean sportfishing and freshwater sportfishing. With all three, supply falls far short of "demand." The assumption is that people who engage in fishing do so with the expectation of success; the higher the success rate, the greater the satisfaction level (and profit level, in the case of commercial fishing). For these reasons, any growth in fish population will increase satisfaction, leading to more "demand" of this resource.

As with wildlife, demand indices were developed to reflect the resource output growth needed to maintain overall user satisfaction at present levels through time. These are based on the assumption that outputs must increase at the same rate as user population if the current level of satisfaction is to be maintained.

Table III-22. Relative Demand for Fisheries

Year	1990	2000	2010	2020	2030
Demand Index	100	109	116	126	134

PLANS OF OTHERS

Although the Forest Service is responsible for managing fisheries habitats located on National Forest lands, State agencies are responsible for harvest and/or production levels governing the fish populations that utilize these habitats. The Washington Department of Fisheries manages the marine, anadromous foodfish, and shellfish species. The Washington Department of Wildlife manages anadromous and resident game fish, as well as other nongame fish species. Both agencies plant juvenile hatchery stocks in habitat on National Forest land.

These stocks supplement natural production and increase the productivity of the habitat. The Washington Department of Wildlife also stocks the high lakes on the Forest which are managed as "put-and-take" fisheries.

Olympic Peninsula Indian tribes plant fish eggs in incubator boxes and/or stock juvenile salmonid species to increase productivity from on-Forest habitats.

INSECTS AND DISEASES

THE ROLE OF INSECTS AND DISEASE

Insects play a very important role in the ecosystem, from providing food for other insects, animals, and fish to pollinating plants. Insects and diseases damage or kill trees, thereby creating snags and down woody material for a variety of wildlife species. Both snags and down woody material, in turn, provide homes for other insects and diseases. Diseases also soften wood, making it easier for cavity nesters to build their nests.

Insects and diseases are two of the natural forces that interact in the environment. They are instrumental in providing for plant diversity and can play a major role in determining the successional stage of a plant community. When present at endemic levels (the natural level in the environment), they can be beneficial. However, when insect populations or incidence of disease reach epidemic levels, adverse consequences may occur.

CURRENT SITUATION

Insects are present throughout the Olympic National Forest; however, they are normally at endemic levels and of little concern. There are six major insect species that occasionally reach epidemic levels. They are: Douglas-fir beetle, silver fir beetle, balsam woolly aphid, western blackheaded budworm, Sitka spruce weevil, and western hemlock looper. The damage they cause affects recreation safety, wildlife habitat and timber crops.

Diseases are also present throughout the Forest. They affect both young plantations and mature forests, with losses in total stand cubic foot volume ranging from 5 to 50 percent. The four diseases of most concern are: laminated root rot, Armillaria root rot, heart and butt rots, and hemlock dwarf mistletoe. The damage from these affects timber production, recreation safety, and wildlife habitat. A number of other diseases, including Rhizina root rot, black stain root disease, and Rhabocline needle cast, occur on the Olympic National Forest but do not cause major damage. White pine blister rust affects most of the western white pine on the Forest, and rust-resistant stock from the Dorena Tree Improvement Project in Oregon is used in reforestation of this species.

INSECTS

Douglas-fir Beetle: Douglas-fir beetle outbreaks are usually associated with disturbances such as windthrow, ice damage, fire damage, insect defoliation, and root rot infection. Beetle populations can increase substantially in the damaged trees, then move to live, green Douglas-fir trees. These trees are most susceptible for one or two years after a major insect population increase. Populations will generally subside after this time. In recreation sites, the trees killed by beetles can be hazardous because of falling limbs and susceptibility to windthrow. However, patches of beetle-killed trees create open areas which promote growth of shrubs, create snags, and are generally beneficial to wildlife habitat.

Silver Fir Beetle: Generally, this beetle is considered to be a secondary pest. Populations typically increase in windthrown, felled, injured, and severely suppressed trees. Trees may also be predisposed to attack by silver fir beetles after experiencing heavy infestations of the balsam woolly aphid. Beetles can kill standing green fir trees, especially Pacific silver fir, if the population density is high or the trees are under stress. Most healthy trees can withstand the low populations common on the Forest. The effects of this insect are similar to those of the Douglas-fir beetle.

Balsam Woolly Aphid: The aphid generally is found along the main stem and crown of Pacific silver fir trees that are nine inches in diameter or larger. Large concentrations along the main stem often cause trees to die quickly, sometimes within two or three years of the initial infestation. Crown infestations, however, cause trees to decline slowly, sometimes hanging on for years. Growth is retarded and the upper portion of the stem may be killed. These insects may also weaken trees and predispose them to attack by silver fir beetles.

Western Blackheaded Budworm: Large populations of the budworm may cause total defoliation of trees and/or kill the tops of western hemlock. Douglas-fir, Sitka spruce, and true firs can also be affected, but to a lesser degree. Tree mortality may occur if heavy defoliation occurs for two or more years. On the Olympic National Forest, populations are not normally high enough to cause significant whole-tree mortality, but will cause loss in growth and some top kill.

Sitka Spruce Weevil: Large plantations of young Sitka spruce are ideal for promoting weevil infestation. The weevil kills or seriously injures terminal shoots when trees are from 8 to 30 years old. This results in diminished height growth, forked tops, and/or crooked stems. This insect's presence is currently limiting the Forest's ability to replant Sitka spruce. As a result, Sitka spruce does not occur over large areas, and the effects of the weevil are minimal.

Western Hemlock Looper: The most extensive and damaging outbreaks of the looper have been recorded in old-growth western hemlock. Large population increases may be triggered by climatic factors. The larvae feed on both old and new needles, completely defoliating some trees. Tree mortality may occur after one or two years of extremely heavy defoliation. Lower defoliation levels will cause top kill and growth loss.

Cone Insects: Damage by cone and seed insects can seriously affect seed yield and quality (Theisen 1976). Seed insects may completely destroy seeds or damage them so they will not germinate. They can also weaken the seeds so they will not retain viability in storage, or become highly susceptible to fungal damage during germination. The list of insects includes two beetles, one seed bug, one cone maggot, four midges, three moths, one seedworm, and two wasps.

Cone and seed insect populations fluctuate naturally from season to season, depending on the number of cones available. Populations increase following years of extensive cone crops and decline when cones are less abundant (Meso 1978). Therefore, large cone crops can absorb residual (low) insect populations, with overall damage less than serious. However, when cone numbers are relatively low, residual insects converge on all available cones with serious results.

DISEASES

Laminated Root Rot: Laminated root rot causes a substantial reduction in productivity in infected stands. Based on surveys conducted by Forest Pest Management on the Olympic National Forest, it is estimated that five percent of the land occupied by susceptible hosts (Douglas-fir, grand fir, Pacific silver fir, Sitka spruce, western hemlock, and western white pine) has reduced production due to the disease. Because the disease affects the roots of host trees, it is extremely hazardous when it occurs in developed recreation sites. Laminated root rot often causes openings in stands. This promotes growth of shrubs, creates snags, and starts the succession of plants over again. Planting with resistant hardwoods or more disease tolerant host trees reduces the losses.

Armillaria Root Rot: This disease reduces the number of trees and growth per acre in the early years of plantation development. Armillaria root rot may kill up to 50 percent of the trees in a plantation. Mortality tends to occur in groups. The disease has many hosts, but it is most common and damaging in young Douglas-fir trees (under 30 years old). If recreation sites are infected, it may be necessary to plant resistant species in order to provide a tree cover.

Heart and Butt Rots: These rots are most common in old-growth. Because heart and butt rots contribute to tree breakage, they create habitat for cavity nesters. They also cause substantial reduction in merchantable volume of old-growth timber stands, with losses ranging from 25 to 50 percent of the cubic foot volume in western hemlock and true firs and 10 to 30 percent in Sitka spruce, western redcedar and Douglas-fir. Danger is greatest in recreation sites where old-growth stands of western hemlock and true fir occur, especially if there has been some tree wounding.

Hemlock Dwarf Mistletoe: Mistletoe is primarily a concern in older timber stands. It causes considerable wood loss, degrades the wood, and causes some tree mortality in old-growth. Losses are often associated with heart rots, but mistletoe may contribute an additional loss of 10 to 20 percent of the volume. Effects are generally minimal in young stands, but can become extreme if the young stand has an infected stand above it. Mistletoe in recreation sites is dangerous due to weakened limbs and tops that might fall. Mistletoe often provides food and cover for wildlife and is generally found in areas that have not been burned for at least 600 years.

HISTORIC TRENDS

Major insect outbreaks on the Olympic National Forest are rare. In the late 1950's, there was a major Douglas-fir beetle attack on the Soleduck District. This rare buildup was probably the result of the 1951 Forks burn that covered about 33,000 acres, 16,000 acres of which was National Forest land. Normally, damage from insects has been limited to scattered trees and small, isolated areas.

Cone and seed insects have caused major damage in the Dennie Ahl Seed Orchard. In 1967, 33 percent of the total seed produced was damaged, mostly by midges. Normally, loss is around three percent. Damage to cones and seed from other areas on the Olympic National Forest has not been recorded.

Diseases are also generally isolated in small areas throughout the Forest. Frequency of occurrence and size of area affected, however, is on the increase.

FUTURE TRENDS

Major insect outbreaks are unpredictable. Although population buildups could occur in logging slash or in damaged timber in the Wildernesses and Olympic National Park, none are expected.

Diseases are likely to affect more areas as timber harvesting continues. New incidence is most likely to occur in young plantations. Increase in root-rot infected stumps may increase the spread of this disease in succeeding stands.

Cone and seed insect populations will continue to fluctuate with the number of cones present. The Dennie Ahl Seed Orchard may have major outbreaks unless some type of control is applied.

FIRE

THE ROLE OF FIRE

Fire has always been a part of the environment of Olympic National Forest. Historically its rates of occurrence have varied widely from one time period to another, depending on changes in climate. Extent and effects of different fires are complicated by the effects of weather, climate, vegetation condition, and stand age. The pattern and periodicity of fires, in turn, affect the seral stages and species of plants occupying the Forest, which in turn affect future fuel patterns and fires (Henderson et al., 1988). The concern with fire and the need for its suppression is based primarily on concern for its economic effects on resource values.

CURRENT SITUATION

Historically fire occurrence was related to climatic patterns, with many more fires during the dry years from 1910 to 1934 than during the wetter decades of the 1960's, 1970's and 1980's. During the relatively wet decade of the 1970's, however, fire occurrence was primarily related to levels of use of the Forest. In the 1970-1979 decade the Forest averaged about 52 fires per year, burning 529 acres. In the 1979-1988 decade, fire occurrence dropped to 19.1 fires per year, burning 270 fires.

In the average year of the decade, 270 acres burned in wildfires with 95 percent of these acres a result of escaped slash disposal fires. Of the slash disposal escaped fire acres burned, 26 percent were reburn acres. During this decade, approximately 5,000 acres per year were treated with prescribed fire with the escaped fires representing a rate of about 3.8 percent of the treated areas.

At the experienced rate of fire occurrence in the past decade (1979-1988) of 19.1 fires burning 270 acres per year, the fire return period for the Forest would be about 2,342 years. This is considerably longer than the "natural" return rate for fire based on Henderson's data of 339 years. This primarily reflects the effects of different climatic conditions.

Normal strategy for suppression of wildfire is to deprive the fire of fuel through the use of fuelbreaks. Tactical application of this strategy is through the development of mineral-soil firelines between the fire and potential fuels, or application of water or chemical fire retardant to reduce fuel ignition potential.

Fuels are the plant materials that burn in a fire. Their readiness to ignite and the rate of spread and intensity of the resulting fire are affected by weather, the quantity, continuity and arrangement of the fuels, the mixture of particle sizes in the fuel bed and other factors. Under rare, extreme fire conditions, almost complete combustion of vegetation can occur on a site, but generally only dead fuel materials are consumed with green trees and plants being only partially consumed. Green plants that are damaged or killed become potential fuels.

FIRE MANAGEMENT EFFECTIVENESS INDEX (FMEI)

Costs and economic values, associated primarily with the commodity resources, are used to determine cost-effective presuppression and suppression investment levels and/or burnable acre limits (USDA Forest Service, Forest Service Handbook 5109.19, 1982).

Presuppression investments include expenditures for fire prevention, detection, initial attack preparedness and fuelbreak establishment. Fuelbreaks are areas of modified fuels designed to assist in containment/ control of fires that occur. In most cases on the Olympic Forest, fuelbreaks are developed through use of timber sales which remove much of the vegetation from the area. Further reduction of residual fuels (slash) is accomplished through a variety of treatments ranging from physical removal to burning under prescribed conditions.

Forest Service fire planning efforts are designed to identify a level of fire suppression capability that will result in the most cost-effective suppression of fires that occur. If a fire escapes initial action, the escaped fire is evaluated through a process called an Escaped Fire Situation Analysis (EFSA), and suppression action is designed to be cost-effective based on the values at risk, projected fire behavior and other factors.

Development of fire presuppression and suppression response plans also considers a variety of fire agency management responsibilities: the forested lands of the Olympic Peninsula are protected by the State of Washington Department of Natural Resources (State, private, and Indian lands), the National Park Service (Olympic National Park lands), and the Forest Service (Olympic National Forest lands). There are also organized fire districts for protection of improved property in more heavily inhabited areas. These entities all have slightly different fire protection objectives which are coordinated, as necessary, in planning and implementation.

HISTORIC TRENDS

Ecological studies (Henderson, 1989) indicate that prehistoric fires were large and infrequent and that ccurrence on the west side of the Forest was very rare. Major fires appear to have occurred at approximately 200-year intervals. However, since early settlement, very large fires which characterized the presettlement era have not occurred. The largest post-settlement fires have occurred on the Soleduck and Quilcene Ranger Districts.

Since 1952, the Olympic National Forest has averaged less than 300 acres of wildfire per year. The worst years were 1975 when 1,003 acres burned, and 1984, when 1,016 acres burned. Although fire-fighting techniques and equipment have improved since the early years, the main reasons for these decades of low fire occurrence are: (1) greatly improved prevention, as most of the severe historical fires were caused by people and, therefore, preventable, and (2) a change in the summer precipitation pattern. During the decades of the 1910's and 1920's, for example, summers with less than two inches of precipitation were common.

During the period from 1953 to 1983, there were only two years with summer (June, July and August) precipitation less than two inches at the Olympia weather station. (Though much of the Forest gets more rainfall than Olympia, this figure is used here as an index to show the marked difference between the summer precipitation patterns when there were extensive fires on the Forest, and more recent times when relatively few acres burned.)

The patterns of past fires also correlate with plant associations and vegetation zones. In the cooler, moister associations, fires appear to have been much less frequent than on drier or warmer ones. An analysis of reconstructed fire patterns showed that the Sitka spruce, silver fir and mountain hemlock zones had far fewer acres burned than the western hemlock, subalpine fir or Douglas-fir zones. During the last 340 years only 30 percent of the area of the silver fir or mountain hemlock zones burned, while 128 percent of the western hemlock zone had. The fire return period for the Sitka spruce, mountain hemlock and silver fir zones for the last 800 years were 900, 844 and 629 years, respectively. The western hemlock, subalpine fir and Douglas-fir zones had fire return periods of 234, 208 and 138 years, respectively (See Table III-23).

These relationships reflect the environmental differences between different groups of associations at the series level. They also suggest that the risk of wildfires in the future varies by plant association or vegetation series.

Table III-23. Summary of Fire History by Vegetation Zone. 1/

	Western Hemlock Zone	Silver Fir Zone	Sitka Spruce Zone	Subalpine Fir Zone	Mountain Hemlock Zone	Douglas-Fir Zone
Acres	430,500	163,600	19,000	14,300	17,300	2,200
Percent of Forest	64	24	3	2	3	<1
Average Fire Return Period for the last 800 years	234	629	900	208	844	138
Acres burned since 1645 (340 years)	550,500	49,200	7,000	19,000	5,100	3,700
Percent of area burned in the last 340 years	128	30	37	133	30	168

1/ Henderson, et al. 1989

Management of the Olympic National Forest has largely concentrated on harvesting mature timber stands and replacing them with young stands. Douglas-fir has been the species most commonly favored. The scale of these stand conversions for the last several decades has been at a rate of 5,000 to 7,000 acres per year, generally in the form of clearcut harvesting in blocks of up to 100 acres in size. The amount of woody material removed from these sites has depended on market conditions at the time of harvest. In some cases, the ground surface has been further cleared by required removal of large, nonmerchantable material to decking sites. Generally, the next step in treating the remaining material has been burning of the area to reduce the residual quantities of smaller fuels. The purpose of this is to reduce wildfire hazards and remove physical obstacles to reforestation of the site. This scale of stand and fuels manipulation is considerably above the natural scale of events.

FUTURE TRENDS

Based on analysis of cost-effective presuppression investment levels, the Forest has developed a proposed funding level that would result in an average burned area of about 100 acres per year, as opposed to the current (1979-1988 projected) rate of about 270 acres per year. The Fire Management Analysis System (FMAS) process will be used to annually evaluate fire program effectiveness and project budget needs (FSM direction).

FUEL TREATMENT

Under Emissions Limit Objectives proposed in the Washington State Implementation Plan (SIP) (Washington State Department of Ecology 1984), developed in response to the Federal Clean Air Act, a "reasonable standard" reduction in total prescribed fire emissions of 35 percent (from the 1976-1979 average level) is to be met by the year 1990. (See also the following section, "Air.")

Development of alternatives to burning for disposing of excess residues are being actively pursued. One of the most promising is the development of markets for previously unused forest residues as energy fuel. (See also the section on "Energy.")

Other alternatives are: accepting increased risk of wildfires due to untreated slash, physically treating slash only in carefully planned fuel breaks or near high risk sites, and/or increasing fire suppression capability to keep fires within acceptable size/damage limits, particularly during periods when fuels are most likely to carry high intensity fires (supplemental protection).

Our current, direct cost of broadcast burning slash is about $285 per acre. This burning reduces debris quantities to levels that permit more economical reforestation by planting and reduces sources of insect and disease infestations and vegetative competition to the planted trees. Use of prescribed fire in conjunction with other means of site treatment is considered in the Forest Service's Regional Vegetative Management Plan and E.I.S. It is estimated that the value of prescribed fire for reforestation site preparation is about $180.00 per acre.

Suppression of escaped slash fires almost doubles the cost of this method of debris treatment. For this reason, methods of slash reduction that will accomplish management objectives while preventing these fires may be cost-effective. The alternative of leaving the slash untreated has been considered but its long-term effects do not appear to be acceptable at this time. It leaves physical obstacles to meeting reforestation objectives and for future, intensive management activities. Studies conducted in Oregon indicate that slash disposal by burning reduces resistance to control of wildfires for about 12 years and rate of spread for about 16 years. Future management savings may be achieved through reduced losses to the new stands of timber and reduced costs of providing for their protection from fire. The alternatives to burning that will accomplish the same thing are too costly for use at this time, even when we consider the cost of escaped slash burns.

It is also true that not all sites benefit from burning. Using new guidelines based on vegetative characteristics of specific sites, we will be able to do a better job predicting the effects of burning on a site. This will enable us to develop better analyses of alternatives. These analyses will consider material in Forested Plant Associations of the Olympic National Forest (Henderson, Peter, Lesher and Shaw 1988). (See also "Forest-wide Standards and Guidelines - Section L, Protection" in the Chapter IV of the Forest Plan.

Our goal is to reduce the use of prescribed fire for slash disposal to the minimum level that will meet management objectives of the Forest Plan. We will also continue to implement improvement in our techniques that reduce the incidence of prescribed fire escapes. We anticipate that we will be able to reduce slash disposal burning to about 50 percent of harvested acres by 1995, and simultaneously reduce particulate emissions and slash burn escapes through application of better techniques and technologies.

Fire is closely linked with air quality and substantially affects visual quality, recreation, old-growth forests, wildlife and fisheries habitat, timber harvest, soil and water and other forest values and outputs. Fire has some benign or beneficial aspects when it occurs or is used in the right place under the right conditions, but in the wrong place at the wrong time, it can do great damage. Because of the complexities of the relationships between fire and the environment in which it occurs, each wildfire and proposed use of prescribed fire is evaluated separately to develop an appropriate suppression response or prescription for its use.

PLANS OF OTHERS

Under State laws, the State of Washington DNR responds to all fires on the private lands it protects with the objective of controlling the fire at minimum burned acreage. On State-owned lands (propriety lands), it may exercise a less intensive suppression policy, but only where its management plans permit. The DNR has legal responsibility for fire protection and suppression on State and private forest lands that lie within the boundaries of Olympic National Forest. Fires originating on National Forest lands may require control suppression to prevent their spread onto these other lands.

The majority of the Olympic National Park is Federally designated Wilderness. Its management plans permit natural fires to play out their role in the ecological development of the Park's biosystems under specified conditions. For this reason, natural fires that originate on the Forest may be permitted to spread into the Park under conditions agreed to by the Park Service.

AIR

THE ROLE OF AIR

Air is essential for almost all living organisms. Air quality is identified as an important element of the environment in provisions of the Federal Clean Air Act and other legislation.

CURRENT SITUATION

Air quality on the Olympic Peninsula is generally considered good. This is due mainly to the Peninsula's lack of industrialization, its low population density and its prevailing weather patterns.

Basic air quality standards for Federally owned lands of the Olympic Peninsula have been established in response to the Clean Air Act Amendments of 1977. Under these standards, the Olympic National Park is designated as a Class I air quality area and the Olympic National Forest has a Class II designation. These classifications establish legal baselines for air quality standards in these areas.

The Wildernesses established in Olympic National Forest by the Washington State Wilderness Act of 1984 currently maintain the Class II standard for air quality in these areas. Studies will be conducted to ascertain whether these areas should be reclassified to Class I.

The major activity on the Forest that affects air quality is the burning of logging slash and debris. The actual amount of slash and debris depends, to a large extent, upon market conditions at the time of logging. The amount consumed in the slash-burning fires depends primarily upon the size and arrangement of the material, its state of curing (readiness to burn) and the way it is ignited.

It has also been expressed that, while smoke as a visibility concern has been addressed, it is a significant health consideration also. This is particularly true where fuelwood is burned in domestic fireplaces and stoves in urban areas. The health aspects of wood smoke, particularly that from woodstoves and fireplaces, are being addressed through State of Washington Department of Ecology regulations on woodstoves and fuelwood burning.

Air quality is being closely monitored by a number of agencies. The results of this monitoring will be used to establish future regulations as needed.

HISTORIC TRENDS

Concern for air quality in the Forest is of relatively recent origin. Beginning in the early 1960's, concern for air quality in the Puget Sound area began to surface. With passage of the Clean Air Act of 1970, the Federal Government began to "zero in" on air pollution factors and identified smoke from slash disposal and other agricultural burning as concerns, but of lesser priority than automobile and industrial emissions.

There are two major sources of air pollutants from the Forest: exhaust gasses and dust from equipment and roads, as well as smoke and particulate matter from slash disposal burning and wildfires. Since the early 1960's, the Forest has been relatively successful at scheduling slash burning to avoid projection of smoke plumes into heavily populated areas. This has been accomplished under smoke management plans developed by the Forest Service, State of Washington Department of Natural Resources and State of Washington Department of Ecology.

FUTURE TRENDS

An objective has been proposed under provisions of the Washington State Implementation Plan (SIP) required by the Federal Clean Air Act Amendments of 1977. This objective is to reduce emissions from prescribed fires by 35 percent of the 1976-1979 level by the year 1990. In essence, this standard could be met through a 35 percent reduction in the amount of residue material disposed of by burning. This reduction in slash volume will most likely occur through better utilization of what is currently seen as unwanted debris, refining burning techniques to meet slash treatment objectives while producing reduced emissions, and closer evaluation of sites to determine whether slash reduction is needed to meet management objectives.

To meet SIP smoke management objectives, the State of Washington Department of Natural Resources has been assigned the responsibility of collating and approving all slash and debris burning proposals on a daily basis. Their procedure evaluates the amount and dispersion of smoke from proposed burns and they have the authority to disapprove ignition if conditions indicate smoke dispersion problems will occur.

The State has been divided into air "cells." Critical smoke avoidance areas have been identified, including the Class I areas referred to previously. Identification of cumulative effects of smoke from prescribed burning is a key objective of this process.

The Forest has been, and is an active participant in research being conducted to develop methods of reducing emissions resulting from Forest activities. The Forest is also active in developing better methods of forecasting effects of proposed emission-generating activities (Washington State Department of Ecology 1984).

PLANS OF OTHERS

It is anticipated that increasingly stringent air quality standards will be established by the Washington Department of Ecology under the provisions of the Clean Air Act. This will affect activities conducted on-Forest that result in air quality problems, as well as the use of woody biomass material for fuel in industrial or domestic applications.

Biomass combustion gasses and smoke contain substantial quantities of air pollutants when burned under uncontrolled conditions. Emission standards have been established and will be enforced for domestic, as well as industrial wood-burning stoves and furnaces.

HISTORICAL AND CULTURAL RESOURCES

OVERVIEW

The cultural resources found in the Olympic National Forest are as unique as the prehistoric and historic people that occupied this remote region. The Olympic Peninsula is a vast, forested area of unusually large timber. Because of its dense undergrowth, it is virtually impenetrable and is renowned for its remote ruggedness. The unusually heavy rainfall and relative inaccessibility have served to establish a rich and unique cultural resource through inhabitants hearty enough to meet the challenge. Some examples are: historic cabins, trails, mines, homesteads, railroad logging remnants, trail shelters, splash dams, historic Forest Service structures (including guard stations, lookout towers, corrals, camps, administrative centers, and Depression Era campgrounds and buildings), prehistoric campsites villages, and summer fishing and hunting encampments and trails.

Many of these properties are unique. They provide the sole record of former inhabitants, ways of life, and human activities. Loss of these cultural resources would leave a large gap in the knowledge of our history, both in terms of understanding the human adaptations, uses and alterations within the Olympic Peninsula rain forest environment, and in terms of their contributions to the social and economic development of the State of Washington.

CURRENT SITUATION

As it is a nonrenewable resource, special consideration is given to cultural resources. In accordance with the National Historic Preservation Act of 1966, the National Environmental Policy Act of 1969, Executive Order 11593, the National Historic Preservation Act Amendment of 1980, and a host of implementing regulations and policy direction as defined in Forest Service Manual 2360, the Olympic National Forest has undertaken a program to identify, evaluate, preserve, protect and enhance cultural resources present within the area administered by the Forest. Efforts are routinely made to locate cultural properties and evaluate their significance for nomination to the National Register of Historic Places.

In 1978, the Olympic National Forest completed an overview study for a comprehensive assessment of the resources present. Since then, over 50,000 acres have been professionally surveyed by various contractors. Cultural Resource Technicians on Ranger Districts also conduct a standard reconnaissance for every project, activity or undertaking. Field reconnaissance, oral interviews and literature searches are conducted to further identify and locate prehistoric and historic resources.

A professional evaluation was completed for structures built during the Depression Era that are representative of the CCC (Civilian Conservation Corps) program. To date, nearly 200 sites have been inventoried, evaluated, and permanently documented. The Seal Rock Shell Midden, Hamma Hamma Guard Station and the High Steel Bridge are listed on the National Register of Historic Places, and 14 other eligible properties will be nominated. The evaluation, nomination, management alternatives, and maintenance of these properties are done in consultation with the State of Washington Office of Archaeology and Historic Preservation (SHPO). Perhaps the greatest benefit of the Forest's focus on this nonrenewable resource program is that most resources will be permanently recorded as they are found and protected thereafter. The present cultural resource program includes an assessment of the effects of Forest undertakings on all cultural properties and the development of measures to avoid or mitigate adverse effects on the sites.

Overall, there is recognition that, as a nonrenewable resource and a fragile, irreplaceable link with past human life, special consideration must be given to cultural properties in the course of land management activities. However, the success in carrying out the program is closely connected with available funding. Ideally, systematic inventory should be carried out well in advance of Forest projects and should be based on a sound research strategy and survey design. A data bank and context must be developed and organized to facilitate discovery of cultural properties, provide a basis for evaluation of significance, and aid in the evaluation of cultural resource needs against other resource management goals so that informed decisions can be made. Where sites are selected for preservation, management should be positive, involving specific maintenance procedures, rehabilitation where necessary, adequate measures for protection, regular monitoring of the effects of natural degradation and public use, and interpretive effects for public involvement, enjoyment and benefit. This approach is dependent upon a sustained investment of money, time and expertise. Without it, unresolved conflicts between competing resource needs will persist, and will result in a continuation of management by mitigation rather than a focused attempt at preservation, protection and enhancement.

A project-by-project approach for development of a data base and associated historic and prehistoric contexts is at best untimely, limited in scope, and ultimately detrimental to cultural resources. That is not to say that a project-level orientation has no benefits, especially in an absence of other systems, programs or methodology, but a balanced approach is essential and desirable whenever possible. A comprehensive effort, in that sense, must be designed, in place, updated, and scheduled to systematically locate and evaluate all resources at the earliest practical date. This is especially critical in order to locate and evaluate resources that may otherwise be left undiscovered through a project survey orientation. Additionally, a systematic and comprehensive approach is essential if development of historic and prehistoric contexts is to have real validity.

Cultural resources are located and evaluated through data base review, literature searches, consultation with SHPO and others, interviews with local experts and informants, and on-the-ground survey and reconnaissance work. The significance of resources are measured by the application of National Register of Historic Names and Places eligibility criteria. The Forest Cultural Resource Management (CRM) program is designed to survey the entire National Forest in compliance with Section 106 of the National Historic Preservation Act in those areas where scheduled resource management activities may affect cultural resources. Project areas with scheduled Forest management activities, are routinely surveyed in advance with SHPO consultation to avoid damage to cultural resource values. Some project activities or locations are also monitored during ground disturbance phases though cultural resources have not been located during earlier reconnaissance or surveys. These monitoring efforts are often prescribed when survey conditions are difficult due to heavy vegetative cover and/or the project activity is scheduled in known or suspected areas where discovery of resources may be likely.

Many historical properties have been identified, evaluated and permanently documented. Evidence of prehistoric use is scarce with a few notable exceptions. A fairly large lithic scatter, a shell midden, some culturally modified trees and several lithic isolates have been discovered in the last few years. Several prehistoric sites have also been discovered within Olympic National Park. The Park Service and Forest Service cooperatively share data to develop a data base and predictive model to enhance survey strategies and design.

Cultural sites on the Forest are protected in a variety of ways. When a site is discovered during the project planning process, the project environmental analysis must address its significance. If a site is found to be significant, it is either avoided or adequate mitigation is provided before project undertakings are allowed to proceed. Development and consideration of alternative management strategies and/or mitigation measures is accomplished through consultation with SHPO or the Advisory Council on Historic Preservation (ACHP). Wildfire control strategies include evaluation of potential damage to cultural resources and measures for protection are prescribed and applied.

Forms of protection and mitigation include: (a) relocation of proposed undertakings, (b) monitoring activities, (c) mandatory restrictions on logging activities, (d) partial or complete data recovery, (e) permanent recordation to Historic American Building Survey (HABS) standards, and (f) educational interpretive displays. One good example is the evaluation, recovery, documentation, and interpretive display of artifacts associated with the Historic CB&M Railroad Company. In recent years, CRM enhancement and interpretation projects have been programmed and funded. There have been some notable accomplishments and benefits from the national program emphasis to enhance and interpret our cultural resources. Some examples are: the Seal Rock Shell Midden Interpretive Trail; our participation in several Washington State Centennial projects, such as "A Time of Gathering" exhibit; CRM Celebration Week at the World Forestry Center; and the Windows on the Past Interpretive Guide.

Specific locations of ceremonial, traditional and religious sites used by Indians have not been mapped or identified. Protection measures will be applied on a site-specific basis through coordination between the Forest Service and tribal leaders as sites are identified.

HISTORIC TRENDS

OLYMPIC PENINSULA

Prior to the mid-1970's, most archaeological and cultural resource surveys on the Olympic Peninsula were conducted on lands other than those administered by the Olympic National Forest.

Concentrated prehistoric and historic use was generally in areas of moderate topography and in the coastal regions. Fishery resources were a principal attraction and account for much of the early use along the lower reaches of the major streams of the Peninsula. Many gathering sites, hunting locations and camps can be readily associated with these areas of heavy use. Archaeological and historical studies and accounts show the Peninsula area to be very rich and productive in archaeological and historical resources. Numerous sites have been recorded, although few have been tested or excavated with results published. In spite of the heavy rainfall, which rapidly deteriorates perishable evidences, literally thousands of objects and artifacts have been recovered. Many sites have been officially recorded, and some discoveries have been spectacular.

The Olympic Peninsula has great archaeological potential. In terms of detailed recoveries and studies, we have literally "barely scratched the surface." Between 1955 and 1975, several surveys were conducted on the Peninsula. Only one was on National Forest land (near Wynoochee Reservoir). One survey of Olympic National Park was conducted by the University of Washington in 1955. It located 19 prehistoric sites, all in the oceanside strip of the Park. Much of the prehistory and sequence of cultural development can be tied to fairly reliable information developed from work in the Fraser River drainage in British Columbia, Canada. Because there are differences in the resources available, much is still to be learned about regional differences and their relationship to local cultures.

OLYMPIC NATIONAL FOREST

While the National Forest areas of the Peninsula are generally very steep, early documented accounts show that inland use did occur. Well-established American Indian seasonal encampments were reported in upper tributaries of the rivers and trails used for commerce. Inland hunting, fishing, and gathering forays no doubt were conducted, as well as ceremonial and spirit quests at sites that today are within the Olympic National Forest. Much of the use probably was transitory. Precise site locations are not very well known, but stream terraces, ridges, saddles and points where trails converged are likely places where archaeological remnants may be found.

Historically speaking, most uses of the Olympic National Forest were associated with management of the National Forest, lumbering, hunting and trapping. Some homesteading and mining occurred, but these uses of the National Forest portion of the Peninsula were not widespread and were limited by severe topography and scarce mineral resources. Many of the early fur traders, explorers and homesteaders settled in the coastal areas or in the river valleys. Farming in these areas offered opportunities for sustaining a meager existence. Fisheries and timber resources continued to provide the basis for development and commerce, much as it is today. What remains of the equipment, cabins, trails, railroad trestles, wagon roads, logging camps, Forest Service guard stations and shelters offer reminders of earlier generations and their lifestyles and pioneering spirit.

AMERICAN INDIANS

Lands managed by the Olympic National Forest have long been used by the Indian people of the Peninsula and Puget Sound areas (see Chapter I, "Overview" for additional details). The lands that now comprise the Olympic National Forest were ceded to the United States by the Point No Point and Quinault Treaties of 1855. Figure III-8 on the following page shows the delineation of lands ceded by each of the treaties that were concluded between then Governor Isaac I. Stevens and the Indian Chiefs, Headmen and Delegates of the various tribes and bands on or adjacent to the Olympic Peninsula. While the various treaties generally resulted in the resettlement of the Indians to reservations, some very important rights and privileges on the ceded lands were retained by these early Americans. All of the treaties included specific provisions and language similar to Article 3, of the Quinault Treaty, "...the right of taking fish at all usual and accustomed grounds and stations is secured to said Indians in common with all citizens of the Territory, and of erecting temporary houses for the purposes of curing the same; together with the privilege of hunting, gathering roots and berries and pasturing their horses on all open and unclaimed lands...". Areas within the ceded lands, which later became the Olympic National Forest, are considered "open and unclaimed lands" with respect to treaty rights.

Certain additional uses and rights on Olympic National Forest lands by American Indians are further recognized by the American Indian Religious Freedom Act (AIRFA - P.O. 95-341). This Act states that it shall be the policy of the United States to protect and preserve for American Indians their inherent right of freedom to believe, express and exercise their traditional religions. This includes, but is not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial and traditional rites. The Act does not convey exclusive use nor does it grant free use of forest products. The Act also does not countermand that publicly owned properties, including objects of antiquity or other cultural resources, remain the property of the United States. Further, the Act does not require that access to all publicly owned sites or properties be provided without consideration of other existing or potential uses or activities.

Inherent in the treaties, various Executive orders and laws that have been enacted and/or litigated, is widely held acceptance and understanding of a U.S. trust or fiduciary duty. That duty centers on caring for the welfare, land and interests of Indians. The trust responsibility for some Federal agencies is quite clear, and yet for others, such as the Forest Service, the trust responsibility is not especially well-defined. This often becomes more obvious when goods and services, related to management of National Forest System lands, are provided for the benefit of all people, but conflict with the interests or concerns of Indian tribes.

The relationship and interaction between American Indian rights and uses of National Forests and other National Forest management activities is complex. While results of litigation may provide some guidelines, many decisions are so specific that results often apply to one National Forest and not to others. Litigation, with respect to Indian rights, is ongoing in many areas of the United States and may result in future changes in management practices on the Forest.

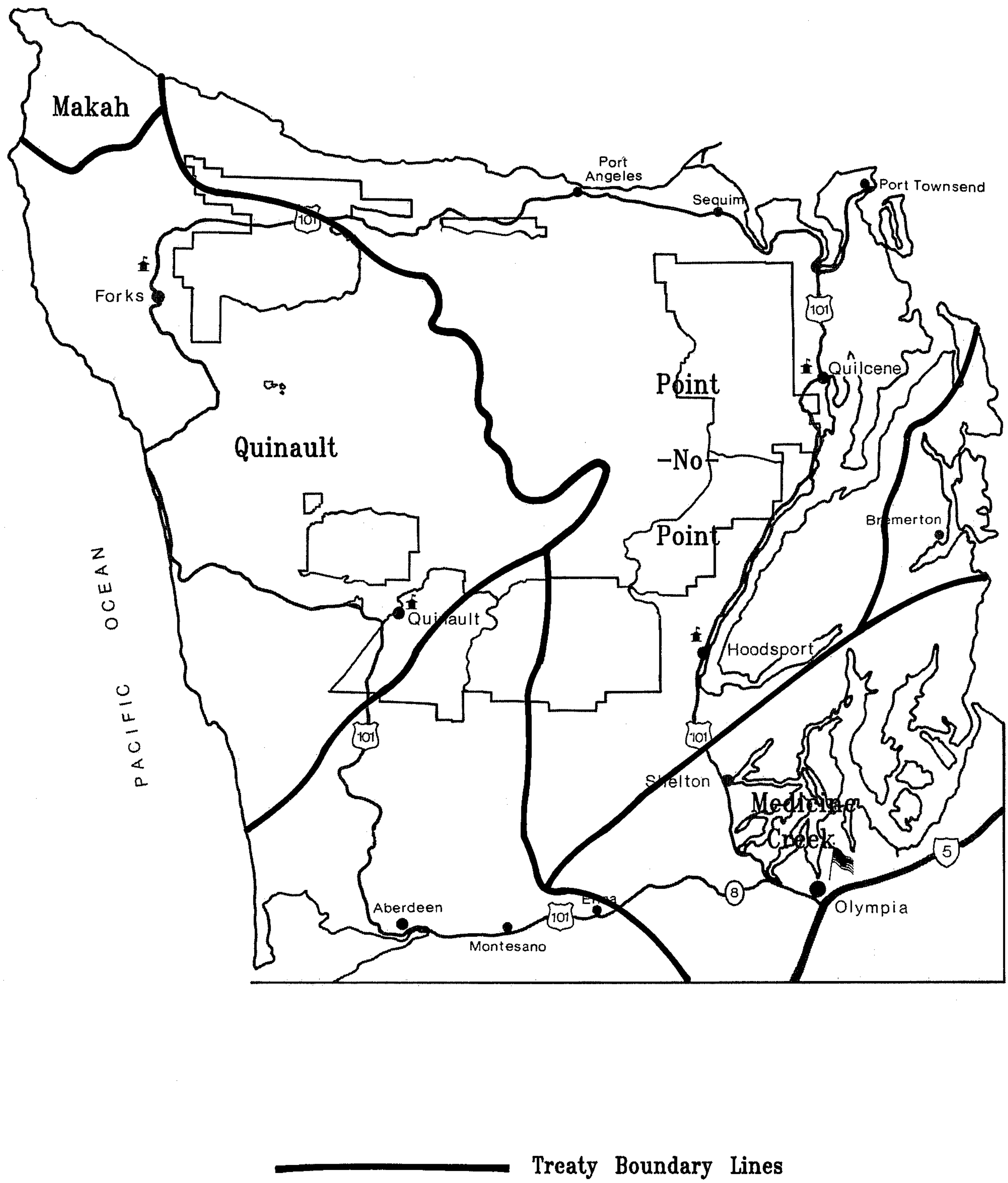


Figure III-8. OLYMPIC PENINSULA TREATY AREAS

In the meantime, fundamental responsibility and accountability can be redeemed through proper management of the resources including consultation with tribes in the formulation and implementation of the Forest Plan. The legitimacy of any claim to a trust or fiduciary responsibility can be met if the intent of applicable treaties, laws or Executive orders is carried out in a just and responsive way. Strong efforts must be made to adjust management of the National Forest in favor of concerns of Indians as far as practicable, while still redeeming our responsibility to all of the people.

At the present time, information about specific locations of traditional American Indian religious sites on the Olympic National Forest is very limited. What is known, is that many ceremonies, religious activities, and special reverences are directly related to the traditional use of cedar and salmon resources. For a special perspective on these issues, please refer to the 1981 Position Statement on the Olympic Forest Plan by Lawrence A. Webster, Suquamish Tribal Chairman. The statement is included in its entirety as Appendix K.

Several related issues are also very important and need to be given consideration. Treaty rights are not the granting or creation of new rights by the United States but the reservation of pretreaty rights. Additionally, treaty rights must be construed as the Indians understood them, and ambiguities are to be resolved in favor of the Indians (Lac Courte Oreilles v. Wisconsin, 1987).

Key to National Forest management concerns is the question of whether the treaty right of taking fish includes or incorporates a right to have treaty fish protected from environmental degradation. At this time, the Courts have generally suggested that an implied right is necessary, since the existence of an environmentally acceptable habitat is essential to fish survival, without which the right would be meaningless (see Winters v. United States; Unites States v. New Mexico; and United States v. Cappaert). The implications are especially important since many anadromous watersheds originate on National Forest administered lands, and the cumulative effects of management are the contexts in which degradation is likely to be considered.

The Shelton CSYU Agreement provides for the cooperative management of some private lands owned by Simpson Timber Company and certain National Forest lands managed by the Forest Service for the primary objective of a sustained, continuous supply of forest products and attendant community stability. The ceded lands of the Medicine Creek Treaty do not include Olympic National Forest ownership. However, these ceded lands do include some of the Simpson Timber Company holdings that are included in the CSYU as well. Simpson Timber Company ownership is not considered "open and unclaimed land" with regard to treaty rights, and State law applies with regard to all forest management practices and standards.

Ceded areas of the Point No Point Treaty include Olympic National Forest "open and unclaimed" lands, some of which also contribute to the make-up of the CSYU. Similar to the Medicine Creek Treaty, the Simpson Timber Company lands of the CSYU are not considered to have "open and unclaimed" status, and all management practices are conducted and authorized under State of Washington laws and regulations.

Rights reserved by the Indians under the various treaties affect Olympic National Forest management activities, particularly those actions that could impair or degrade water quality and anadromous fisheries habitat. This will continue to present a challenge, especially in the context of cumulative effects, their other concerns and the need to honor the treaty rights of the affected American Indians which predate subsequent agreements or commitments.

Further information related to American Indian issues is provided later in this chapter under the discussions of Local Communities and Sustained Yield Units. Also, refer to Appendices A and K.

RECREATION

THE ROLE OF RECREATION

The Olympic National Forest plays an important role in providing developed and dispersed recreational opportunities in the northwest corner of the State of Washington. Situated on the Olympic Peninsula, enriched with many recreational and scenic attractions, the Forest offers a wide variety of recreational activities and settings. Opportunities for camping, picnicking, fishing, hunting, backpacking, auto touring and hiking are among the more common and popular activities available. Unique activities, such as clam digging, oyster picking and saltwater scuba diving are also available.

The Forest provides opportunities for recreation in a range of unique forest settings. The Olympic Rain Forest, saltwater beach and tidelands, rugged mountainous high country, and large lowland lakes are major attractions. The Forest also provides a range of environments that offer different experiences. Primitive settings, at one end of the range, involve a high probability of isolation from the sights and sounds of humans and a high degree of risk and challenge. At the other end of the range are the Roaded and Rural settings, where opportunity for affiliation with other users or groups is high, and dangerous risks and challenges are much less likely to occur.

Recreational opportunities on the Forest also include facilities and areas that have national and regional significance. Lake Quinault Lodge is a large, rustic resort with dining room, swimming pool, gift shop and bar. Nestled in the Olympic Rain Forest on the south shore of Quinault Lake, the lodge provides yearlong use. The Quinault Lake area also has several developed Forest Service campgrounds and picnic areas, and 68 recreational residences. Visitors to this popular recreation area have the unique opportunity to drive or walk through one of the world's few temperate rain forests. Dense ferns, emerald green mosses and lichens, and giant old-growth conifers are common characteristics of the Olympic Rain Forest.

In 1984, the Washington Wilderness Act established five Wildernesses on the Olympic National Forest. These new Wildernesses include a variety of rugged, mountainous settings, attracting visitors from throughout the Pacific Northwest. The Wilderness component is described in more detail later in this chapter.

There are other public land management agencies involved in providing significant recreational opportunities on the Olympic Peninsula. Olympic National Park is a major provider with over 900,000 acres. Over 876,500 acres or 97 percent of the Park is classified as Wilderness. The Park's Wilderness plays a major role in providing opportunities at the Primitive end of the Recreation Opportunity Spectrum. The other 3 percent of the Park provides Roaded recreation opportunities. The Park recorded over 3,474,700 visits in 1986. The Washington State Department of Natural Resources and Washington State Parks also provide recreation opportunities and facilities, especially at the Roaded end of the spectrum. Some private landowners offer developed recreation facilities that provide additional Roaded recreation opportunities. These combined Federal and other lands provide one of the widest ranges of recreational settings of any geographical location in the contiguous United States. Saltwater beaches to glacier-capped peaks; lush rain forest to tundra-like slopes; large, lowland lakes to small, alpine tarns; and wide, meandering rivers to small cascading streams; are among the many contrasting features available for the use and enjoyment of the public.

CURRENT SITUATION

USE SEASON AND ORIGIN OF VISITORS

Over 98 percent of the Forest's recreation use occurs during the six month period from late spring to early fall. The major recreational activities during this time of year include auto touring, camping, resort lodging, picnicking, hiking, hunting, fishing, recreational residence use and gathering forest products. Due to the Forest's steep topography, dense vegetation and lack of snow at the lower elevations, it does not receive much winter recreation use. Winter recreation use includes low elevation hiking, Christmas tree cutting, cross-country skiing on roads, and recreational residence use. There are no developed winter sports or downhill ski areas on the Forest. The characteristics which limit winter use also restrict the opportunity for off-road vehicle use. The road system provides opportunity for some use by four-wheelers and snowmobilers, but off-road travel is restricted to trail bike use on existing trails that are open to ORVs.

Zip code information collected from fee envelopes at two Forest campgrounds gives an indication of the origin of the Forest's visitors. A site inventoried on the west side showed that approximately 48 percent of the use originated within the State of Washington. The remaining use indicated that 15 percent was from Oregon, 14 percent from California and 23 percent from other states. The campground inventoried on the east side of the Forest indicated that roughly 74 percent of its use came from within Washington State. The remaining use was approximately 13 percent from Oregon, 5 percent from California and 8 percent from other states.

Recreation Use

The eastern half of the Forest is within two hours driving time of the 2.5 million residents of the lower Puget Sound area (King, Kitsap, Mason, Pierce, Snohomish and Thurston Counties). Currently, auto touring, camping, resort lodging, hunting, picnicking, hiking, recreation residence use and gathering forest products are the most popular activities on the Forest. Dispersed recreation accounts for approximately 70 percent of the Forest's annual Recreation Visitor Days (RVDs). Recreation use at developed sites accounts for the remaining 30 percent.

The Olympic National Forest receives a tremendous amount of use from visitors who want to recreate on the Forest specifically. Their reasons vary from wanting to participate in activities that are limited or prohibited on adjacent lands (e.g., hunting, which is prohibited in the Park) to recreating in a particular setting found only on the Forest. The Forest's close proximity to Olympic National Park also has an influence on Forest recreation use. Although no specific study has been conducted, personal contacts with the recreating public indicate that a fair amount of the Forest recreation use is the result of people driving or walking through the Forest to access facilities or attractions within the Park. The Forest also provides for "overflow" use when Park facilities are full.

In 1986, total recreation use on the Olympic National Forest was ranked 9th among the 19 National Forests in the Pacific Northwest Region (Washington and Oregon). The Forest's ranking within the Region is higher if only summer Recreation Visitor Days of use are compared.

Recreation use in 1986 was 1,469,600 Recreation Visitor Days. A Recreation Visitor Day is a measure of recreation use that represents 12 person-hours of participation in recreational activities on the Forest; it may be one person for 12 hours or 12 people for one hour each. A summary of RVDs by recreational activities for 1986 is shown in Table III-24.

Table III-24. Recreation Visitor Days by Activity

Recreation Activity	1986 1/ RVD (M)	Percent of Total Use
Dispersed camping	391.7	26.7
Automobile travel	323.7	22.0
Developed camping	184.3	12.5
Resort lodging	154.5	10.5
Hunting	101.5	6.9
Viewing scenery	79.4	5.4
Picnicking	57.4	3.9
Trail hiking, riding, and climbing	50.6	3.4
Gathering forest products	50.2	3.4
Fishing and boating	45.0	3.0
Swimming, water play, and diving	20.2	1.3
All other activities	11.1	1.0
TOTAL	1,469.6	100.0 %

1/ 1986 RVD use figures from RIM Reports numbers 2300-1 and 2300-101.

RECREATION INVENTORIES

Recreation Opportunity Spectrum

Recreation management has the goal of providing a wide variety of recreation opportunities from which the Forest visitor can obtain satisfying recreational experiences. By managing natural settings and the activities that occur within them, the Forest can provide a range of opportunities for recreation experiences.

The Recreation Opportunity Spectrum (ROS) consists of a combination of recreational activities, forest settings and probable experience opportunities arranged as a spectrum. This spectrum is divided into six classes: Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded-Natural and Modified, Rural and Urban. Table III-25 summarizes acreages for each ROS class on the Forest.

Table III-25. Acres of Recreation Opportunity Spectrum (ROS) Classes

ROS Class	Outside Wilderness	Inside Wilderness	Total	% of Total
Rural	5,099	0	5,099	1
Roaded - Natural	436,730	0	436,730	69
Roaded - Modified	41,640	0	41,640	7
Semi-Primitive Motorized	6,599	0	6,599	1
Semi-Primitive Non-Motorized	49,090	36,020	85,110	13
Primitive	4,901	52,245	57,146	9
Total	544,049	88,265	632,324	100

The ROS classes are defined as follows:

Primitive: This class provides the opportunity for users to experience a very high degree of solitude and isolation from the sights and sounds of human activity, in an environment that is essentially unmodified. Most of these areas on the Forest occur within Wilderness.

Semi-Primitive Non-Motorized: This class is similar to the Primitive class, except there may be very subtle alterations to the natural environment, and they are closer to the sights and sounds of human activity. These areas occur within Wilderness and unroaded areas.

Semi-Primitive Motorized: This class provides the opportunity to experience a high to moderate degree of isolation from the sights and sounds of humans, in a setting where the landscape may seem moderately altered when viewed from within the area. This ROS class occurs near relatively low-standard roads in an area that still appears natural, or adjacent to trails open for motorized use in unroaded areas.

Roaded-Natural and Modified: This class provides the opportunity for users to experience a moderate degree of isolation from the sights and sounds of humans, in an environment that is moderately altered and generally accessible by passenger vehicles. In some situations, the setting is heavily modified by timber harvesting activity. Most of the Forest is in the Roaded Natural class.

Rural: This class is often the setting between the cities and the forests. It may include large, well-developed campgrounds, resorts, and other facilities that cater to large numbers of people and provide a high level of personal comfort and amenities.

Urban: This class is dominated by buildings and people in a heavily modified environment. Recreation areas include city parks, large resorts, or highly developed playgrounds. The Forest does not have land in this ROS class.

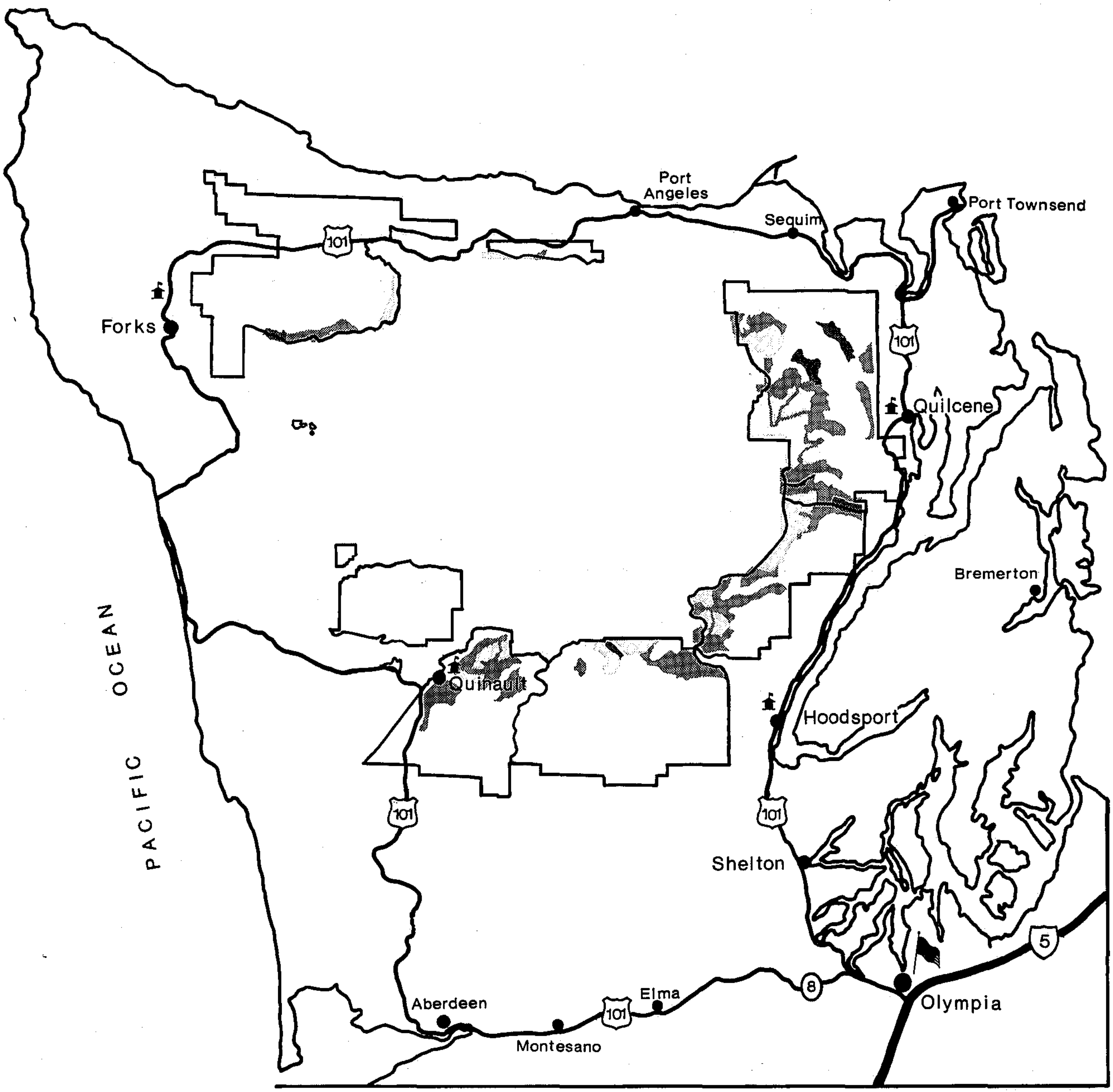
Developed Recreation

Developed recreation sites provide recreation opportunities that are planned and designed to accommodate concentrated numbers of visitors who want to participate in activities such as camping, picnicking, or resort lodging.

Approximately 27 percent of the RVDs of use on the Forest are associated with developed recreation sites. This use is associated with campgrounds, which account for 44 percent of the developed recreation use, Lake Quinault Lodge (39 percent), picnic sites (14 percent), recreational residences (1 percent), boating sites (1 percent) and observation sites (1 percent).

Fourteen of the twenty campgrounds on the Forest have user fees. Daily site fees range from a low of $3.00 to a high of $8.00. One of these sites has a $30 user fee for group use but no fee for individual use. The other six campgrounds have no fee associated with use of their facilities at this time, but some may be converted to fee sites in the future. There is also no fee for day-use facilities, such as picnic areas, boat ramps and observation sites.

Generally, developed recreation use on the Forest occurs on weekends. Although certain areas and activities receive heavy use throughout the week. For example, the Quinault Lake area, with three campgrounds, picnic facilities, a resort lodge, recreational residences and nature trails, is a popular destination area. Visitors often spend several days (weekday and weekend both) in this area. Seal Rock Campground



CLASSES

Primitive

Semiprimitive - Nonmotorized

Semiprimitive - Motorized

Figure III-9. RECREATION OPPORTUNITY SPECTRUM

is a developed site with 2,700 feet of saltwater shoreline and associated tidelands with shellfish. At this site, use during the oyster-picking season is related directly to low tides and may occur any day of the week.

Campgrounds are considered "well managed and well used" when they consistently operate between 20 to 40 percent theoretical capacity. Theoretical capacity is equal to the number of "persons at one time" (PAOT) that the facility can accommodate, multiplied by the number of days in the use season, then multiplied by two RVDs. (There are two RVDs in a 24-hour day). Recreation sites receiving use that is between 20 to 40 percent of theoretical capacity are well used sites and are subject to soil compaction, trampling of vegetation and wear and tear on facilities such as toilets, tables, fire rings and water systems. Those sites where use consistently exceeds 40 percent of theoretical capacity are extremely heavily used and represent the highest priorities for future expansion. The Forest currently has five campgrounds that consistently exceeds 40 percent theoretical capacity (Seal Rock, Willaby, Hamma Hamma, Lena Creek and Elkhorn). There are 10 sites where use is consistently between 20 to 40 percent of theoretical use, and only five campgrounds where use averages below 20 percent.

The Lake Quinault Lodge has a well-deserved reputation as one of the premier resorts in the Northwest. It is located on the south shore of Quinault Lake, approximately two miles from Highway 101, and has been serving its guests since the 1890's. The existing main lodge buildings were constructed in the 1920's and the newer motel units were added in the 1970's. Although the lodge is privately owned, it is located on National Forest land and operates under the terms of a Special Use Permit granted by the Forest Serivce. Currently additional facilities are planned that will provide additional dining facilities and rooms.

There are 68 recreation residences located on the south side of Quinault Lake. Each residence is privately owned on sites occupied under a Special Use Permit administered by the Olympic National Forest. Most of these recreational structures serve as second homes for their owners, who have their primary residences elsewhere.

Table III-26 provides a brief summary of the Forest's existing inventory of developed sites and their capacities.

Table III-26. Existing Developed Sites

	Fee	Number Units	PAOT 1/	ROS Classification
Campgrounds				
Big Creek	Yes	23	115	Roaded
Brown Creek	Yes	20	100	Roaded
Brown Creek House	No	10	50	Roaded
Campbell Tree	No	12	60	Roaded
Chetwoot	No	8	40	Roaded
Coho	Yes	58	290	Roaded
Collins	Yes	16	80	Semi-Primitive, Motorized
Dungeness Forks	No	10	50	Roaded
East Crossing	No	10	50	Roaded
Elkhorn	Yes	20	100	Semi-Primitive, Motorized
Falls Creek	Yes	31	155	Rural
Falls View	Yes	30	150	Roaded
Gatton Creek	Yes	15	75	Rural
Hamma Hamma	Yes	15	75	Roaded
Klahowya	Yes	55	275	Roaded
Lena Creek	Yes	14	70	Roaded
Lena Lake	No	29	145	Semi-Primitive, Non-Motorized
Rainbow	No/Yes 2/	9	45	Roaded
Seal Rock	Yes	42	210	Roaded
Willaby	Yes	30	150	Rural
TOTAL		457	2,285	
Picnic Sites				
Interrorem	No	3	15	Semi-Primitive, Motorized
Picnic Units in Campgrounds 3/	No	29	145	Roaded
TOTAL		32	160	
Boating Sites				
Coho	No	18	90	Roaded
Falls Creek	No	4	20	Rural
Klahowya	No	5	25	Roaded
Willaby	No	5	25	Rural
TOTAL		32	160	
Observation Site				
Mt. Walker	No	10 4/	50	Roaded
Resorts				
Lake Quinault Lodge				
Sleeping	Yes	92	230 5/	Rural
Eating	Yes	136	136	Rural
Bar	Yes	50	50	Rural
TOTAL		278	416	

	Fee	Number Units	PAOT 1/	ROS Classification
Recreation Residences				
Residences	Yes	68	340	Rural

1/ Average 5 persons per unit.
2/ No fee for individual use. Fee for group use.
3/ Units = Coho - 4, Falls Creek - 5, Falls View - 4, Gatton Creek - 3, Seal Rock - 9, Willaby - 4.
4/ Parking spaces.
5/ Average 2.5 persons per room.

Table III-27. Proposed Developed Sites

Camping Sites	Number Units 1/	PAOT 2/	ROS Classification
Big Creek *	40	200	Roaded
Campbell Tree Grove *	13	65	Roaded
Chakchak	40	200	Roaded
Church Creek	40	200	Roaded
Cottonwood Flats	28	140	Roaded
Dungeness Forks *	17	85	Roaded
East Crossing *	20	100	Roaded
Eena	18	90	Roaded
Elkhorn *	15	75	Semi-Primitive, Motorized
Elk Creek	20	100	Semi-Primitive, Motorized
Falls Creek *	25	125	Rural
Gatton Creek *	9	45	Rural
Hamma Hamma *	20	100	Roaded
Hoh River	10	50	Roaded
Humptulips ORV	20	100	Roaded
Jefferson Lake	7	35	Roaded
Julas	100	500	Rural
Klahanie **	54	270	Roaded
Klahowya *	40	200	Roaded
Klugel Creek	60	300	Roaded
Lena Creek *	24	120	Roaded
Lower Dosewallips	20	100	Semi-Primitive, Motorized
Lower East Fork Humptulips	12	60	Roaded
Marple Creek	30	150	Roaded
Matheny Creek	20	100	Roaded
Moollak	40	200	Roaded
Newbury Creek	20	100	Roaded
North Quilcene (Horse)	15	75	Roaded
North Quilcene (ORV)	20	100	Roaded
Ollalie *	10	50	Rural
Oxbow	50	250	Roaded
Pine Lake	15	75	Roaded
Rainbow *	10	50	Roaded
Sams River	20	100	Roaded
Spider Lake	20	100	Roaded
Soleduck ORV	20	100	Roaded
South Fork Skokomish ORV	30	150	Roaded
South Fork Soleduck	45	225	Roaded
Upper East Fork Humptulips	20	100	Roaded
West Fork Humptulips	10	50	Roaded
Wynoochee Falls **	24	120	Roaded
Wynoochee ORV	30	150	Roaded
TOTAL	1,101	5,505	

	Number Units 1/	PAOT 2/	ROS Classification
Picnic Sites			
High Steel Bridge	20	100	Roaded
Lower Satsop Lake	10	50	Roaded
Pine Lake	20	100	Roaded
Spider Lake	10	50	Roaded
Spoon Creek Falls	5	25	Roaded
Picnic units in proposed campgrounds	25	125	Roaded
TOTAL	90	450	
Boating Sites			
Bear Gulch	25	125	Roaded
Hoh River	10	50	Roaded
Kokanee	10	50	Roaded
Falls Creek	30	150	Rural
South Fork Soleduck	10	50	Roaded
TOTAL	85	425	
Observation Sites			
High Steel Bridge	16	80	Roaded
Higley Peak	10	50	Roaded
Humptulips Ridge	8	40	Roaded
Northpoint	5	25	Roaded
Moonlight Dome	8	40	Roaded
Quinault Ridge	10	50	Roaded
West Fork Humptulips	10	50	Roaded
TOTAL	67	335	

1/ Represents an estimate number of units.
2/ Average 5 persons per unit.
3/ Current ROS classification of the proposed site.
* Potential expansion of existing campgrounds.
** Rehabilitate/reconstruct abandoned sites.

Undeveloped Recreation

Undeveloped recreation is that part of the total recreation opportunity occurring outside developed sites. It includes such activities as hunting, fishing, hiking, gathering forest products, mountain climbing, boating, and auto touring, as well as camping and picnicking in Wildernesses and unroaded areas. Currently, 73 percent of the Forest's total recreation use is in undeveloped recreation.

The Forest has approximately 2,500 miles of maintained roads that provide opportunities for undeveloped roaded recreation. These roads provide access to popular undeveloped recreation sites along rivers and at lakes, and lead to trailheads accessing Wildernesses and unroaded areas. Auto touring (driving forest roads for pleasure) is the Forest's number one recreation use.

The Forest has a total of 227 miles of trails, providing access to a variety of undeveloped recreation areas. The trail system accesses Wildernesses, unroaded areas, popular roadside nature walks, streams and lakes.

Approximately 52 percent of the trail system is below 3,000 feet elevation. There are four designated National Recreation trails on the Forest, totaling 21 miles. Fifteen of the trails that begin in the Forest end in Olympic National Park.

The Forest's system trails are narrow travel ways which are managed and maintained on a regular basis to meet specific trail management objectives. Table III-28 provides an inventory of the Forest's existing trail system by Ranger District. Table III-29 summarizes trails on each Ranger District by category: wilderness miles and miles closed to motorized vehicles, pack and saddle stock, and mountain bicycles.

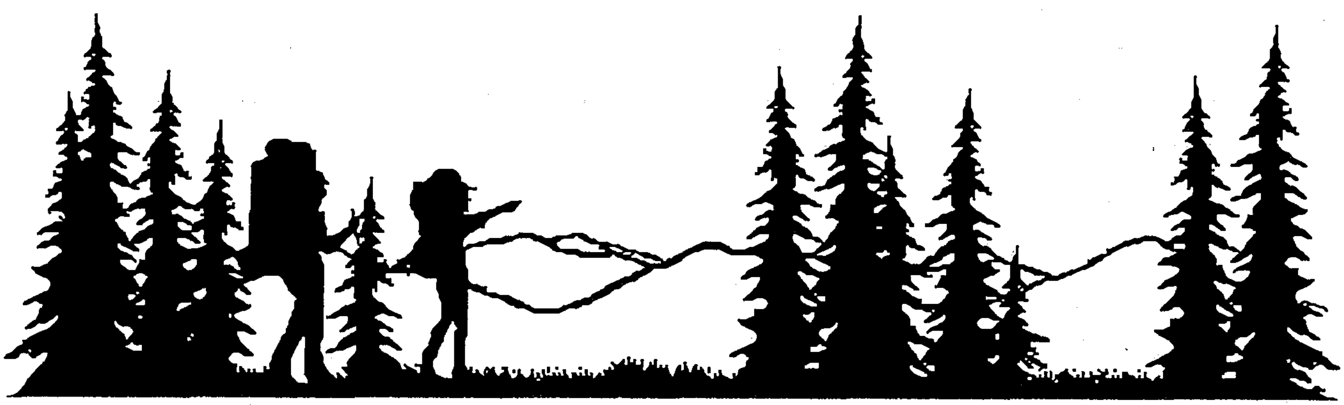


Table III-28. Existing Trails by Ranger District

			Closed to: 1/		
Trail Name	Number	Miles	Motorized Vehicles	Stock	Mtn. Bikes
Hood Canal Ranger District					
Mt. Washington	800	1.1	e		
Duckabush	803	6.2	a & d		a & b
Interrorem	804	0.5	f	a	c
Elk Lake	805	3.0	b		
Jefferson Ridge	808	2.9	g		
Mt. Jupiter	809	2/ 7.2	a & d		a & b
Lena Lake *	810	4.5	b	b	
Upper Lena Lake	811	1.2	d	b	b
Mt. Ellinor	812	2.4	b	b	d
Ellinor Short Cuts	812.1	0.5	b	b	d
Putvin	813	3.0	a & d	b	a & b
Mt. Rose	814	4.8	a & d	b	a & b
Tirnell	815	0.1	f	a	c
Scout Lake	818	3.0	a & d	b	a & b
Monarch Tree Grove	820	0.3	b	b	
The Brothers	821	4.5	a	b	a
Mildred Lakes	822	5.5	a & d	b	a & b
Snow Lake	823	1.5	b	b	d
Ranger Hole	824	0.8	e	c	
Big Creek Loop	827	1.1	b	b	
Big Creek	827.1	1.0	b	b	
Jefferson Lake	829	0.5	e	c	
Flat Lake	864	1.0	e		
Anderson Butte	865	0.5	e	c	
Church Creek Shelter	870	0.7	b		
Church Creek	871	3.5			
Dry Creek	872	3/ 6.6	b		
Lower South Fork Skokomish	873	11.7	b		
Upper South Fork Skokomish	873.1	4.9	d		b
Wynoochee	874	0.3	d		b
Brown Creek	877	0.8	f	a	
Wynoochee Lake Shore*	878	12.0	b	b	
Working Forest	878.1	0.5	b	b	
Spider Lake	879	2.1			
Cushman Cliffs	881	0.5	e	c	
Spoon Creek Falls	885	0.3	e	c	
Cedar Creek	887	0.3	e	c	
TOTAL DISTRICT MILES		101.3	95.7	50.1	45.6
Soleduck Ranger District					
Rugged Ridge	883	0.3	d		b
Pioneer's Path	884	0.3	b	b	d
Pyramid Peak	886	0.5	d		b
Little River	889	0.5	d		b
TOTAL DISTRICT MILES		1.6	1.6	0.3	1.6

Table III-28. Existing Trails by Ranger District (cont'd.)

Trail Name	Number	Miles	Closed to: 1/ Motorized Vehicles	Stock	Mtn. Bikes
Quilcene Ranger District					
Lower Maynard Burn	816	0.4	a		a
Gold Creek	830	6.2			
Royal Creek	832	0.5	d		b
Lower Quilcene	833	6.2			
Big Quilcene	833.1	5.3	a		a
Dungeness	833.2	8.1	a & d		a & b
Lower Dungeness	833.3	5.8			
Gray Wolf	834	9.1	a & d		a & b
Little Quilcene	835	4.1	d		b
Mt. Zion	836	1.8			
Ned Hill	837	1.0	d		b
Slab Camp	838	3.1	a		a
Mt. Townsend	839	6.7	a & d		a & b
Tubal Cain	840	8.6	a		a
Tunnel Creek	841	7.6	a		a
Silver Lake	842	2.5	a		a
Bear Mountain	843	2.0			
Buckhorn Lake	845	0.5	a		a
Deer Ridge	846	3.6	a & d		a & b
Tull Canyon	847	1.5	a		a
Falls View Loop	848	0.1	b	b	d
Heather Basin	863	3.8	a		a
Falls View Canyon	868	0.6	b	b	d
Rainbow	892	0.5	b	b	d
Home Lake	893	0.9	a		a
Mt. Walker	894	2.0			
Seal Rock	895	0.2	f	a	c
Three O'Clock Ridge	896	0.5	b	b	d
TOTAL DISTRICT MILES		93.2	69.2	1.9	69.2
Quinault Ranger District					
West Fork Humptulips	806	4.0			
Colonel Bob	851	2/ 5.5	a & d		a & b
Colonel Bob Summit	851.1	1.8	a	b	a
Quinault Loop *	854	3.9	b	b	d
Lodge	854.1	0.6	c	b	d
Rain Forest *	855	0.6	b	b	d
Higley Peak	856	4.0	d	b	b
Jetcher Canyon	857	2.4	a & d	c	a & b
Pete's Creek	858	2.4	a & d		a & b
Lower Pete's Creek	858.1	1.0			
Elk Ridge	859	2.7	d	c	b
Willaby Creek	860	1.7	b	b	d
TOTAL DISTRICT MILES		30.6	25.6	17.7	25.6
TOTAL FOREST MILES		226.7	192.1	70.0	142.0

1/Reference Forest-wide Standards and Guidelines for trail closures for explanation of a-f.
2/ 0.3 mile outside Forest boundary.
3/ 0.7 mile outside Forest boundary.
* National Recreational Trail

Table III-29. Summary of Existing Trail Mileage by Ranger District

		Miles in Wilderness: 2/		Miles Closed to:		
Ranger District	System Trails 1/	A	B	Motorized Vehicles	Stock	Mtn. Bikes
Hood Canal	101.3	25.0	9.2	95.7	50.1	45.6
Quilcene	93.2	57.0	11.7	69.2	1.9	69.2
Quinault	30.6	12.7	0.3	25.6	17.7	25.6
Soleduck	1.6	0.0	0.0	1.6	0.3	1.6
TOTAL	226.7	94.7	21.2	192.1	70.0	142.0
PERCENT	100%	42%	9%	85%	31%	63%

1/ System trails are managed to specific trail standards at regular intervals.
2/ A - Miles of trail inside Wilderness boundary.
B - Miles of trail outside but providing access to Wilderness between the trailhead and Wilderness boundary

Table III-30. Proposed Trails by Ranger District

			Closed to: 1/		
Trail Name	Number	Miles	Motorized Vehicles	Stock	Mtn. Bikes
Hood Canal Ranger District					
Hamma Hamma	802	2.0	f	a	c
Huckleberry Creek	807	5.0	a		a
Jefferson Ridge	808.1	2.6			
Big Creek	827.1	1.5	e	c	
Duckabush Fisherman	828	2.6			
Skokomish ORV	886	20.0 *			
Wynoochee ORV	866.1	20.0 *			
Klone Lakes	867	4.0			
Le Bar Horse Loop	869	17.0			
Upper Elk Lake	805.1	1.0			
Bear Gulch	876	3.0			
Wynoochee River	878.2	3.0	b		d
TOTAL DISTRICT MILES		81.7	11.5	3.5	10.0

Table III-30. Proposed Trails by Ranger District (cont'd.)

			Closed to: 1/		
Trail Name	Number	Miles	Motorized Vehicles	Stock	Mtn. Bikes
Quinault Ranger District					
West Fork Humptulips	806	10.0			
Campbell Tree Grove	806.1	0.5	b	b	d
East Fork Humptulips	806.2	14.0			
Stovepipe Mountain	817	1.0	e	c	d
Moonlight Dome	819	1.0	e	c	d
Sam's River	850	8.5	b		
Mt. O'Neil	851.2	1.0	a	c	a
Quinault Loop Ext.	854.2	1.6	b	b	d
Resort Extension	854.3	0.6	b	b	d
Fitness	854.4	0.5	b	b	d
Julas	854.5	0.5	b	b	d
Rain Forest Disability	855.1	0.3	b	b	d
Fletcher Canyon	857.1	2.6	a	c	a
Willaby Creek	860.1	5.0	b	b	d
Highway 101 Corridor	861	7.5	g		
South Shore Bicycle	862	4.0	b	b	
Quinault ORV	866.3	20.0 *			
Gatton Creek	888	0.6	b	b	d
Gatton Creek Ext.	888.1	4.0	b		
TOTAL DISTRICT MILES		83.2	39.2	19.2	15.2
Quilcene Ranger District					
Jupiter Lakes	801	13.8	a		a
Upper Maynard Burn	816	2.4	a		a
Slide Creek	816.1	3.0	a		a
Dose Fisherman	826	3.8			
Elkhorn Loop	826.1	1.0	f	a	c
Notch Pass	831	3.5			
Lower Tunnel Creek	841.1	2.0			
North Bear Mtn.	844	3.0			
Deadfall	849	3.5			
East Zion	852	3.5			
North Zion	853	4.5			
Quilcene ORV	866.2	30.0 *			
Snow Creek	890	2.0			
Cedar Flat	891	10.0			
TOTAL DISTRICT MILES		86.0	20.2	1.0	20.0

Table III-30. Proposed Trails by Ranger District (cont'd.)

			Closed to: 1/		
Trail Name	Number	Miles	Motorized Vehicles	Stock	Mtn. Bikes
Soleduck Ranger District					
Pine Mtn.	825	2.0	f	a	c
Highway 101 Corridor	861.1	6.0	g		
Calawah/Soleduck ORV	866.4	20.0 *			
Spruce PAW RR 2/	875	9.0			
Klahanie Bald Eagle	880	2.0	f		
Snider Jackson	881	9.0	a		
Mt. Muller	882	8.5			
Snider Ridge	882.1	3.5			
Kloshe-Nanich	882.2	3.0			
Littleton Loop	882.3	5.0			
Bogachiel	001	2.0	d		b
Baldy Ridge	002	8.0	d		b
Elwha	003	2.0			
TOTAL DISTRICT MILES		80.0	20.0	4.0	12.0
TOTAL FOREST MILES		330.9	90.9	27.7	57.4

1/ Reference Forest-Wide Standards and Guidelines for trail closures, for explanation of a-f.
2/Port Angeles Western Railroad. Constructed during WWI to get spruce for airplane.
* Miles shown are estimates. Potential mileage and location for ORV trails will be addressed in projected planning following the completion of a comprehensive ORV plan for the Olympic Peninsula.

Table III-31. Summary of Proposed Trails by Ranger District

			Miles Closed To:		
Ranger District	Proposed Trails	Miles in Wilderness	Motorized Vehicles	Stock	Mtn. Bikes
Hood Canal	81.7	5.0	11.5	3.5	10.0
Quilcene	86.0	19.2	20.2	1.0	20.2
Quinault	83.2	2.6	39.2	19.2	15.2
Soleduck	80.0	0.0	20.0	4.0	12.0
TOTAL	330.9	26.8	90.9	27.7	57.4
PERCENT	100%	8%	27%	8%	17%

Table III-32. Trail Management Priorities

Priority	Management	Trail Miles
1	Maintain trails to meet management objective.	133.1
2	Reconstruct substandard trails to meet management objectives.	93.6
3	Construct new trails outside Wilderness.	303.1
4	Construct new trails inside Wilderness.	27.8

MANAGEMENT PRACTICES

Developed Recreation

The Olympic National Forest manages a total of 93 developed recreation sites, including administration of special use permits for the Lake Quinault Lodge and recreational residences. Management of these sites focuses on maintaining and operating each site in a safe, sanitary and aesthetically attractive condition. Visitor contacts, fee collection and law enforcement are ongoing parts of this management.

Undeveloped Recreation

Management of undeveloped recreation areas is designed to provide a variety of recreation opportunities not found at developed sites. The major emphasis is to develop and maintain a road and trail system that provides opportunities for undeveloped recreation activities such as hiking, fishing, hunting, nature study, horseback and trail bike riding, picnicking and camping. Roads, trailhead parking lots, toilets, and trail shelters and bridges are some of the dispersed recreation facilities maintained on the Forest.

Recreation management within Wilderness conforms to the Wilderness Act of 1964 administering these wild lands "in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, (and) the preservation of their wilderness characteristics...." Management of Wilderness focuses on retaining the area's primeval character and influence, without permanent improvements or human habitation. More information about Wilderness on the Forest is presented later in this chapter.

There are 13 unroaded areas on the Forest. Some of these unroaded areas provide opportunities for unroaded recreation activities such as hunting, fishing, mountain climbing and cross-country hiking. A few of these areas have trail access, while most are only accessible by cross-country travel on foot. Additional information about unroaded areas is presented later in this chapter, as well as in Appendix C.

Facility maintenance, visitor contacts, law enforcement and litter cleanup are some of the responsibilities of management of dispersed recreation areas.

The current trail management program includes protecting, improving and/or expanding the trail system as prioritized in Table III-29. These priorities, along with trail condition surveys, are used as guidelines to plan where available funding will be allocated.

The Forest Service initiated its National Recreational Strategy in 1988 in an effort to strengthen and round out multiple-use management of the National Forests. Olympic National Forest will continue to implement the Recreational Strategy which is aimed at providing greater customer satisfaction through more and better high-quality recreation services. Customers, in this context, are the recreational users of the Forest and adjacent areas and facilities. Customer satisfaction will be improved by seeking out new ideas, providing opportunities for a variety of user groups to participate in development and use of the Forest, promoting an outdoor ethic, promoting tourism that will help build strong communities and improve quality of life, providing interpretive services and matching human resource needs with recreation opportunities. Partnerships with other agencies, user groups and private enterprise will be sought to help develop and maintain recreation facilities, test new ideas, adopt mutual cooperation, represent groups with special needs, and provide funding.

HISTORIC TRENDS

During the years 1977 through 1986, recreation use on the Olympic National Forest has exceeded one million RVDs in eight of the ten years. The average annual use for the decade was 1,206,400 RVDs. Annual use has fluctuated due to such factors as weather, gas prices and the eruption of Mt. St. Helens. 1/ Auto touring, camping, resort lodging, hiking, viewing scenery, picnicking and hunting were consistently the high-use recreation activities on the Forest during this period. Off-highway vehicle use has been minimal, but has increased during the last two years.

The use of Seal Rock Campground on Hood Canal has exceeded 40 percent of theoretical capacity since 1979. The Hamma Hamma Campground (six miles off Highway 101 in the Hamma Hamma drainage) has exceeded 40 percent of theoretical capacity since 1980, and recreation use at Willaby Campground (on the south shore of Quinault Lake) has exceeded 40 percent of theoretical capacity since 1981. Due to the heavy use at these sites, improvements to upgrade their condition have recently been completed. Seal Rock Campground has received improvements to the road, camping spurs and water system. A six-fixture flush toilet and a two-fixture vault toilet have also been installed. The gravel road at the Hamma Hamma Campground has been paved and new vault toilets have been installed. Willaby Campground has received new camp unit facilities, tables and fireplaces, along with new road paving, camping spur levelling, and boat ramp and parking lot construction. Both Lena Creek and Elkhorn campgrounds have been exceeding 40 percent theoretical capacity since 1985. New vault toilets were installed at Lena Creek while no new facilities or improvements have been made at Elkhorn. Most of the ten campgrounds that are receiving use between 20 to 40 percent theoretical capacity have received improvements in one form or another. For example, Klahowya now has a flush toilet, Big Creek has two new vault toilets and a well, Brown Creek has a new vault toilet and improvements to the road, and Falls Creek has a new flush toilet.

In 1980, the Forest operated six fee sites with fees ranging from $2.00 to $5.00 per unit. The Forest currently has 14 fee sites, with fees ranging from $3.00 to $8.00 per unit. During the period from 1980 to 1984, the Forest collected a total of $168,560 in campground fees, an annual average of $33,712. Campground fee collections increased each year during this five-year period, with a total increase of 114 percent from 1980 to 1984. There are several factors that accounted for the consistent increase in fees collected: (1) increased use, (2) increased fees charged, (3) increase in the number of fee sites, (4) increased emphasis on fee collections, and (5) the use of volunteer campground Hosts, who remind visitors that there is a fee for use of the campground.

The Lake Quinault Lodge continues to be a popular resort, with use exceeding 150,000 RVDs four of the last five years. In response to demand for this facility, the lodge owners expanded capacity of the resort in 1970, by constructing 16 motel units adjacent to the lodge. This addition also included an indoor swimming pool. A master plan for the lodge was made in 1983 and is being revised.

Off-road vehicle (ORV) use on the Forest has increased considerably over the last few years. Currently there are no developed facilities on the Forest for ORVs. ORV use is presently limited to Forest Service roads for "street legal" vehicles and to trails that are not closed to ORVs. Vehicles using these trails must be 40 inches or less in width and equipped with spark arresters. There are over 2,000 miles of Forest roads that "street legal" ORVs can travel and 34.6 miles of trail open to motor bikes. There are no trails or routes available for three- and four-wheeled vehicles that are wider than 40 inches and not "street legal." Four-wheel drive vehicles are currently limited to Forest Service roads. Snowmobiles are limited primarily to Forest roads above snowline during the winter months due to steep terrain and dense vegetation. Some roads have seasonal closures to all types of motorized use for wildlife protection purposes.

1/ Closures of recreation sites on the Gifford Pinchot National Forest increased use on the Olympic Peninsula.

Off-road vehicle use is considered a legitimate use of National Forest lands, and Olympic National Forest will plan, develop and manage ORV facilities in accordance with Title 36 Code of Federal Regulations. The Forest has entered into a Non-Highway Off-Road Vehicle Activity (NOVA) Program agreement with the Interagency Committee for Outdoor Recreation to prepare a comprehensive study for the interagency management of recreational ORV use on the Olympic Peninsula. The objectives of this study will be to: (1) consult with land managers and user groups to determine issues, concerns and opportunities related to ORV use; (2) analyze pertinent characteristics of ORV recreationists and related needs to be satisfied; (3) analyze existing and recommended ORV facilities on the Peninsula; (4) identify ORV needs and opportunities; and (5) prepare alternatives addressing identified issues, concerns and opportunities and determine their relative effects on Forest resources and other users. The comprehensive ORV study is scheduled to be completed in 1990.

Mountain biking is a new type of recreational use taking place on Forest trails. These non-motorized vehicles are prohibited within Wildernesses. There are 84.7 miles of trail outside Wilderness that are open to mountain bicycles. The Forest will begin to monitor for demand, resource damage and user conflicts as this use takes place on National Forest trails.

Existing interpretive opportunities on the Forest include four nature trails with interpretive signs, a guided walk, slide programs, free brochures, the Elderhostel program and "fireside talks." All four Ranger District reception offices are branch offices of the Pacific Northwest National Parks and Forests Association and have maps and books for sale. They also provide a range of information and services including recreation opportunity guides and permits for Christmas trees and firewood.

The Olympic National Forest is not the only land manager on the Olympic Peninsula providing the public with recreational opportunities. The State Department of Natural Resources, Washington State Parks, and Olympic National Park also provide facilities and opportunities. The Olympic National Park manages the largest area of Federal land on the Peninsula. The Park contains over 900,000 acres, most of which is in rugged and remote mountainous backcountry, but also includes almost 32,000 acres of Pacific Ocean frontage. The Park, with its snowcapped mountains, Roosevelt elk, lush rain forests and 57 miles of wild and scenic ocean beaches, receives over 3.4 million visitors per year. It has 19 campgrounds with a total of 900 camp units and a PAOT capacity of approximately 4,700. The Park also has 600 miles of trails.

With its vast acreage of rugged backcountry, the Park offers more Primitive and Semi-Primitive Non-Motorized recreation opportunity than any other Peninsula landowner. Due to such factors as steep topography, dense vegetation, and difficult route finding, the Park's backcountry users primarily stay along trail corridors and in open meadows and lake basins.

The Park affects the recreation resource on the Forest in several ways. As a neighboring land manager with major outdoor recreation attractions, the Park draws people to the Forest who might not otherwise visit it. For example, Forest recreational use is generated as people travel to Park destinations. There is also a fair amount of recreational use on the Forest that is overflow from crowded or full Park facilities. There are also Park regulations that some visitors want to avoid. Park restrictions, such as limits on party size, no pets allowed on trails, and no firearms or open campfires in the backcountry, encourage some people to recreate on the Forest instead.

Local governments and private entrepreneurs provide some facilities that complement or compete with the agency provisions, but, generally, due to their location, direct competition is minimal.

Implementation of the Forest Service's National Recreation Strategy is intended to lead to "partnerships" that will coordinate development and provision of services to maximize overall benefits and services for the users/owners of the Forest.

FUTURE TRENDS

The demand for outdoor recreation is increasing for both developed and undeveloped recreation. Based on historic trends and projected population growth by county, recreation use on the Forest is expected to continue to increase. Table III-33 shows projected recreation use figures to year 2030. These figures are based on expected population growth in the four-county Olympic Peninsula area, the Puget Sound area and the Pacific Northwest in general.

Table III-33. Acres, RVD Capacity and Demand by ROS Class

			RVDs in Thousands			
Type and ROS Class	Total Acres	RVD Capacity	1986 RVD	1990 RVD	2000 RVD	2030 RVD
Developed (All Activities)		421.7	367.2	379.3	428.6	561.5
Developed (Camping Only)		164.5	184.3	189.8	214.5	281.0
Undeveloped Non-Wilderness:						
Primitive	4,901	.5	1.6	1.7	1.9	2.6
Semi-Primitive, Non-Motorized	49,090	38.4	39.1	40.3	45.5	61.0
Semi-Primitive, Motorized	6,599	2.9	6.2	6.4	7.2	9.7
Roaded Natural & Modified	478,370	1,912.7	961.9	990.8	1,119.6	1,500.3
Rural	5,099	20.2	4.7	4.8	5.4	7.2
Wilderness:						
Primitive	36,020	17.2	29.3	30.0	33.0	43.2
Semi-Primitive	52,245	48.4	59.6	61.1	67.2	88.0
FOREST TOTAL	632,324	2,472.0	1,469.6	1,514.4	1,708.4	2,273.5

Note: 1986 RVDs based on RIM Report 2300. RVD projections for 1990-2030 are based on The Washington Statewide Outdoor Recreation Plan (SCORP) and State of Washington's Forecasting and Support Division of the Office of Financial Management.

Recreation visitor days of use have consistently exceeded 40 percent of theoretical capacity at five developed campgrounds, and current annual use is at 53 percent of theoretical capacity for all of the Forest's campgrounds. Demand projections indicate a need for an increase of approximately 2,285 Persons at One Time (PAOT) or approximately 457 units by the end of the planning period and an increase to 5,027 PAOT by the second decade, and to 6,700 PAOT by the fifth decade. This need could be met by expanding existing sites or constructing new sites. Tables III-24 and III-25 provide a listing of potential sites and existing sites that could be expanded. The activity schedule in the Forest Plan lists the sites proposed for construction during this planning period.

The Lake Quinault Lodge master plan includes 36 additional motel-type units to be completed in 1990. A new banquet and conference room facility is also proposed for the near future.

Undeveloped recreation includes a wide range of activities and settings. The demand for road-related settings and activities, such as roadside camping, hunting, fishing, and driving for pleasure, will continue. The Forest, with its 2,500 miles of available roads, will be able to meet the foreseeable demand for roaded recreation. The demand for undeveloped unroaded recreation also involves a wide range of activities and settings. Hiking, mountain climbing, fishing, trail bike and horseback riding, camping, hunting, and viewing outstanding scenery are some of the popular undeveloped recreational activities that place a demand on unroaded areas. With approximately 85,800 acres of the Olympic National Forest in unroaded areas outside of Wildernesses, it is assumed that use of some of these unroaded areas will increase in importance as recreation use increases.

The Primitive and Semi-Primitive areas on the Forest have a current demand that exceeds existing RVD capacity (see Table III-33 for a Summary of Capacity). This assumes completion of planned trails and retaining all Primitive and Semi-Primitive areas in their current condition. Given this situation, the Forest will be unable to provide the necessary Primitive and Semi-Primitive acres to meet demand and, therefore, the visitor's Primitive and Semi-Primitive experiences will continue to be impacted by higher user densities, reductions in unroaded acres due to development and management-imposed restrictions limiting user density.

The reason for the Forest's seemingly small, theoretical capacity is due to two factors. The first of these is the topographic and vegetative conditions occurring in the areas which provide Semi-Primitive and Primitive experiences. Most of the areas in these ROS classes are steep and rugged, and often contain very dense vegetation which limits mobility. As a result, only a small proportion of the acreage in these areas can actually be used (i.e., occupied) by recreationists. Users are largely confined to trails and the shorelines of lakes. This reduces the per-acre capacity of Primitive and Semi-Primitive areas to provide RVD outputs.

The second factor limiting capacity is the nature of the desired experience itself. A necessary facet of the overall Primitive or Semi-Primitive experience is a sense of solitude. This cannot be attained if there are numerous encounters with other people in the primitive environment. To have a "standard" primitive experience, it is essential that only a limited number of human encounters occur. Because of this, the number of RVDs (per acre of accessible land) consistent with a full quality experience is relatively small, especially when contrasted with the acceptable number of RVDs per acre associated with undeveloped roaded recreation. The role of solitude in providing a "standard" quality undeveloped roaded experience is not nearly as significant as it is in the case of undeveloped unroaded recreation.

The development of additional trails will help to disperse use and increase RVD capacity for Semi-Primitive and Primitive opportunities on the Forest. Future trail construction will provide opportunities for a variety of trail users with an emphasis on developing trails outside of Wilderness. See Tables III-28 and III-28a for information concerning potential trails on the Forest.

It is anticipated that the need for interpretive facilities and information services will increase. We have future interpretive and informational opportunities including nature trails with interpretive signs, brochures, slide programs, recreational opportunity guides, wilderness maps, multi-agency informational offices, Elderhostel programs, cooperative interpretive programs and auto tours. The Supervisor's Office will become a branch office of the Pacific Northwest National Parks and Forests Association once it is relocated near Highway 101.

PLANS OF OTHERS

The Sixth Edition of the Washington State Comprehensive Outdoor Recreation Plan (SCORP) published in 1985, identifies present and future needs for outdoor recreation resources. This is done through the identification and analysis of present public participation in relationship to existing resources and developed facilities. SCORPs annual activity forecasts and the Olympic National Forest's Recreation Information Management (RIM) data were used to develop recreation demand projections used in this document.

The Federal Highway Administration did a study in 1973 and 1974 for the Washington State Highway Department and the Olympic National Park. This study evaluated the engineering feasibility of an alternate route that would eliminate the present conflict between commercial (mainly logging truck) and recreation traffic along the south shore of Lake Crescent on U.S. Highway 101. The study indicates that it is possible and feasible to construct a bypass route along the Bear Creek Twin River drainages (on Olympic National Forest land), from U.S. Highway 101 to State Road 112. This route would then follow existing State Road 112 to Port Angeles, bypassing the Lake Crescent area. The project has progressed no further than the planning stage due to a lack of funds. If this bypass route is completed, it is assumed that there will be a minor increase in recreation use in the Bear Creek-Twin River drainages, consisting primarily of sightseeing and auto touring.

The State of Washington DNR, in a 1979 Draft Environmental Impact Statement, identified the need to actively pursue an outdoor recreation program to help accommodate the ever-increasing demand for public recreation facilities in the State of Washington. The DNR has one Multiple Use Area (MUA) on the Olympic Peninsula. MUAs are areas that have been extensively developed with outdoor recreation facilities intended to accommodate a wide variety of recreational activities, including hunting, fishing, camping, picnicking, hiking, and driving for pleasure. The Hoh-Clearwater MUA is located in western Jefferson County, and contains approximately 105,500 acres. This MUA offers excellent fishing and hunting and contains five campgrounds. There are an additional nine DNR campgrounds on the Peninsula outside of the MUA.

The Olympic National Park Proposed Master Plan and Final Environmental Statement, published in 1976, identified several actions that could guide future recreation management in the Park. It recommended 96 percent of the Park for inclusion in the National Wilderness Preservation System. In November 1988, Congress created the Olympic Wilderness which added 876,669 acres of the Olympic National Park to the National Wilderness Preservation System. All five of the existing Wildernesses in the Olympic National Forest are contiguous to the Wilderness within the Park. Recreation management activities (signing, trailhead information and registration, and trail management and maintenance) are, and will continue to be, coordinated with the Park. The Park's Master Plan also provides for no new in-Park roadside campgrounds. The Plan states that additional camping needs should be met by private interests or by State and Federal agencies with landholdings outside of the Park. Another recreation management action identified in the Park's Master Plan is the implementation of the Park's Backcountry Management Plan. The Park's increasing number of visitors is causing erosion, soil exposure and compaction and loss of plant cover, and is limiting the opportunity for solitude. The Backcountry Management Plan is aimed at the prevention or mitigation of human impacts in the backcountry. Park and Forest Service managers will continue to coordinate efforts to educate people in proper use of the fragile backcountry environment. Although primitive and Semi-Primitive opportunities on the Olympic National Forest will help mitigate some of the user impacts in the Park by diverting use to the Forest, the same prevention and mitigation concerns apply to the National Forest as its use increases.

SCENERY

THE ROLE OF SCENERY

The scenic resource provides a variety of beautiful landscape settings on Olympic National Forest. There are several popular recreational areas on the Forest that are rated for their scenery. The scenic beauty of these settings is often the major attraction of the area. The Quinault Lake valley with its 3,700-acre lake, lush rain forest vegetation, and surrounding steep, undulating ridges, is an example of an area in which the scenery serves as a major attraction. In other situations on the Forest, the scenic resource plays an important role as a scenic backdrop viewed from popular recreation areas, including highly used sites and travel routes.

The scenic quality of the Olympic National Forest is highlighted by several different types of landscape settings common to the "Olympic character type." Large, lowland lakes surrounded by dense conifer forest, alpine meadows, rugged mountain ranges and the lush Olympic rain forests are the major scenic types of attractions. The Forest exhibits extensive glaciation, with broad U-shaped river valleys and rocky peaks surrounded by alpine cirques, lakes and meadows.

Lower elevations are blanketed with dense stands of Sitka spruce, Douglas-fir, western redcedar, western hemlock and Pacific silver fir. At the higher elevations, the conifer forests give way to meadows of wild flowers, clumps of alpine trees and the precipitous slopes of mountain peaks.

CURRENT SITUATION

Much of the Olympic National Forest has been subjected to intensive timber management activity during the past 40 years. Roads and clearcut patches are evident in all major drainages. As a whole, the Forest today provides a wide range of vegetative diversity. Forest stands ranging from large old-growth to recently harvested and planted areas are present throughout.

The Olympic National Forest is seen from many key recreation roads on the Olympic Peninsula. U.S. Highway 101, several State, county and Olympic National Park roads, and most Forest roads provide views of National Forest lands. Many of these roads have high visitor sensitivity. There are also several high-use recreation areas and sites that involve scenic landscape backdrops. These include popular recreation areas such as Quinault Lake, Lake Cushman, Hood Canal and Lake Crescent, as well as the metropolitan areas of Puget Sound (Olympia, Tacoma, Seattle, Everett, Bremerton) and the local communities of the Olympic Peninsula.

The scenic resource has been inventoried in order to develop Visual Quality Objectives (VQOs), which are suggested forest management standards designed to protect and maintain scenic quality. The VQOs specify, in relative degrees, levels of deviation from a natural-appearing landscape which are acceptable. The categories of scenic quality are defined as follows:

Preservation (P) - Generally only ecological changes are evident.

Retention (R) - Management activities are not evident to the casual Forest visitor.

Partial Retention (PR) - Management activities may be evident, but must remain subordinate to the characteristic landscape.

Modification (M) - Management activities may dominate the landscape, but they follow naturally established form, line, color, and texture.

Maximum Modification (MM) - Management activities may dominate the landscape, but appears as a natural occurrence when viewed in the background.

Currently, there are two areas on the Forest for which the assigned VQOs must be met when designing and implementing management activities. These are: (1) the east face of Quilcene Ridge (Green Mountain) as viewed from U.S. Highway 101 and Puget Sound, (2) and the west and north faces of South Quinault Ridge which are viewed from Lake Quinault, Olympic National Park and U.S. Highway 101. There are also five Wildernesses (88,265 acres) and one Research Natural Area (1,468 acres), all of which have the Preservation VQO.

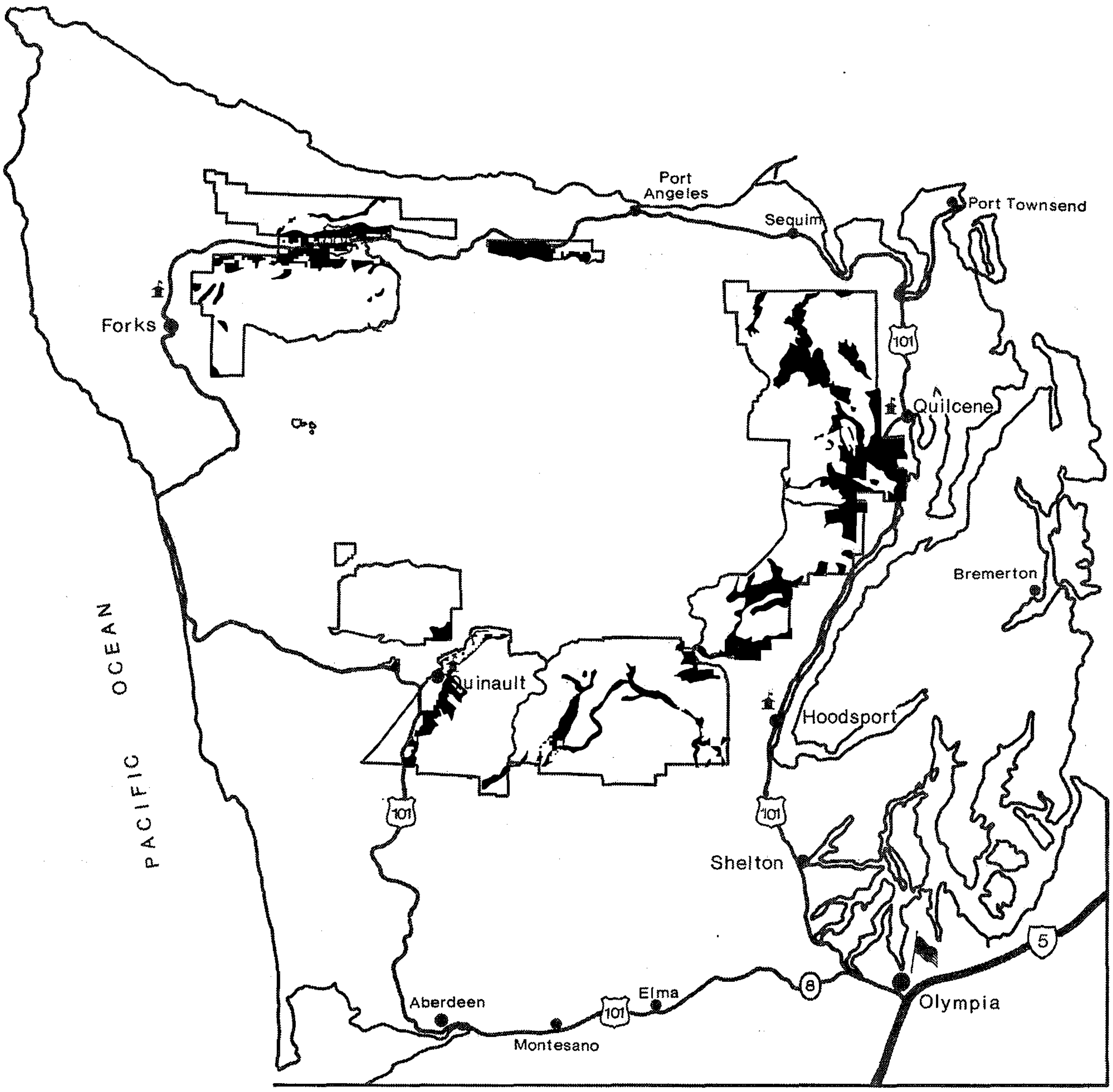
The Forest currently has 18 Sensitivity Level 1 viewsheds, which call for a high level of scenic protection, and two Sensitivity Level 2 viewsheds, which involve a moderate level of scenic protection. There are also a few small areas of concentrated use that involve scenic lake foregrounds where a scenic allocation is warranted.

Approximately 90,000 acres of the Forest are within these 20 viewsheds. The Visual Quality Objectives currently inventoried within these viewsheds are as follows (see also Figure III-10):

Retention (R)	22,600 acres
Partial Retention (PR)	67,500 acres

In visually sensitive areas, such as Sensitivity Level 1 and 2 viewsheds, visual management is aimed at retaining or creating a desired landscape character derived from natural characteristics. Tree species, scale of stand and trees, contrasting vegetation, size of trees and natural openings, textural patterns, bark characteristics, and canopy cover are traits that help determine the desired landscape character for a given area.

The Forest Service visual management system recognizes that a forest is a constantly changing community of plants and animals and, therefore, requires a dynamic management system that will perpetuate an attractive and diverse landscape. Visual management on the Olympic National Forest involves three primary visual management practices: (1) enhancement, (2) rehabilitation, and (3) establishing and maintaining a desired landscape character by controlling the amount of visual alteration of the natural-appearing landscape. Enhancement and rehabilitation are short-term management practices, while establishing and maintaining a desired landscape character involves long-term management.



LEGEND

■ Retention/Partial Retention

Figure III-10. VISUAL QUALITY OBJECTIVES

Visual Quality Objectives (VQO) and Existing Visual Conditions (EVC)

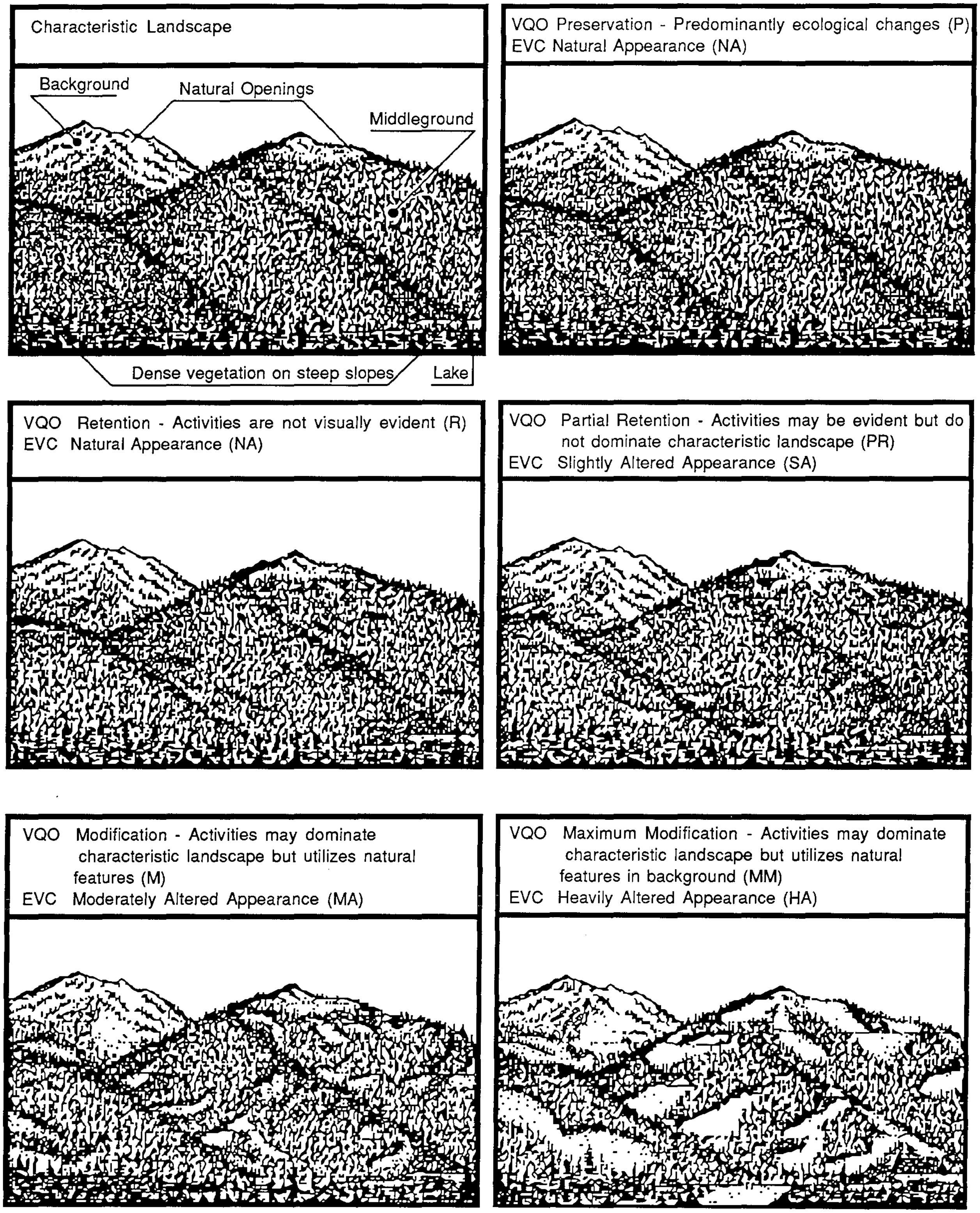


Figure III-10a. VISUAL QUALITY OBJECTIVES (VQO) AND EXISTING VISUAL CONDITIONS (EVC)

Table III-34 provides a summary of the existing visual condition of the Forest's 20 sensitivity level 1 and 2 viewsheds. See Figure III-11 for the viewshed locations.

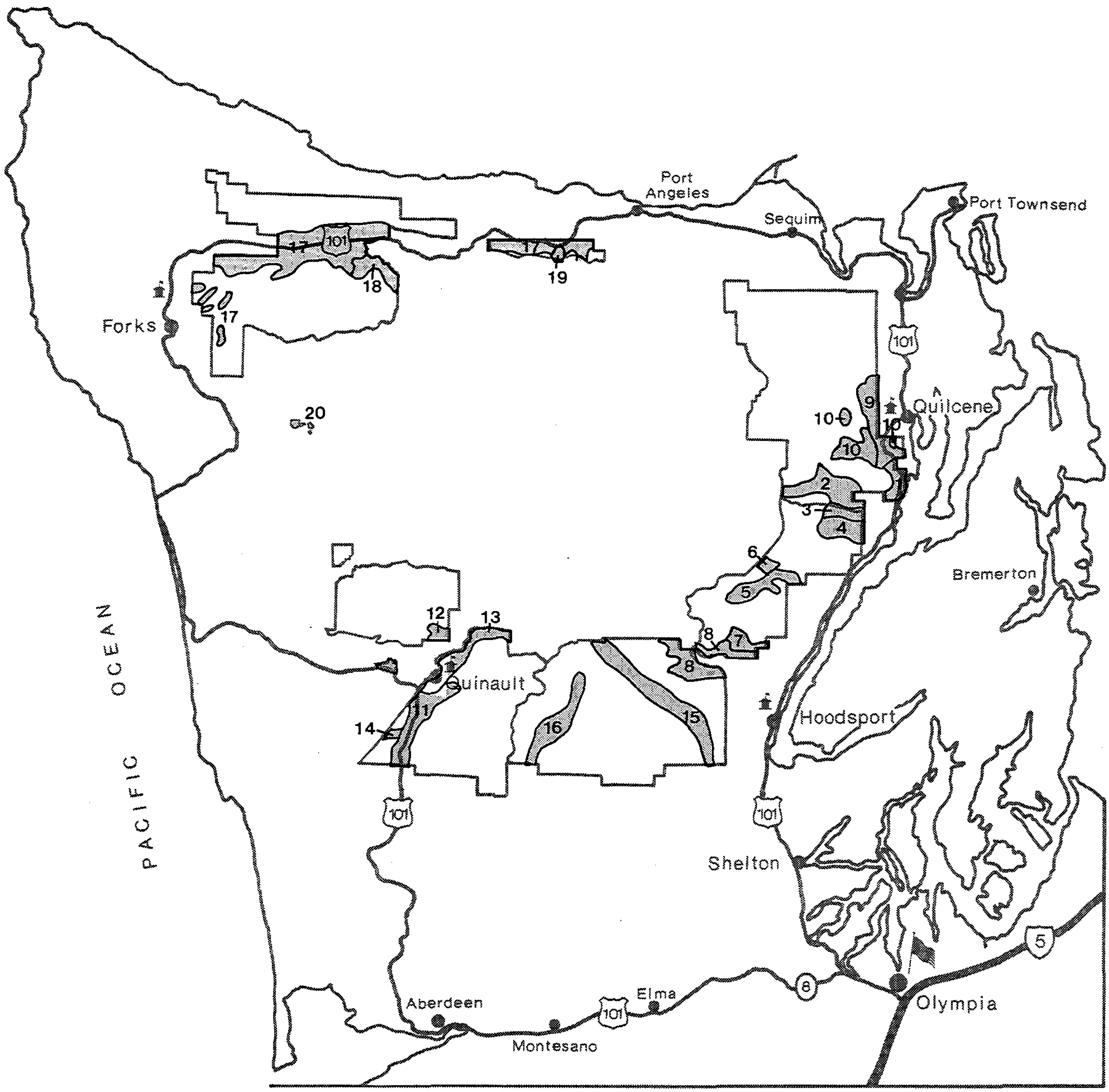
Table III-34. Existing Visual Condition

Viewshed	Total Acres	Visual Quality Objective	Existing Visual Condition 2/
Hoodsport Highway 101	1,977	Retention & Partial Retention	Natural Appearance
Dosewallips Road	6,065	Retention & Partial Retention	Moderately Altered Appearance
Jupiter Ridge Trail	1,319	Retention	Heavily Altered Appearance
Duckabush Road	1,591	Retention & Partial Retention	Natural Appearance
Hamma Hamma Road	6,135	Retention & Partial Retention	Natural Appearance
Lena Lake Trail	697	Retention	Natural Appearance
Big Creek Road	2,661	Retention & Partial Retention	Moderately Altered Appearance
Lake Cushman Road	7,581	Retention & Partial Retention	Slightly Altered Appearance
Quilcene Highway 101	6,449	Retention & Partial Retention	Slightly Altered Appearance
Mt. Walker	3,508	Retention & Partial Retention	Heavily Altered Appearance
Quinault Highway 101	6,373	Retention & Partial Retention	Natural Appearance
North Shore Road	1,769	Partial Retention	Slightly Altered Appearance
South Shore Road	6,494	Retention & Partial Retention	Natural Appearance
Moclips Highway	400	Partial Retention	Natural Appearance
S. Fork Skokomish Road 1/	3,296	Partial Retention	Slightly Altered Appearance
Wynoochee 2/	5,792	Partial Retention	Moderately Altered Appearance
Soleduck Highway 101	25,288	Retention & Partial Retention	Slightly Altered Appearance
Soleduck Park Road	2,053	Retention & Partial Retention	Slightly Altered Appearance
Elwha Park Road	183	Retention	Natural Appearance
Hoh Road	454	Retention	Natural Appearance
TOTAL	90,085		

1/ Existing Visual Condition is the existing visual appearance of a given viewshed described in terms of the degree to which the natural appearing landscape has been altered. The four degrees of visual alteration are as follows:

> *Natural Appearance* - An area or viewshed where the landscape appears natural or unaltered by management activities, generally less than 5 percent. This condition applies to areas where the visual quality objectives of Partial Retention and Retention are being met.
>
> *Slightly Altered Appearance* - An area or viewshed where the landscape has a slightly altered appearance, generally less than 10 percent. This condition applies to areas where the visual quality objective of Partial Retention is being met.
>
> *Moderately Altered Appearance* - An area or viewshed where the landspace has a moderately altered appearance, generally less than 20 percent. This condition applies to areas where the visual quality objective of Modification is being met.
>
> *Heavily Altered Appearance* - An area or viewshed where the landscape has a heavily altered appearance, generally more than 20 percent. This condition applies to areas where the visual quality objective of Maximum Modification is being met.

2/ Sensitivity level 2 viewsheds (all others are sensitivity level 1 viewsheds).



LEGEND

Viewsheds

Figure III-11. VIEWSHEDS

HISTORIC TRENDS

Public concern for management of the scenic resource has increased as leisure time has increased and access to the National Forests has improved. Evolution of a visual management system has paralleled the increase in outdoor recreation use on public lands.

Information about management of the scenic resource of the Forest prior to the 1950's is lacking. It is assumed that certain areas on the Forest were recognized as visually sensitive landscapes, and management activities that would alter the views were avoided. The Quinault Ridge area may be an example of this.

During the 1950's and 1960's, the Forest Service implemented a visual program involving Landscape Management Units. These were areas identified as having scenic qualities that warranted special protection. Generally, management activities that would alter the scenic quality within these Units were avoided. In the early 1970's, the Forest Service created the Visual Management System, which involved inventorying the entire Forest and assigning a Visual Quality Objective to every acre. Visitor sensitivity, variety classes, and distance zones were the major criteria used to establish the Visual Quality Objectives (VQOs). The VQOs provide a technical way of identifying the degree of acceptable alteration a given landscape can receive. The scenic resource is being managed under this system today.

FUTURE TRENDS

It is anticipated that the concern for scenery on Olympic National Forest will continue to increase, especially in those areas adjacent to or surrounding high use recreation areas and facilities. Forest and Park visitors in these areas will generally have a high degree of interest in the scenic qualities of National Forest lands. It is assumed that the scenic character will continue to change in the areas where forest management activities, such as timber harvesting and road construction, are implemented.

PLANS OF OTHERS

The State of Washington's Department of Natural Resources (DNR), in its 1979 Draft Environmental Impact Statement, states that "Aesthetics are playing an increasingly important role in the planning and design stages of resource management. Maintaining landscapes that can be viewed from popular recreation travel routes and heavily used recreation areas in a pleasing aesthetic condition is now a high priority of the Department insofar as this can be achieved with current forest management practices." The DNR's Manual contains policy guidelines requiring that scenic management concepts be followed to minimize the visual impact of timber harvesting and road building. The guidelines include such actions as limiting sidecasting of road excavation materials, revegetating exposed soil surfaces, and a higher than normal degree of right-of-way debris disposal along roads to special use areas. The Manual also suggests that certain actions be considered in the case of visually sensitive timber sales, such as avoiding long, straight unit boundaries and removal of slash.

The purpose of the Olympic National Park is to "... preserve for the benefit, use, and enjoyment of the people, the finest sample of primeval forests of Sitka spruce, western hemlock, Douglas-fir, and western redcedar in the entire United States; ... to conserve and render available to the people, for recreational use, this outstanding mountainous country, containing numerous glaciers and perpetual snowfields, and a portion of the surrounding verdant forests together with a narrow strip along the beautiful Washington coast." The scenery of the Olympic National Park is, therefore, managed in a way that parallels the

Preservation Visual Quality Objective, which allows for ecological changes only. Preservation management of the Olympic National Park will perpetuate the natural state of its scenery.

WILDERNESS

THE ROLE OF WILDERNESS

When Congress passed the Wilderness Act in 1964, its stated purpose was to assure that an increasing population did not occupy and modify all undeveloped areas within the United States, leaving no lands protected in their natural condition. Therefore, Congress created the Wilderness Preservation System, to be administered for the use and enjoyment of included lands by the American people in a way that will leave them unimpaired for future use and enjoyment as wilderness. The System is also to provide for continued protection of included areas, preservation of their wilderness character, and the gathering and dissemination of information regarding their use and enjoyment as wilderness (Hendee et al. 1978).

The Wilderness Act defined wilderness in the following way: "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Congress also recognized that wilderness was a resource unto itself, and more than a state of mind or sense of being.

CURRENT SITUATION

The Washington State Wilderness Act of 1984 created five Wildernesses on the Olympic National Forest as follows: Buckhorn Wilderness, 44,433 acres; Colonel Bob Wilderness, 11,961 acres; Mt. Skokomish Wilderness, 15,936 acres; The Brothers Wilderness, 16,836 acres; and Wonder Mountain Wilderness, 2,349 acres. In 1986 there was a boundary adjustment between the Olympic National Forest and the Olympic National Park that altered the size of three Wildernesses. This boundary adjustment decreased the size of Buckhorn Wilderness by 175 acres, The Brothers Wilderness by 154 acres, and the Mt. Skokomish Wilderness by 2,921 acres. A total net change of 3,250 acres of Forest Wilderness were transferred to the Park.

The current Wilderness acres are as follows: Buckhorn Wilderness, 44,258 acres; Colonel Bob Wilderness, 11,961 acres; Mt. Skokomish Wilderness, 13,015 acres; The Brothers Wilderness, 16,682 acres; and Wonder Mountain Wilderness, 2,349 acres.

The Wildernesses within the Olympic National Forest will be managed under a nondegradation policy, which recognizes that in an existing Wilderness one can find a variety of natural and social settings. These range from the most pristine to those where naturalness and opportunities for solitude have been significantly diminished by established uses. It is the intent of this policy to assure that appropriate diversity and existing wilderness character are maintained. It is further intended that all of the most pristine areas will not be reduced to the minimum acceptable standard of naturalness simply to disperse and accommodate more use. To meet this policy, the Limits of Acceptable Change (LAC) process will be followed in each of the five Wildernesses. LAC is a framework for establishing acceptable and appropriate resource, social, and managerial conditions in recreation settings. LAC represents a reformulation of the recreational carrying capacity concept, with primary emphasis now on the conditions desired in the area rather than on how much use an area can tolerate. The Forest began this ongoing process in 1989 and it will be included and monitored in each Wilderness Implementation Schedule.

The existing capacity of each Wilderness in each Wilderness Resource Spectrum (WRS) class is shown in Table III-35. The following Wilderness Resource classifications were used to determine the existing capacity:

Semi-Primitive Trailed - An area that is characterized by a predominantly unmodified natural environment. The area involves use corridors that are within 3 miles of any road and generally receive moderate to high visitation. Day use may be a significant portion of the visitation. Evidence of other users within the area is moderate to high, and sights and sounds of adjacent activities outside the Wilderness are often present. This is the least pristine WRS class.

Primitive Trailed - An area that is characterized by an unmodified natural environment. The area involves use corridors that are beyond 3 miles of any road and generally receive low to moderate visitation and low to no day use. Evidence of other users within the area is low to moderate, and sights and sounds of adjacent activities outside the Wilderness may be present.

Semi-Primitive Trailless - An area that is characterized by an unmodified natural environment. Consists of areas that are outside of the use corridors and are within 3 miles of any road. Use is low, and some day use may be present. Evidence of other users within the area is low, and sights and sounds of adjacent activities outside the Wilderness are often present.

Primitive Trailless - An area that is characterized by an unmodified natural environment. Consists of areas that are outside of the use corridors and beyond 3 miles of any road or a minimum of one mile where the area has a topographic screen from any road. Use is very low to low, and there is no day use. Evidence of other users within the area is very low to low, and sights and sounds of adjacent activities outside the Wilderness are generally not present. This is the most pristine WRS class.

Table III-35. Existing Wilderness Capacity by WRS (RVDs per Year)

Wilderness	Trailless: Semi-Primitive & Primitive	Trailed: Semi-Primitive	Trailed: Primitive	Total RVD Capacity
Mt. Skokomish	1,212	16,326	1,170	18,708
The Brothers	1,596	2,880	2,481	6,957
Wonder Mtn.	234	0	600	834
Buckhorn	4,052	18,984	8,724	31,760
Colonel Bob	1,120	5,328	954	7,402
TOTAL	8,214	43,518	13,929	65,661

Note: RVD capacity based on Forest calculations involving trail and lake corridors and trailless areas by WRS management intensities.

In addition to the Forest Wildernesses, the Olympic National Park has added 876,669 acres to the National Wilderness Preservation System. This brings the total designated Wilderness on the Olympic Peninsula over 964,900 acres.

The following general information describes resources and opportunities available within each Wilderness.

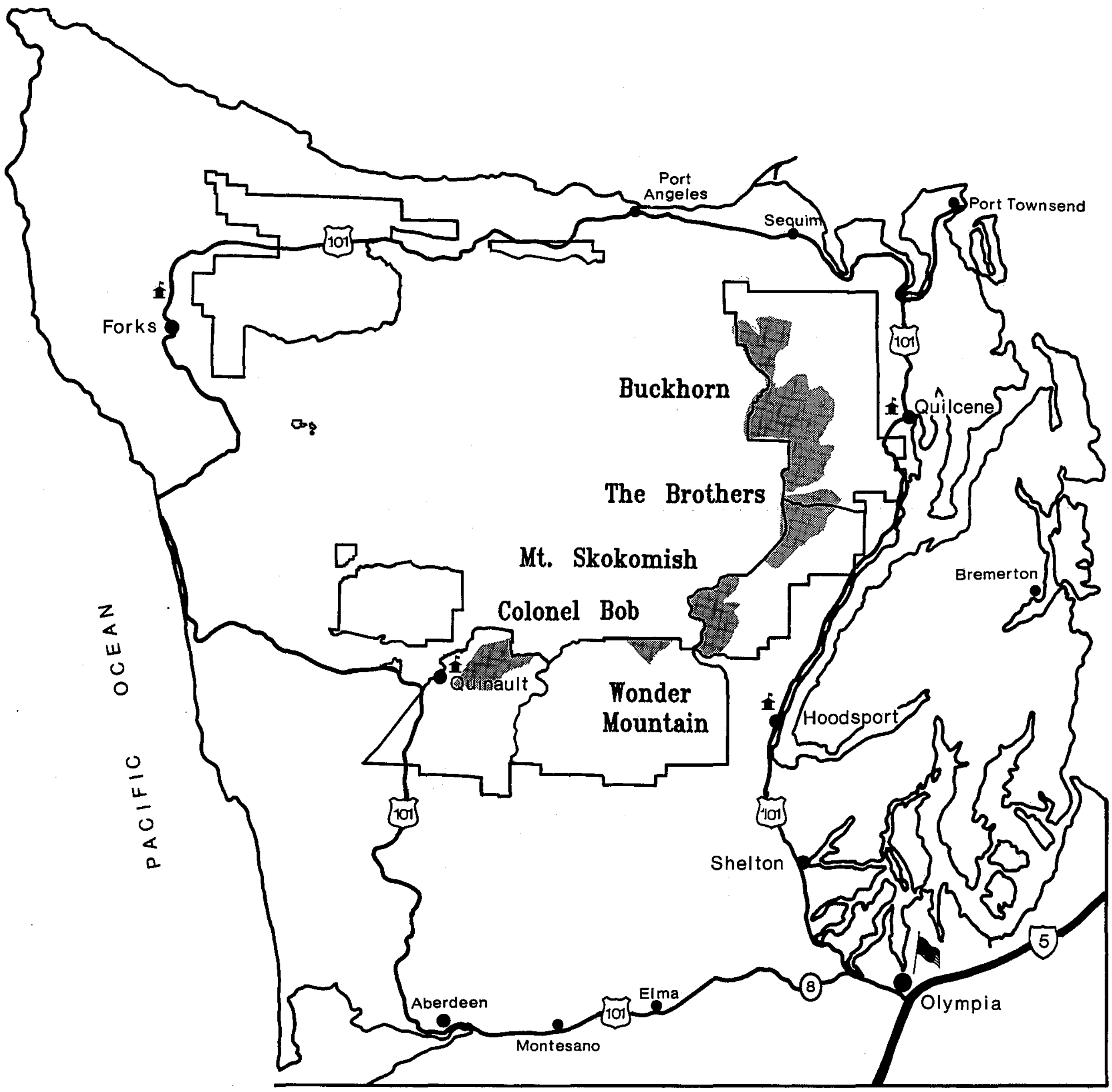


Figure III-12. WILDERNESSES

BUCKHORN WILDERNESS

The 44,258 acre Buckhorn Wilderness is bordered by the Olympic National Park on the west. The remaining boundary extends north of the Gray Wolf River and south to the Dosewallips River. Within the Wilderness are 216 acres of private land in a patented mining property (Tubal Cain).

Landforms range from a high peak area in the westerly portion to foothills and valley bottoms. The elevational range is from about 1,000 feet on the Gray Wolf River to 7,134 feet at Mt. Fricaba, the highest peak on the Forest. Other major peaks include Tyler and Maynard Peaks, Buckhorn and Iron Mountains and Mt. Townsend.

Located in the rain shadow of the Olympic mountains, the rugged topography of the Buckhorn Wilderness creates a very diverse vegetative pattern that extends from above timberline to rich stream-bottom forests. Vegetation in much of the area is more typical of the considerably drier Cascade Range than the Olympic mountains.

Access

The Buckhorn Wilderness is easily accessed from at least seven points at which road systems are within one quarter mile (by trail) of the Wilderness boundary. Other points of entry are somewhat farther from roads. Four major road systems provide access: the Ned Hill and Dungeness roads on the north, the Big Quilcene road along the east side, and the Dosewallips road along the south boundary.

The trail system accessing the Wilderness includes the Gray Wolf and Slab Camp Trails in the north, Tunnel Creek in the south, and Big Quilcene, Tubal Cain, Dungeness, Mt. Townsend and Little Quilcene Trails in the center, or core, of the Wilderness. Four trails provide access to Olympic National Park: the Gray Wolf, Deer Ridge, Royal Creek and Home Lake Trails. The Gray Wolf, Home Lake, and Deer Ridge Trails are routes of access for hikers originating from within the Park. Trails that are entirely within the Wilderness are Tull Canyon, Heather Basin, Silver Lake and Buckhorn Lake.

Watershed

Water flowing from the Buckhorn Wilderness enters two major river drainages, the Dungeness and Big Quilcene Rivers. Water from the Dungeness drainage provides an off-Forest water source for the City of Sequim. This drainage also provides the Sequim Valley with irrigation water and water for the Dungeness Fish Hatchery.

The Big Quilcene drainage makes up a significant part of the municipal watershed for the City of Port Townsend. Water from the Big Quilcene is key to the operation of the Big Quilcene Fish Hatchery.

Fish and Wildlife

Several lake and stream fisheries exist within the Wilderness. Atlantic salmon have been introduced in two lakes. Seven of the nine lakes have been stocked with fish by the Washington State Department of Wildlife. Fish stocking, often facilitated by the use of helicopters, was an established practice prior to the creation of this Wilderness. The two lakes that are not stocked with fish are incapable of supporting a fishery. The lower reaches of most of the major streams support resident trout. The segment of the Gray Wolf within the Wilderness supports four species of salmon. The most noted is the early run of "pinks" that ascend well up into the Wilderness. Steelhead and sea-run cutthroat trout are also found in the Wilderness segment of the Gray Wolf.

Deer use portions of the area for summer and winter range. Bear, cougar and bobcat have been observed over most of the area. Elk have been seen in the Gray Wolf drainage. Several small herds of mountain goats range in the upper Dungeness. The Olympic marmot is present and the northern spotted owl, bald eagles and goshawk have been sighted.

The area provides good opportunities for hunting deer, mountain goat, bear and, to a lesser degree, elk. Hunter success is about average, with the ruggedness of the terrain partially offset by the open meadows and sparse timber at higher elevations.

Historical and Cultural Resources

The major historical features within this Wilderness are associated with the Tubal Cain Mine operation and access to the mine. All of the structures at the main tunnel were abandoned in the 1920's and later destroyed by a snow slide. These are within the boundaries of the patented claims, as are the main tunnel and most of the other short tunnels. The cabins at Tull City and the Tull Canyon Trail are located off the claims on National Forest land. There are various improvements and structures within this Wilderness that provide reminders of what occurred in the earlier days, such as trail shelters, hunter/trapper camps and the mining claims in Tull Canyon.

Recreation

The Buckhorn Wilderness is the only Wilderness on the Olympic National Forest where there is significant use of pack and saddle stock. A number of trails have been, or are planned to be, reconstructed to bring them back to their original standard which accommodated pack and saddle stock.

The Buckhorn Wilderness has a variety of attractions. The tumbling waters and canyons of the Gray Wolf River are the major attraction within the northern portion. The southern area has Harrison Lake and the slopes of Mt. Constance. The core of the Wilderness is dominated by high, open meadows in the Buckhorn Mountain area, Charlia Lakes and the Dungeness River. Cross-country travel above 5,000 feet is limited by topography rather than vegetation. The sparse stands of timber near timberline and the many open areas provide ample opportunity to leave the trails to explore for campsites and vistas.

A number of high-use camping areas have been identified where the existing impacts may be approaching the limit of acceptable change. These include the Gray Wolf Valley in the vicinity of Camp Tony, Camp Handy, Boulder Shelter, Marmot Pass, Camp Mystery, Shelter Rock Camp and Goat Lake. Less popular destinations include Tull City, Silver Lakes, Camp Windy, Slide Camp, Buckhorn Lake, Tubal Cain Mine and Charlia Lakes.

Trails and Structures

There are 68.7 miles of trails inside or accessing the Buckhorn Wilderness boundary. All are open to hikers and most are open to pack and saddle stock. Not all of the trails open to pack and saddle stock are constructed or maintained to a suitable standard for that purpose.

There are seven trail bridges within the Wilderness. The largest is a three-stringer facility, 70 feet long, constructed to accommodate horse use across the Gray Wolf. The Slab Camp trail has the most bridges (four). Numerous retaining walls and sections of puncheon exist within the system. Lengths of culvert were installed to accommodate trail bike use before the Wilderness was established.

There are three trail shelters and remnants of pasture fences within the Wilderness. A number of hunter cabins/shelters have been removed in the past few years. The remains of the cabins at Tull City are slowly deteriorating.

THE BROTHERS WILDERNESS

The Brothers Wilderness covers 16,682 acres on the east side of the Peninsula. It extends from the Dosewallips River in the north to Lena Lake in the south. At the East Fork of Lena Creek, except for a relatively gentle valley area, the entire Wilderness is quite precipitous, with tree-covered slopes extending to about 5,000 feet. Elevation ranges from 600 feet near the Dosewallips River to the 6,866 foot summit of The Brothers. Other named peaks include Mt. Jupiter, the high point on rugged Jupiter Ridge.

Access

Three trails provide the primary access into The Brothers Wilderness. The Lena Lake Trail approaches the southern end of the Wilderness from the Hamma Hamma Road. The Trail forks at Lena Lake, with the Upper Lena Lake Trail skirting the southern edge of the Wilderness and The Brothers Trail entering the Wilderness. The Duckabush Trail follows the Duckabush River through the midsection of the Wilderness. This trail also provides access to the interior of Olympic National Park. Entering the Wilderness from the east, the Mt. Jupiter Trail traverses Jupiter Ridge for 7 miles, with the last 2 miles within the Wilderness.

The Dosewallips Road, situated on the north bank of the Dosewallips River, parallels the north boundary of the Wilderness. The Wilderness boundary lies on the south bank of this river. Other roads approaching the Wilderness boundary are the Duckabush and the Hamma Hamma. By trail, these roads are 1 mile and 3 miles away from the Wilderness boundary, respectively.

Watershed

There are no major rivers with headwaters in the area. However, Jupiter Lakes and several small unnamed ponds are located on Jupiter Ridge.

Water flowing from The Brothers Wilderness enters three major river drainages: the Hamma Hamma, the Duckabush and the Dosewallips. Water from these drainages serves minor agricultural and domestic needs. Water from the Hamma Hamma has been identified as a potential water source for the City of Bremerton.

Proposed hydropower projects downstream from The Brothers Wilderness include run-of-the-river projects on the lower Hamma Hamma, Lena Creek and the Elkhorn project on the Dosewallips. The Wilderness boundary along the Dosewallips was located specifically to allow for the Elkhorn hydropower project near the ONF/ONP boundary.

Fish and Wildlife

Several lake and stream fisheries exist within the Wilderness. In the past, all six of the Jupiter Lakes have been stocked with fish by the Washington State Department of Wildlife. Fish stocking, facilitated by use of helicopters, was an established practice prior to the creation of this Wilderness. Jupiter Lake #1 is currently not recommended for stocking due to its size and limited depth.

The fishing in these lakes is a significant local attraction. It is an important recreation experience for the user.

A resident trout fishery exists in the Duckabush River throughout the Wilderness. Incidental hiking and camping is associated with fishing in the river corridor. A 50-foot waterfall at Little Hump prevents anadromous fish from passing upstream beyond it.

Deer is the most common big game species found. On occasion, elk, black bear and mountain goat are seen at lower elevations. Other mammals that may be found include mountain lion, marmot and perhaps the pine marten, along with bald and golden eagles and numerous other bird and small animal species.

There is limited deer and elk hunting in the Duckabush Valley bottom, and occasional goat hunting on Jupiter Ridge.

Historical and Cultural Resources

The valley between Little Hump and Big Hump, as well as a portion of the slopes above the Duckabush River, was railroad logged in the 1920's. The area has since been reforested with a thrifty stand of Douglas-fir. Evidence of the logging is limited to sections of railroad grade, stumps with springboard holes and an occasional section of abandoned logging cable. Many users walk the trail, including a section of the railroad grade, without realizing that logging ever took place there.

Recreation

Due to the steepness of the trails and the dense vegetation and rugged terrain, there is limited pack and saddle stock use in this Wilderness. There are a few hunter camps along the Duckabush River. The Duckabush Trail has just been reconstructed to accommodate pack and saddle stock. The Park Service uses pack stock on this trail to service its backcountry locations.

The major attraction within The Brothers Wilderness is The Brothers Peak, elevation 6,866 feet. The Brothers is one of the more popular climbing peaks in the Olympic Mountains. Mt. Jupiter and the adjacent Jupiter Lakes provide other day-use and destination camping attractions.

The Duckabush River corridor provides both destination and nondestination use attractions. The broad valley between Little Hump and Big Hump, only 2 to 3 miles from the Duckabush Trailhead, is the primary day-use destination. Popular campsites are located at the base of Big Hump and on the first flat along the river upstream from it.

Due to the dense vegetation and the extremely steep terrain, recreational use other than hunting and mountain climbing is limited to the trail corridors and lake basins.

Two high-use camping areas have been identified where impacts may eventually approach the limit of acceptable change, Jupiter Lakes and the Duckabush River Corridor. A third high-use area, The Brothers climbing route, is not seen as a problem area as most climbers camp outside the Wilderness at Lena Lake Campground.

Trails and Structures

There are 17.9 miles of trail inside or accessing The Brothers Wilderness. The four and one-half miles of The Brothers trail are closed to pack and saddle stock.

The first 1.0 mile of the Mt. Jupiter Trail is on Washington State Department of Natural Resources land. This section of trail, from the existing trailhead to the Forest boundary, is very steep. Once on the ridgetop, the trail continues to climb with occasional steep pitches.

The Duckabush Trail is basically a river gradient trail, except for the climb over Little and Big Hump. This trail was recently reconstructed to bring it to standard for horse use. The Brothers Trail accesses the base of The Brothers, a popular peak with climbers. There are four trail bridges in the Wilderness.

MT. SKOKOMISH WILDERNESS

The Mt. Skokomish Wilderness is located in the southeast portion of the Forest, north of Lake Cushman. This 13,015-acre Wilderness includes some very steep, rugged terrain. Elevations range from just over 800 feet near Lake Cushman to the 6,612 foot summit of Mt. Stone. The broad valley of Huckleberry Creek and the basin containing the Mildred Lakes complex are about the only areas of relatively gentle terrain. Major peaks include Mts. Skokomish, Henderson, Cruiser, Pershing, Washington, Ellinor, Rose Stone and Copper Mountain. A series of isolated fingers of land, following various ridges, radiate out from Mts. Washington, Ellinor and Pershing. Barren ridges and numerous steepfaced rock outcrops are present throughout this Wilderness.

Stands of old-growth trees, consisting primarily of Douglas-fir, western hemlock, and western redcedar, occur on the lower slopes. At upper elevations, subalpine fir, western white pine and dwarf juniper give way to the rock and scattered alpine vegetation commonly found in the subalpine and alpine zone.

Access

There are two major road systems that provide access to Wilderness trailheads or cross-country routes. The Lake Cushman road provides access to the southern boundary and the Hamma Hamma road accesses the northeast boundary. Two secondary roads, the Big Creek and the Jefferson Lake roads, provide access to cross-county routes along the eastern boundary.

There are four trails that provide foot access into the Wilderness. The Mt. Rose, Mildred Lakes, Scout Lake and Putvin Trails all begin in the National Forest and enter the Wilderness within less than one quarter mile of their beginning. The Wagonwheel and Flapjack Lake Trails are in the Park, but also provide trail access to the Wilderness boundary. The Mt. Ellinor and Mt. Washington Trails, which are in the Forest, but outside the Wilderness, also provide access to the Wilderness boundary.

Watershed

The headwaters of the Hamma Hamma River, Huckleberry Creek (a tributary of the Hamma Hamma) and Jefferson Creek are located within this area. Smaller tributaries of the North Fork Skokomish River, such as Bear Gulch, drain into Lake Cushman. The Hamma Hamma River supports resident rainbow and cutthroat trout, while the Mildred Lakes are the only lakes with a trout fishery.

Lakes include the three Mildred Lakes. The largest covers 38 acres, while the other two are much smaller at 6.5 and 10.5 acres in size. Other lakes include Lake of the Angels, Murdock Lakes, Ellinor Pond and Pershing Pond.

Fish and Wildlife

Several lake and stream fisheries exist within the Wilderness. Six of the eight lakes have been stocked with fish by the Washington State Department of Wildlife. Fish stocking, including the use of helicopters, was an established practice prior to the establishment of this Wilderness. The two lakes that are not stocked are not capable of supporting a fishery due to their shallowness. The lower reach of Huckleberry Creek is the only known stream supporting resident trout. Lake fishing is heavy at the readily accessible Mildred and Wagonwheel Lakes and is an important recreation experience for many visitors.

Elk, deer, bear and mountain goat are often seen. Mountain lion, pine marten, Olympic marmot and bald and golden eagles have occasionally been observed.

The area provides good opportunities for hunting elk, deer, goat and bear. Hunter success is below average because of the heavy cover and difficult terrain.

Historical and Cultural Resources

There are no inventoried historical or cultural sites within the Mt. Skokomish Wilderness. There is documented evidence of hunting and trapping activity in the Whitehorse Creek area and cabins may possibly exist. Mining claims may have been located in the Mt. Rose and Copper Mountain areas during early, turn of the century prospecting activities. Cabin, trail or shelter remnants may be found as inventory surveys are expanded within the Wildernesses.

Recreation

Due to the steepness of the trails, dense vegetation and rugged terrain, there is little or no pack and saddle stock use in the Wilderness. There are no plans to provide facilities for this type of use.

The major attractions are Mildred Lakes, Lake of the Angels, Mt. Stone, Mt. Skokomish and the Sawtooth Ridge including Mt. Cruiser. These lakes and peaks are the main destinations of the majority of the users entering the Wilderness. Due to the dense vegetation below 5,500 feet and the steep terrain, recreational use other than hunting and mountain climbing is limited to trail corridors, lake basins and meadows.

Three high use camping areas have been identified where the existing impacts may be approaching the limit of acceptable change: Mildred Lakes Basin, Wagonwheel Lake and Lake of the Angels. Use of these lakes will continue to increase as they become better known and as use in more accessible areas forces people to seek more primitive sites. This is especially evident at Mildred Lakes where use has increased over 400 percent in the last decade, from 1,200 RVDs per year in 1974 to 6,100 RVDs in 1983.

Trails and Structures

There are 16.3 miles of trails within or accessing the Mt. Skokomish Wilderness. None of these trails are open to pack and saddle stock. The Putvin, Mildred Lakes and Scout Lake Trails provide access to fragile, high elevation lakes. The Mt. Rose trail provides access to the summit of Mt. Rose at an elevation of 4,301 feet. All four of these trails are steep and primitive. Use within the Wilderness is confined primarily to trail corridors, areas around lakes and the open ridges above timberline. The experience level along the existing trail system is Semi-Primitive due to either the physical setting or the user density.

There are no existing trail bridges or structures within the Wilderness. There is one planned foot-log across Huckleberry Creek on the Mildred Lakes Trail. Due to heavy use, there may be need for a future administrative facility within the Mildred Lakes Basin.

WONDER MOUNTAIN WILDERNESS

The 2,349-acre Wonder Mountain Wilderness borders Olympic National Park west of the Lake Cushman-Staircase area. Topography is generally rugged and ranges from a low elevation of 1,741 feet in McKay

Creek to the summit of Wonder Mountain at 4,758 feet. The lower slopes are heavily timbered, giving way to massive rock outcrops and precipitous pinnacles at higher elevations.

The Wonder Mountain Wilderness is an important scenic backdrop for the Lake Cushman area and visitors travelling to the Staircase area of Olympic National Park. Activities within the Wilderness include cross-country hiking, rock climbing and a limited amount of fishing. Other than boot-worn user paths to the ponds near Wonder Mountain, no trails exist.

The nearest roads are over the ridge from the Wilderness, in the Four Stream and South Fork of the Skokomish drainages.

Access

Arduous cross-country travel is the only means of accessing this Wilderness. The road system in the Four Stream area, northwest of Lake Cushman, provides access to difficult cross-country routes from May through October. Access roads are closed from November 1 through April 20. The Four Stream Road is nearly three-quarters of a mile southeast of, and 1,500 feet in elevation below, the ridge which forms the boundary of the Wilderness. The Steel Creek road system approaches the Wilderness from the southwest, but this access route is also about three-quarters of a mile away from and nearly 2,000 feet below the ridge.

Watershed

McKay Creek, the major drainage within this Wilderness, is a tributary to the North Fork of the Skokomish River and its impoundment, Lake Cushman. There are a few small ponds in the area.

The existing Lake Cushman hydropower project is downstream from the Wonder Mountain Wilderness.

Fish and Wildlife

Wonder Lake Ponds #1, #2, and #3 are located within the Wilderness. Trout are present in #1 and #2. The lakes have been stocked with fish in the past by the Washington State Department of Wildlife. Fish stocking, often facilitated by use of helicopters, was an established practice prior to the creation of this Wilderness.

The fishing in these lakes is not a significant local attraction and is not a major recreation experience for most users.

Historical and Cultural Resources

There are no known historical or cultural sites within the Wonder Mountain Wilderness.

Recreation

Due to the dense vegetation and rugged terrain, there is limited use in this Wilderness. There are a few campsites near the Wonder Ponds. The major attractions are the seclusion this Wilderness provides as well as the Wonder Ponds. No high use camping areas have been identified where the impacts may eventually approach the limit of acceptable change.

Trails and Structures

There are no trails or structures within the Wilderness and no trails are planned to provide access to or within it.

COLONEL BOB WILDERNESS

The Colonel Bob Wilderness is located east of Quinault Lake in the southwestern portion of the Forest. This 11,961-acre Wilderness contains steep, rugged topography. Elevations range from approximately 400 feet in the Quinault Valley to 4,509 feet on an unnamed peak near Mt. Colonel Bob.

Most of the Wilderness lies above the 1,500-foot elevation level. The lower slopes are moderately to heavily forested with western hemlock, Pacific silver fir, and western redcedar, with some Douglas-fir and mountain hemlock. In addition to the profuse vegetation and ground cover, there is a proliferation of mosses and lichens forming typical "rain forest" conditions. Annual precipitation exceeds 160 inches.

At higher elevations, subalpine and alpine vegetation, meadows, rock outcrops, and peaks dominate the landscape.

Under current conditions, even with its trails, the Wilderness presents an outdoor challenge for hiking and primitive camping. The lack of some features (water bodies and major rivers) limits the range of outdoor opportunities. The size of the area provides moderate opportunity for solitude. From the top of any peak, a panorama of timber harvesting can be seen to the north, south and west. The view to the northeast is into the Olympic National Park.

Access

The Colonel Bob Wilderness is accessed by three trails, all of which lead, or are planned to lead, to the top of Mt. Colonel Bob (elevation 4,492 feet). The Colonel Bob Trail approaches from the Quinault Valley on the northwest. The trailhead is just off the county road which serves the upper Quinault Valley. The Pete's Creek Trail has a trailhead on the West Fork of the Humptulips Road from the south. It climbs quickly to join the Colonel Bob Trail at the Gibson Peak slide area. The third trail, Fletcher Canyon, has a trailhead just off the county road near the northeast corner of the Wilderness. This trail dead ends in Fletcher Canyon about one mile from the trailhead. Access by cross-country travel is extremely rare due to the extremely rugged terrain.

Watershed

The headwaters of Fletcher, Inner, Merriman, Ziegler, Haas and Pete's Creeks are all within the Colonel Bob Wilderness. All except Pete's Creek are minor tributaries of the Quinault River. Pete's Creek flows into the West Fork of the Humptulips.

Fish and Wildlife

There are no lakes within the Colonel Bob Wilderness. Steep stream gradients and waterfalls block passage for anadromous fish prior to or at the Wilderness boundary. None of the streams are known to support fish within the Wilderness.

Elk, bear and deer may be seen. Mountain goat, cougar, pine marten, and bald and golden eagles have also occasionally been observed. The area provides limited hunting opportunities for elk, deer and bear.

Hunter success for big game is far below average because of the heavy cover and extremely difficult terrain.

Historical and Cultural Resources

The Ewell's Creek (Colonel Bob) Trail was constructed about 1928. A similar trail on a similar alignment may have been used by Purl Mulkey to obtain access to his trapper's cabin circa 1915. No evidence of the original trail or the Mulkey cabin can be found today.

Recreation

Due to the steepness of the trails, dense vegetation and rugged terrain, there is very little pack and saddle stock use in this Wilderness. There are no plans to provide facilities for this use. However, the trail system is open to use of pack and saddle stock.

The major attractions are the views from the top of Colonel Bob and rock climbing opportunities. The peaks are the main destinations of the majority of users entering this area. Due to the dense vegetation below 3,600 feet and the steep terrain, recreation use other than hunting and mountain climbing is limited to the trail corridors and meadows.

Two camping areas, Mulkey Shelter and Moonshine Flats, have been identified where the existing impacts may eventually approach the limit of acceptable change.

Trails and Structures

There are 13.0 miles of trail inside or accessing the Colonel Bob Wilderness. All except the last 1.8 miles of the Colonel Bob Trail, are open to stock use. Both the Colonel Bob and the Pete's Creek Trails lead to the top of Mt. Colonel Bob. For those camping overnight the most popular destination is Moonshine Flats. Both trails have sections of steep grades. The Fletcher Canyon Trail is about one mile in length and dead ends without arriving at any destination. Its use is very light.

The elevation gain from the Pete's Creek trailhead to the summit of Colonel Bob is approximately 3,300 feet, with a round trip distance of about 9 miles. The elevational gain from the westside is about 4,000 feet, with a round trip distance of approximately 14.5 miles. Access to the top of Colonel Bob falls into the "strenuous" category according to "The Mountaineer" guide trip classification.

There is one trail bridge and one trail shelter, the Mulkey Shelter, within the Wilderness boundary.

HISTORIC TRENDS

Although the Olympic Peninsula has not had any formally designated Wilderness until recently, the demand for it had been expressed for some time, and had steadily increased. Since Wilderness on the Forest is a new designation, historic trends of use are not available. However, recreation use in Primitive or Semi-Primitive settings within the Forest is increasing (see "Recreation") throughout the Nation as a whole, indicates that use of a given area increases at an accelerated rate once it is identified as Wilderness.

The January 1979 Second Roadless Area Review and Evaluation (RARE II) Final Environmental Impact Statement evaluated nine roadless areas totaling 154,912 acres. Portions of four areas (Quilcene, The Brothers, Mildred Lakes and Colonel Bob, 87,656 acres) were proposed as additions to the Wilderness

Preservation System. Wonder Mountain, 9,468 acres, was designated for further planning and the remaining acres were allocated to nonwilderness uses.

The Washington State Wilderness Act of 1984 created five Wildernesses on the Olympic National Forest. In November 1986 there was a boundary adjustment between the Forest and the Olympic National Park that changed the Wilderness acreage. This Forest/Park boundary adjustment transferred a total of 3,250 wilderness acres from the Forest to the Olympic National Park. Buckhorn Wilderness was reduced in size by 175 acres, The Brothers Wilderness was reduced by 154 acres and Mt. Skokomish Wilderness was reduced by 2,921 acres. The five Wildernesses and their current acres are as follows: Buckhorn, 44,258; The Brothers, 16,682; Mt. Skokomish, 13,015; Wonder Mountain, 2,349; and Colonel Bob, 11,961.

FUTURE TRENDS

If current trends in Wilderness use in the Pacific Northwest continue, it is expected that the opportunity to "get away from it all" will become severely limited on the Peninsula within the next 20 to 30 years. This assumes that Wilderness users will still expect the same experience levels that are available today, namely the opportunity to hike and camp in a natural setting without encountering very many other people or observing signs of human use.

Since the amount of Wilderness is currently limited to the 88,265 acres designated on the National Forest and the 876,669 acres in Olympic National Park, these areas can be seen as fixed. Opportunities to improve the distribution of users are available through construction of additional trails, but the added user capacity this will generate is not expected to keep pace with the increased demand. The Forest's potential Wilderness recreation visitor day (RVD) capacity, assuming completion of all currently identified potential trails by year 2030, is 87,100 RVDs per year (see Table III-36).

Current and projected use of the five Wildernesses on the Olympic National Forest is displayed in Table III-37.

Demand estimates are based on SCORPs projections of growth in demand for the relevant recreational experiences.

Table III-36. Summary of RVD Use and Capacity

			Projected Existing:		
	Acres	1986 RVD	2000 RVD	RVD Capacity	Potential RVD Capacity
Wilderness	88,265	88,900	100,200	65,700	87,100

Note: Potential RVD capacity is based on all proposed Wilderness trails being constructed.

Table III-37. Existing and Projected Annual Wilderness RVDs of Use

ROS Class	1986	1990	2000	2030
Semi-Primitive	59,600	61,100	67,200	88,000
Primitive	29,300	30,000	33,000	43,300
TOTAL	88,900	91,100	100,200	131,300

Note: 1986 RVDs based on RIM Report 2300-1. 1990 to 2030 RVD projections based on SCORP and State of Washington's Forecasting and Support Division of the Office of Financial Management.

RESEARCH NATURAL AREAS

THE ROLE OF RESEARCH NATURAL AREAS

Research Natural Areas (RNAs) are tracts of land where natural processes are allowed to dominate, and where some natural feature(s) is preserved for research and education. The main reasons for preserving these tracts can be summarized as follows:

1. To provide areas against which the effects of human activities in similar environments can be measured.

2. To provide sites for study of natural processes in undisturbed ecosystems.

3. To provide gene pool preserves for plants and animals, particularly of rare and endangered species.

CURRENT SITUATION

The Forest's one RNA, established in 1932, is the Quinault RNA. The 1,468-acre area near the southeast shore of Quinault Lake is representative of a coastal plain tract of western hemlock, Sitka spruce, western redcedar and Douglas-fir.

Four other RNAs, administered by the Olympic National Park, are located on the Peninsula. These are:

Hades Creek: representing Pacific silver fir-western hemlock stands located at low elevations on the northwestern edge of the Olympic Peninsula;

Higley Creek: representing western hemlock stands on a mountain slope and valley bottom in the southwestern part of the Olympic Peninsula;

Jackson Creek: representing an old-growth Douglas-fir stand growing on a major river terrace in the western part of the Olympic Peninsula; and

Twin Creek: representing "rain forest" Sitka spruce-western hemlock stands growing on terraces along the Hoh River.

Several of the vegetation elements of the Peninsula are not currently represented in the RNA system. Some of these have been identified as priority needs (Dyrness et al. 1975).

Vegetative conditions meeting two of these priority needs have been identified within the Forest. These are located near Buckhorn Mountain and Wet Weather Creek. The former contains rich endemic vegetation of the eastern Olympic Mountains, and the latter represents western hemlock-Douglas-fir/rhododendron and western hemlock-Douglas-fir/salal plant communities. Both of those areas are within the Buckhorn Wilderness.

NATIONAL NATURAL LANDMARKS

THE ROLE OF NATIONAL NATURAL LANDMARKS

The purpose of the National Natural Landmark Program is to identify and encourage the preservation of nationally significant examples of the full range of ecological and geological features that constitute the Nation's natural heritage. The program is administered by the Secretary of the Interior. Areas designated as National Natural Landmarks are listed in the National Registry of Natural Landmarks which is published annually in the "Federal Register" in October and updated in April. The process used to identify, study, and designate natural landmarks was published in the "Federal Register," Vol. 45, No. 238 on December 9, 1980.

CURRENT SITUATION

Currently, there are no designated National Natural Landmarks on the Forest. However, five potential areas that have been identified by the National Park Service include:

1. Dungeness River headwaters.
2. Hamma Hamma River headwaters.
3. Quinault Research Natural Area.
4. Wet Weather Creek.
5. Pat's Prairie.

The Dungeness, Hamma Hamma and Wet Weather Creek areas are entirely within established Wildernesses, and the boundary of the Quinault area coincides with the established Quinault Research Natural Area. The Pat's Prairie area is currently being managed as a unique botanic area and activities that could significantly alter natural conditions are not permitted.

The Dungeness River headwaters area is currently being assessed by the National Park Service. A preliminary report describing its features was completed in 1981 by an independent contractor, but no recommendation has yet been made by the Park Service.

WILD AND SCENIC RIVERS

THE ROLE OF WILD AND SCENIC RIVERS

The intent of the Wild and Scenic Rivers Act (W&SRA) is to preserve a system of free-flowing rivers along with their immediate environment for the enjoyment and benefit of present and future generations. Rivers to be included in the system are those that have "outstandingly remarkable" scenic, recreation, geologic, fish and wildlife, historic, cultural or other values.

The following excerpts from the Federal Register (September 7, 1982) define Wild, Scenic and Recreational River classifications:

> Wild River areas--Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.
>
> Scenic River areas--Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.
>
> Recreational River areas--Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along shorelines and may have undergone some impoundment or diversion in the past.

Designation of a river under the Wild and Scenic Rivers Act of 1982 bestows on it a legal status and protection beyond what is provided for other streams. Its future development and management must conform to the objectives of the Act.

CURRENT SITUATION

The Olympic Peninsula does not currently have any designated Wild, Scenic or Recreational Rivers under the W&SRA.

In preparation of the Draft Forest Plan, 17 rivers that originate on or flow through Olympic National Forest were evaluated for their potential for designation under the Act. (The Dungeness/Gray Wolf were considered as one river.) Included in these rivers were six that were identified by the Heritage, Recreation and Conservation Service (HCRS, now part of the National Park Service) in The Nationwide Rivers Inventory issued in 1982. In 1988, five were identified by Washington State Parks that meet their criteria for designation as State Scenic Rivers.

Three rivers were recommended for designation as Wild and Scenic Rivers in the Draft Forest Plan Preferred Alternative, the Dungeness/Gray Wolf (considered as one river) and the Duckabush.

The Big Quilcene, Skokomish and its South Fork, Wynoochee, East Fork Humptulips and the Calawah were found to be ineligible for Wild and Scenic River designation.

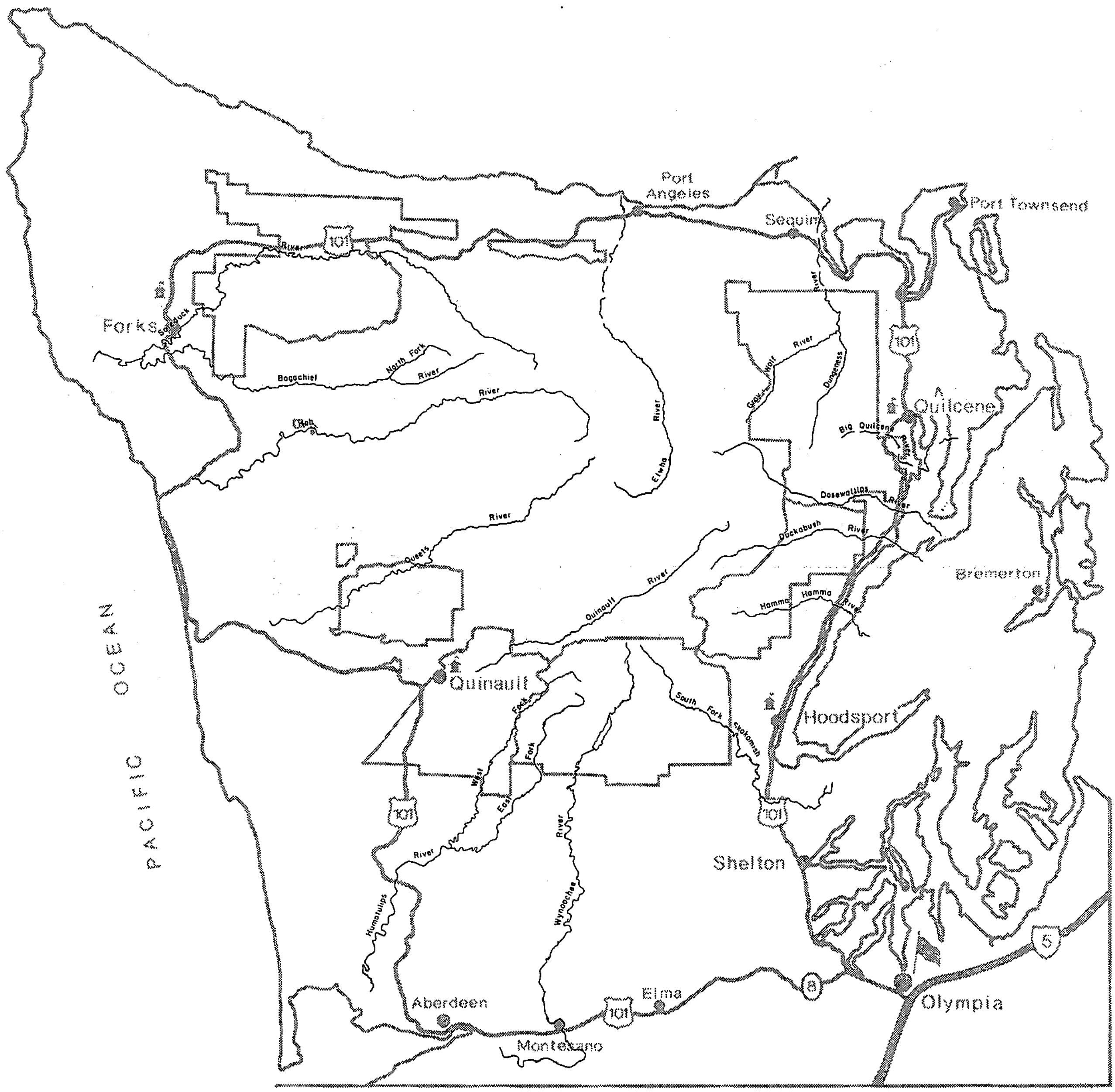
Responses received commenting on the Draft Forest Plan were both numerous and sharply divided in their views regarding the Wild and Scenic Rivers issue. Because of the concerns expressed and the receipt of additional information regarding resource values it was apparent that, at a minimum, we needed to review our earlier evaluations.

All of the rivers considered in the Draft were completely reevaluated. The number of rivers considered was increased from 15 to 17, with the Gray Wolf and Skokomish Rivers evaluated on their own merits.

The reevaluation is detailed in Appendix F of the FEIS, "Wild and Scenic River Review." Of the 17 rivers evaluated, 14 were determined to be *eligible*, having at least one "outstandingly remarkable" value. Of these it was determined that the Elwha, Bogachiel, Quinault and Hoh should be evaluated for *suitability* by the National Park Service, because of only minor acreages of National Forest land within the river corridors. The Big Quilcene, Skokomish and Calawah and its three branches were again found to be ineligible.

Effects of adding rivers to the Wild and Scenic River System in Forest Plan Alternatives are displayed in Chapter IV of the FEIS. Future management of the other (nonrecommended) rivers is addressed in Appendix F of the FEIS and the appropriate Standards and Guidelines (see FEIS, Appendix D, and Forest Plan, Chapter IV).

The purposes and authority for study of wild and scenic rivers are in the Wild and Scenic Rivers Act of October 1, 1982, as amended. Revised USDA-USDI Guidelines for Eligibility, Classification, and Management of River Areas, dated September 7, 1982, supplement the Act. These guidelines direct the Secretary of Agriculture to study and submit to the President a report on the suitability or nonsuitability of a studied river or segment of it for addition to the National Wild and Scenic Rivers system. For rivers flowing through the National Forests the Forest Service is designated as the agency responsible for this study.



LEGEND

————	Eligible
-------------	Ineligible

Figure III-13. POTENTIAL WILD AND SCENIC RIVERS

Table III-38. River Eligibility and Potential Classification Under the Wild and Scenic Rivers Act

			Miles		
River	River Segment	Eligibility & Classification	National Forest	Other	Total
Big Quilcene		Ineligible			18.9
Bogachiel 2/	Source to ONP Boundary	Wild		24.3	24.3
	ONP Boundary to Soleduck River	Recreational		22.4	22.4
	Total Miles			46.7	46.7
Calawah & 3 Forks	Ineligible		Unestimated		96.1
Dosewallips 2/	Source to Station Creek	Wild		12.5	12.5
	Station Creek to ONF Boundary	Scenic	7.2	2.7	9.9 *
	ONF Boundary to mouth	Recreational		5.9	5.9
	Total Miles		7.2	21.1	28.3
Duckabush 1/ 2/	Source to Brothers Boundary	Wild	4.4	12.5	16.9 *
	Brothers Boundary to ONF Boundary	Scenic	3.4	1.6	5.0
	ONF Boundary to mouth	Recreational		2.2	2.2
	Total Miles		7.8	16.3	24.1
Dungeness	Confluence Milk & Heather Creek to Road 2860	Wild	4.1		4.1
	Road 2860 to Silver Creek	Scenic	1.9		1.9
	Silver Creek to Sleepy Hollow Creek	Wild	2.8		2.8
	Sleepy Hollow Creek to ONF Boundary	Scenic	5.4	0.5	5.9
	ONF Boundary to Fish Hatchery	Recreational		2.9	2.9
	Fish Hatchery to mouth	Ineligible		10.5	10.5
	Total Miles		14.2	13.9	28.1
Elwha	Source to Lake Mills	Wild		28.8	28.8
Gray Wolf	Source to 2780 Road	Wild	6.8	9.4	16.2 *
	2870 Road to Dungeness	Scenic	1.2		1.2
	Total Miles		8.0	9.4	17.4
Hamma Hamma	Murdock Lake to Road 25	Wild	3.4		3.4
	Road 25 to Lena Creek	Scenic	5.5		5.5
	Lena Creek to Mouth	Recreational	2.6	6.3	8.9
	Total Miles		11.5	6.3	17.8
Hoh 2/	Source to Jackson Creek	Wild		20.7	20.7
	Jackson Creek to ONP Boundary	Scenic		5.8	5.8
	ONP Boundary to Hoh Indian Reservation	Recreational	1.0	27.1	28.1
	Total Miles		1.0	53.6	54.6

			Miles		
River	River Segment	Eligibility & Classification	National Forest	Other	Total
Humptulips & West Fork 1/ 2/	Campbell Creek to ONF Boundary	Scenic	15.8	1.6	17.4
	ONF Boundary to East Fork	Recreational	0.2	12.4	12.6
	East Fork to Hwy 101	Recreational		4.5	4.5
	Hwy 101 to mouth	Recreational		23.6	23.6
			16.0	42.1	58.1
East Fork Humptulips	Stovepipe Creek to ONF Boundary	Scenic	11.1		11.1
	ONF Boundary to West Fork	Recreational		13.4	13.4
	Total Miles		11.1	13.4	24.5
Quinault	Source to Graves Creek	Wild		16.2	16.2
	Graves Creek to Cannings Creek	Scenic		6.5	6.5
	Cannings Creek to Quinault Lake	Recreational	0.4	9.5	9.9 *
	Total Miles		0.4	32.2	32.6
Soleduck 1/ 2/	Source to Soleduck Road	Wild		6.9	6.9
	Soleduck Road to South Fork	Scenic	1.05	8.05	9.1 *
	South Fork to ONF Boundary	Recreational	6.05	8.25	14.3 *
	ONF Boundary to Bogachiel	Recreational		34.6	34.6 *
	Total Miles		7.1	57.8	64.9
Skokomish		Ineligible			9.0
South Fork Skokomish	Source to Rule Creek	Wild	2.5	1.1	3.6
	Rule Creek to Le Bar Creek	Scenic	9.8	0.6	10.4
	Le Bar Creek to Gorge	Recreational	2.7	1.0	3.7
	Gorge to gauging station	Wild	3.4	3.2	6.6
	Gauging station to North Fork	Recreational		3.2	3.2
	Total Miles		18.4	9.1	27.5
Wynoochee 1/	Clark Creek to Reservoir	Recreational	4.7		4.7
	Fish barrier to ONF Boundary	Scenic	2.1	1.0	3.1
	ONF Boundary to Chehalis River	Recreational		44.7	44.7
	Reservoir to fish barrier	Ineligible	10.7		10.7
	Total Miles		17.5	45.7	63.2

* Two or more segments of the same classification are combined within the section of river.
1/ Studied by Washington State Parks for inclusion in the State Scenic Rivers System.
2/ Identified by HCRS in the National Park Service's Nationwide Rivers Inventory (1982).

UNROADED AREAS

THE ROLE OF UNROADED AREAS

Unroaded areas serve an important role as the remaining undeveloped portions of the National Forest for which Wilderness is a future option. In general, once an area is roaded it is no longer considered potential Wilderness. Timber harvesting, however, does not necessarily result in an irreversible removal of land from future consideration as Wilderness. For example, there is presently an area within The Brothers Wilderness that, although harvested in the past, now appears natural to the casual observer.

Unroaded areas also provide opportunities for recreational activities associated with the Primitive end of the Recreation Opportunity Spectrum (ROS). (Refer to the previous discussion of "Recreation" for a definition of terms.) Unroaded areas, like Wilderness, provide opportunities associated with unmodified or predominantly natural-appearing environments. They provide opportunities for solitude and for activities that will test a person's outdoor skills. Hiking, mountain climbing, dispersed camping, hunting, fishing, trailbike and horseback riding, and gathering forest products are some of the more popular recreation activities associated with unroaded areas. Unroaded areas also serve as scenic backdrops (South Quinault Ridge, Green Mountain, and Mt. Baldy) for popular recreation areas and travel routes.

Wildlife also benefits from unroaded areas. Spotted owls and other old-growth or mature habitat dependent species, such as pileated woodpeckers and flying squirrels, inhabit these areas. Unroaded areas also provide undisturbed habitat for big game species such as elk and deer.

CURRENT SITUATION

There are 13 unroaded areas inventoried on the Olympic National Forest. They range in size from 491 acres to over 19,000 acres, with the average size being about 6,300 acres. There is a approximately 85,800 acres within the unroaded areas.

The Mt. Zion and Jefferson Ridge unroaded areas currently provide recreation opportunities for trail-bike riding in a Semi-Primitive setting; the other unroaded areas do not. The Olympic National Forest is one of the few public land areas on the Peninsula currently providing opportunities for trail-bike riding in a predominantly natural-appearing environment. Primitive and Semi-Primitive areas with trails open to motor vehicles are few in number on the Olympic Peninsula. Trails inside the Olympic National Park, within the Wildernesses and in most unroaded areas are closed to motor vehicles, thus limiting the area available for this recreational activity.

Table III-39 provides a summary of the existing unroaded areas and their sizes. An approximation of their location is represented in Figure III-14.

Table III-39. Unroaded Areas - Olympic National Forest

Area Name	Acres
McDonald	491
Quilcene	19,017
Mt. Zion	5,384
Green Mountain	4,561
Jupiter Ridge	8,308
Jefferson Ridge	9,369
Lightning Peak	7,174
Upper Skokomish	6,182
Moonlight Dome	5,931
South Quinault Ridge	9,852
Rugged Ridge	4,564
Mt. Baldy	3,895
Madison Creek	1,079
TOTAL	85,807

The Washington State Wilderness Act of 1984 specified that these unroaded areas will not be considered for inclusion in the National Wilderness System at the present time, since the Wilderness designation decision was made in the Act itself. (For more detailed information concerning the unroaded areas, refer to Appendix C.)

HISTORICAL TRENDS

There were eight unroaded areas identified on the Olympic National Forest during the first Roadless Area Review and Evaluation (RARE). In the October 1973 Final Environmental Impact Statement for that study, three areas, totaling 70,270 acres, were selected as Wilderness Study Areas--Mildred Lakes (14,041 acres), Quilcene (43,000 acres) and The Brothers (13,229 acres). Included in this total are 216 acres of private land (Tubal Cain Mine).

Three other areas (Elk Reade, 8,344 acres; Rugged Ridge, 6,168 acres; and Mt. Baldy, 7,398 acres) were analyzed in the Soleduck Land Use Plan completed in March 1975. The Final Environmental Impact Statement allocated 3,895 acres of the Mt. Baldy area to management as unroaded with no timber harvesting. The remaining acres were allocated to general forest uses, with emphasis on timber management.

The Quinault Land Use Plan, completed in July 1976, analyzed four additional unroaded areas totaling 32,607 acres--Matheny Ridge (5,866 acres), Moonlight Dome (5,202 acres), Colonel Bob (12,673 acres) and South Quinault Ridge (8,866 acres). The Final Environmental Impact Statement identified 12,120 acres of the Colonel Bob area to be added to the Wilderness Study Areas from the original RARE study. There were 3,418 acres of the South Quinault Ridge area allocated to timber harvesting without road construction and 1,261 acres of the area allocated to special recreation and scenic management. Except for the part of the South Quinault Ridge area within the Research Natural Area, the remaining unroaded acres were allocated to general forest uses.

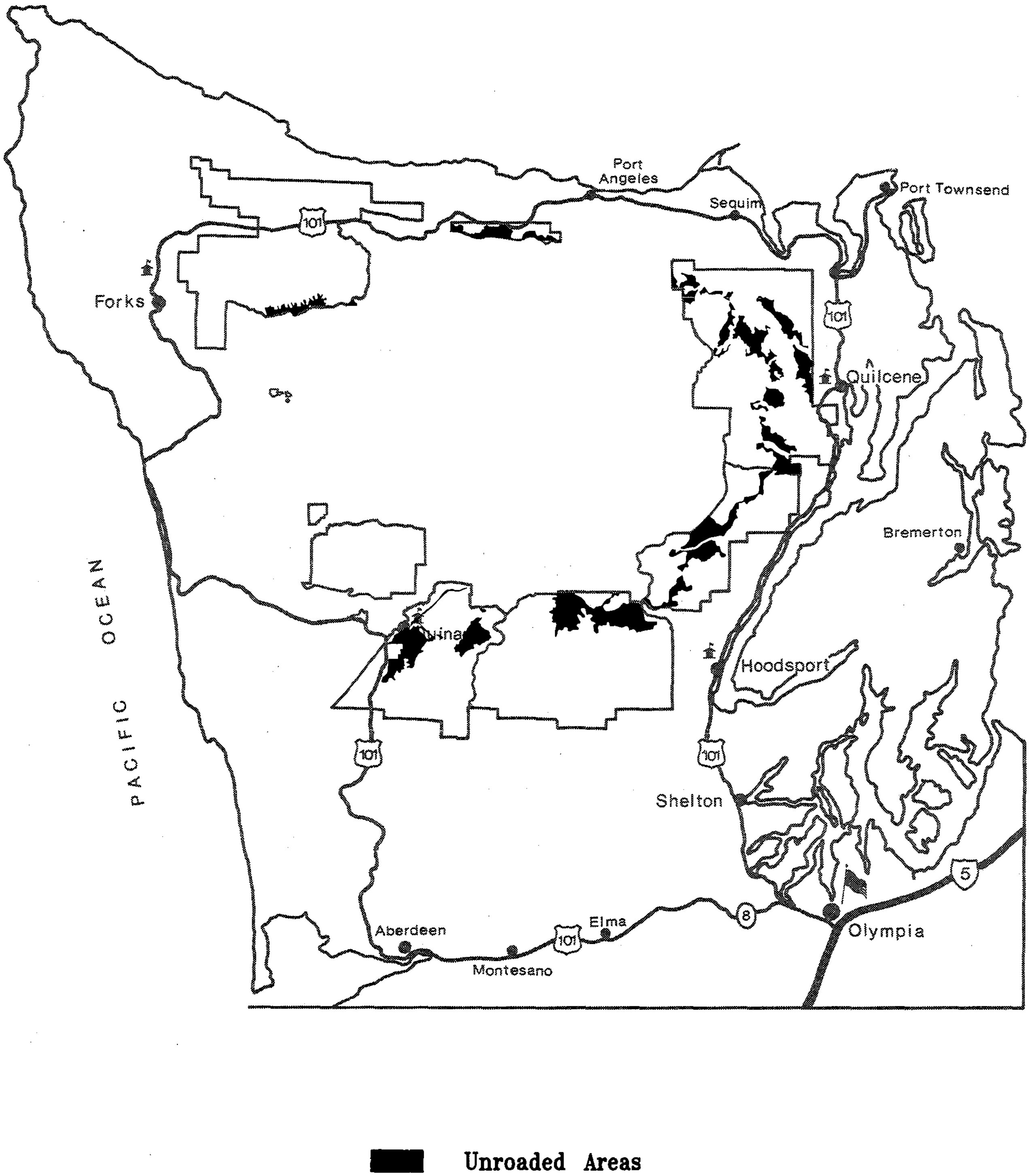


Figure III-14. UNROADED AREAS

The November 1978 Final Environmental Impact Statement for the Timber Resource Management Plan for the Shelton Cooperative Sustained Yield Unit allocated 3,418 acres in the upper South Fork Skokomish drainage to a special recreation management area, aimed at providing unroaded recreation opportunities. This area had not been identified as unroaded in the RARE process because of the cooperative agreement between the USDA-Forest Service and Simpson Timber Company, under which management of Shelton CSYU lands is primarily for the production of timber products. (Refer to the discussion of "Sustained Yield Units", later in this chapter, for detail.)

Nine unroaded areas (154,912 acres) were evaluated in the January 1979 RARE II Final Environmental Impact Statement. Portions of four areas (Quilcene, The Brothers, Mildred Lakes and Colonel Bob), totaling 87,656 acres, were proposed for Wilderness. Wonder Mountain (9,468 acres) was designated for further planning, and the remaining acres were allocated to non-Wilderness uses.

The Canal Front Land Management Plan, covering the Hoodsport (now Hood Canal) and Quilcene Ranger Districts, was completed in May 1979. The Final Environmental Impact Statement (FEIS) included analysis of seven unroaded areas involving 142,894 acres. The FEIS allocated portions of three areas (Quilcene, 43,000 acres; The Brothers, 13,229 acres; Mildred Lakes, 14,041 acres) to Wilderness study, and one area (Wonder Mountain, 9,297 acres) to further planning. The remaining acres were allocated to varied general forest uses and special management designations.

The Washington State Wilderness Act of 1984 created five Wildernesses on the Olympic National Forest, as follows: Buckhorn Wilderness, 44,433 acres; Colonel Bob Wilderness, 11,961 acres; Mt. Skokomish Wilderness, 15,936 acres; The Brothers Wilderness, 16,836 acres; and Wonder Mountain Wilderness, 2,349 acres. All unroaded areas not classified as Wilderness in the 1984 Wilderness Act were designated as available for nonwilderness multiple uses.

In 1986 there was a boundary adjustment between the Olympic National Forest and the Olympic National Park that altered the size of three unroaded areas and eliminated one. The forest transferred 1,757 acres of the Mt. Baldy area and 218 acres of the Pine Mountain area to the Park. The Pine Mountain area was only 230 acres and, therefore, it is no longer considered an unroaded area. The Madison Creek unroaded area was altered, with 120 acres of the Park added to the Forest and 510 Forest acres transferred to the Park. Five hundred and fifty-five acres of the Park were added to the Rugged Ridge unroaded area. A total net change of 1,810 acres of unroaded Forest land were transfered to the Olympic National Park.

The Forest/Park boundary adjustment decreased the size of the Buckhorn Wilderness by 175 acres, the Brothers Wilderness by 154 acres and the Mt. Skokomish Wilderness by 2,921 acres. A total net change of 3,250 acres of Forest Wilderness was transferred to the Olympic National Park.

Table III-40. Remaining Unroaded Areas

RARE II Number	Unroaded Area	Net RARE II Acres	Current Inventoried Acres	Reason for Acre Change
B6081	Quilcene	24,445	19,017	Some acres were included in the Buckhorn W. in 1984 and some have been roaded.
6082	Mt. Zion	5,419	5,384	Road Construction
6083	Green Mountain	5,379	4,561	Road Construction
B6084	Jupiter Ridge (The Brothers) 1/	11,5161	8,308	Some acres were included in the Brothers W. in 1984
B6085	Jefferson Ridge (Mildred Lakes) 1/	10,385	9,369	Road Construction
6086	Lightning Peak (Wonder Mountain) 1/	9,468	7,174	Some acres were included in Wonder Mtn W. in 1984.
6088	McDonald	530	491	New acre estimate.
L6089	Pine Mountain	230	0	1986 Forest/Park boundary adjustment.

1/ ( ) = Name of unroaded area inventoried in RARE II.

FUTURE TRENDS

The demand for unroaded areas is expected to increase as recreation use of Primitive and Semi-Primitive areas increases. Also, there is the desire to retain more area in older forest plant communities for the benefit of wildlife and fish, and the desire to have areas left in their natural condition because people like to know that some of these undeveloped areas still exist. It is expected that the available acreage in unroaded areas will continue to decrease as management activities such as road construction and timber harvesting occur in some of the remaining unroaded areas.

Future consideration for addition to the Wilderness system on the Olympic National Forest will be limited to unroaded area remaining within these 13 areas when the Forest Plan is revised. Refer to Table III-39 for further detail regarding presently remaining unroaded areas.

ROADS

THE ROLE OF ROADS

Roads are the primary transportation facility on the Olympic Peninsula. Most of the travel on the Peninsula is by automobile, and the principal means of transporting goods is by truck. The Peninsula road network (including the Forest's road system) serves as access to the Forest for recreationists and other users, and also provides the routes by which products are transported from the Forest. In addition to destination-oriented travel, pleasure driving (for which roads themselves serve as a recreation resource) is a popular pastime on the Peninsula.

CURRENT SITUATION

The principal travel route on the Peninsula consists of a system of highways (U.S. Highways 101 and 12, State Route 8) which form a loop around the Peninsula. From this loop, State and county roads extend outward to serve smaller communities and forested lands. The Forest development road system forms the final element of this hierarchy. With the exception of Olympic National Park, there are few destinations (other than the Forest itself) served by the Forest's road network.

Travel on the main loop route around the Olympic Peninsula is influenced by recreation traffic and logging traffic, both highly seasonal and quite variable. While travel on the Peninsula loop is normally convenient and uncongested, there are periods (usually during summer) when heavy recreation and/or logging use leads to significant congestion in some areas. To the extent that the National Forest generates this traffic, it influences the overall travel environment on the Peninsula loop.

On the county roads of the Peninsula, traffic volumes and types vary widely from road to road. In some cases, traffic generated by the Forest is a substantial proportion of total road use. Where this is the case, the Forest Service may, through the Forest Highway program, share in the cost of road improvement. Currently, there are 12 county roads designated as Forest Highways.

Traffic on Forest development roads consists primarily of Forest users, both commercial and recreational. The principal exceptions are those Forest roads which provide access to Olympic National Park (Road 24 on the Hood Canal District and Road 2610 on the Quilcene District). These roads also serve as access to private developments within the National Forest boundary, and carry substantial traffic not related to use of the Forest. Road management goals on these roads include accommodation of Park traffic and, where possible, encouragement of county acquisition of roads providing access to private subdivisions.

In many cases, Forest development roads are linked to the public road system by roads administered by either the Washington State Department of Natural Resources or private timber industry landowners. In such situations, cooperative maintenance and reconstruction agreements, rights-of-way, and/or share-cost agreements between the Forest and neighboring landowners are necessary. Because there are numerous such road use agreements, each of them somewhat unique, it would be inappropriate to discuss them in detail in this document. Details regarding these agreements may be obtained at the Forest Supervisor's Office.

The Forest road system has been greatly influenced by the Forest's steep, dissected topography. As a result of high construction costs and difficult terrain, much of the road system resembles a stream network. Main routes collect traffic from dead-end branch systems, with interconnection of routes within the Forest being the exception rather than the rule. For example, only one Forest road connects Ranger Districts, which is Road 22 between Hood Canal and Quinault Districts. In general, the links between Districts and even drainage road systems are county and State roads rather than Forest development roads.

Approximately 2,600 miles of Forest development roads currently exist. The road system also includes 91 permanent bridges, 23 temporary bridges (three of which will not be replaced), and 62 permanent retaining walls. The primary links between the Forest system and State and county roads are the Forest's arterial (190 miles) and collector (570 miles) roads. These roads are the primary travel routes on the Forest, and generally serve large or heavily used land areas. The remainder of the system (1,840 miles) consists of local roads. These facilities are usually intended to provide access for a specific resource utilization activity, such as a timber sale, and are shorter and serve smaller land areas than the arterials and collectors. Resource service rather than travel efficiency is emphasized in their location, design, and operation.

Most roads (including locals) are surfaced with some type of rock in order to provide traction and support in the Olympic's wet climate. Some heavily traveled roads (105 miles in all) are surfaced with asphalt pavement in order to reduce maintenance costs and enhance user convenience. The vast majority of Forest roads (97 percent) are single lane; turnouts (short segments of road wider than the usual road width) are generally constructed on such roads for user safety.

At present, approximately 75 percent of the total Forest, and 88 percent of the non-Wilderness area, is considered roaded (i.e., having at least a preliminary access system in place). Within roaded areas, road density averages about 3.29 miles of road per square mile. Roads occupy about 4 percent of the roaded land.

Management of the Forest development road system is documented in the Road Management Objectives developed for each system road. These objectives, which are available for review at the Forest Supervisor's Office, establish the operation and maintenance standards necessary to serve resource management objectives and access needs. Road Management Objectives presently reflect the resource objectives of current direction, but will be modified as necessary to reflect the road management needs associated with implementation of the Preferred Alternative.

Assessment of the bridges on the Forest indicates that 36 of the 114 bridges will require reconstruction or replacement in the next 25 years. These needs are based on the age and projected use of the bridges in question. The list includes 15 log stringer bridges over 15 years old and 11 treated timber bridges over 35 years old, as well as two concrete bridges and five moveable bridges. A total of 33 bridges will require replacement, with three more needing major reconstruction.

Road management on the Olympic National Forest is not designed to provide the level of service found on public roads. The legal definition of a public road is one that is under the jurisdiction of a public road authority and open to public travel (Forest Service Handbook 7709.16). In the context of this definition, the Forest Service is not a public road authority, and Forest Service roads are not public roads. Forest development roads are roads under the jurisdiction of the Forest Service which are necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources (Title 23 USC 101, as amended by the Surface Transportation Act of 1978). This distinction is not generally understood by the public.

Normally, Forest development roads can accommodate incidental public service traffic. However, when the majority of road use is comprised of public service or other non-Forest Service traffic (such as commercial or residential development and/or local government use), the Forest Service will actively negotiate the transfer of its jurisdiction to the appropriate public road authority. In most cases, this is the county government.

Direction for the maintenance of each Forest development road is documented in its Road Management Objectives. The purpose of road maintenance is to provide resource protection, safe access to users (where use is planned), and protection of the road investment. All roads receive basic custodial maintenance to insure adequate drainage. Closed roads may have drainage structures removed and waterbars or crossditches installed to reduce erosion. Roads remaining open to traffic receive the degree of maintenance dictated by amount and type of planned use, available funding, and maintenance priorities.

The Forest's current road closure program is also documented in the Road Management Objectives. There are two principal components of this program: seasonal closures and long-term closures. Seasonal closures are used during critical periods to prevent harassment of wildlife and to avoid damage to roads and adjacent resources. The proportion of the Forest's road system managed with long-term closures has increased significantly in recent years, especially within the Shelton Cooperative Sustained Yield Unit. This is done to reduce maintenance costs, improve wildlife habitat conditions, and reduce siltation rates.

Road closures may be accomplished either by blocking the road entrance to all traffic, or by gating as authorized in 36 CFR 261. In the case of gated closures, limited administrative traffic and use related to timber sales, contracts, or permits may be allowed. The current maintenance and road closure status of the Forest development road system is as follows:

- -Maintained for Passenger Car Use - 29% of system
    - Open continuously - 27% of system
    - Seasonally closed (gated) - 2% of system
- -Maintained for High Clearance Vehicle Use - 48% of system
    - Open continuously - 42.5% of system
    - Seasonally closed (gated) - 5.5% of system
- -Gated Closure (long term) - 6% of system
- -Blocked to All Traffic - 17% of system

During periods of timber haul, some of the roads maintained for high clearance vehicles may be restricted to logging use alone in order to provide for public safety.

HISTORIC TRENDS

Early access to the Forest was primarily by rail. Several of the more accessible areas were railroad logged in the early 1900's. Some of the rail systems on the Shelton CSYU were in use until recently. Road construction began in earnest in the late 1940's, as the emphasis shifted from rail transport to truck transport. As harvest levels expanded throughout the 1950's and 1960's, the Forest's road system developed rapidly. By the late 1970's, most of the main road system was in place.

Travel on the Forest's road system has always been a mixture of harvest-related traffic and recreation traffic. There has been, however, a major shift in the proportion of each type of traffic. Until the 1960's, recreation travel was a relatively minor component of total Forest traffic. Since then, the proportion of recreation-oriented traffic has increased dramatically. This has been due to the increased demand for outdoor recreation in general, particularly the growth in popularity of pleasure driving. A secondary factor in the shift in traffic proportions has been the stabilization of the Forest's harvest level. This grew steadily until the 1970's, but has been fairly stable over the last 15 years. As a result, the volume of harvest-related traffic has leveled off.

FUTURE TRENDS

The popularity of recreation travel by auto is expected to continue increasing. Therefore, demand for recreational use of Forest roads is likely to expand. The volume of harvest-related traffic will depend on programmed harvest level.

All of the Forest's potential arterial system and most of its potential collector system have been constructed. The majority of future road construction will be for the purpose of accessing individual timber sales or relatively small (up to 5,000 acres) harvest areas. All of the identified potential developed recreation sites currently have access, and road construction to serve recreation is likely to be limited to short local roads.

Because of the relative completeness of the Forest's road system and the increasing volume of recreation traffic, emphasis has shifted in recent years from road construction to reconstruction and road management. This shift is expected to continue, with increasing importance being placed on traffic management and road maintenance management as tools for increasing the efficiency of system operation. Increased use of road closures (both seasonal and long-term) is likely to be especially important, as this strategy serves to reduce maintenance costs, improve wildlife habitat conditions, and reduce siltation rates.

PLANS OF OTHERS

Forest road development and management plans exist within the context of a broad range of road plans developed by other agencies and organizations. The activities of the Forest have the potential to affect the construction, maintenance and traffic management plans of the following organizations:

- Washington State Department of Natural Resources
- Adjacent private timber industry landowners
- Olympic National Park
- Highway Departments of Clallam, Grays Harbor, Jefferson and Mason Counties
- Washington State Department of Transportation

Where Forest roads link with the road systems of these entities, coordination of management is routinely accomplished through cooperative agreements, rights-of-way and/or share-cost agreements. Numerous such agreements are currently in existence. If future changes in Forest management direction necessitate modification of these or development of additional agreements, it is expected that the required coordination can be accomplished in the usual manner. At present, there are no anticipated changes in Forest road management likely to have a major effect on the road management plans of other agencies and organizations.

STRUCTURES AND UTILITY CORRIDORS

THE ROLE OF STRUCTURES AND UTILITY CORRIDORS

Included in this discussion are the Forest's administrative sites and structures, special use structures and utility corridors. Administrative sites serve a variety of purposes related to the administration and management of the National Forest. Utility corridors provide the land area needed to develop transmission facilities for basic utilities such as electricity, telephone and water lines. Special use structures are facilities developed and operated under special use permit to serve the specific purpose of the operator. Their uses are widely varied. These facilities provide permittees the opportunity to utilize Forest land as a base for activities or operations compatible with the management goals of the Forest Service.

CURRENT SITUATION

The Forest currently utilizes many different structures for administrative purposes. These are located both on National Forest land and on leased sites. The most prominent of these are the Forest Supervisor's Office, the District Ranger Stations, and the two principal work centers on the Forest (Satsop and Snider). Numerous, smaller facilities support a wide range of administrative functions. A few of the structures were constructed during the early periods of National Forest administration and have historic significance. A total of 22 administrative buildings were constructed prior to 1940. The remainder are newer and have few unique characteristics, interest or value. It is anticipated that the current numbers and locations of administrative sites will remain fairly stable in the foreseeable future.

Major utility corridors on the Peninsula are generally contiguous to Highway 101, either running directly along the Highway 101 corridor or extending out from this corridor to a local terminus. Utility corridor permits currently in effect on the Forest include power lines, telephone lines and water lines. In addition, rights-of-way have also been granted for roads and railroads. No significant new utility corridor development is anticipated at this time. If renewed interest in hydropower arises, additional utility corridors may be needed (see the discussion on "Energy").

There are many private structures on National Forest land which are authorized by special use permits. These improvements range from weather stations to the historic Lake Quinault Lodge. Authorization of existing or new special use permits will be approved as long as they serve the public interest and use does not conflict with Forest goals or management direction in the Forest Plan.

MINERALS

THE ROLE OF MINERALS

In general, the geologic structure of the Olympic Peninsula is a broad dome made up of Mesozoic and early Tertiary marine sedimentary rocks. Flanking the dome of older sedimentary rocks on its north, east and south sides are several belts of Mesozoic and Eocene volcanic rocks interbedded and intertongued with marine and nonmarine sedimentary rocks of Tertiary age. Of most interest, as far as mineral resources are concerned, are the oil and gas potential associated with the sedimentary formations interbedded in the Tertiary volcanics, the manganese potential associated primarily with limestone-basalt contacts in the Tertiary sedimentary and volcanic deposits, and common-variety minerals used for road construction purposes.

As policy, the Forest Service encourages the exploration for, and development of, mineral resources. The objective is to manage mineral activities in an appropriate manner, consistent with multiple-use management principles. The exploration for and development and production of mineral and energy resources are to be integrated with the use, conservation and protection of other resources.

Mineral commodities are grouped by law into three distinct classifications: locatables, leasables and salables. The manner in which each is managed, and the authority of the Forest to control the exploration for and development of each commodity, varies considerably.

Locatable minerals are those which, when found in valuable deposits, can be acquired under the General Mining Laws of 1872, as amended. Examples of locatable minerals occurring on the Forest include, but are not limited to, manganese, iron, copper, mercury, placer gold, asbestos and limestone if of suitable quality. Lands adjacent to the Forest have reported occurrences of cobalt, nickel, lode gold, silver and zinc. Of these commodities, manganese appears to be of most interest, and the importance of even this mineral is questionable.

Citizens, and those who have declared their intent to become citizens, of the United States have a statutory right to explore vacant unwithdrawn public land for locatable minerals. Upon discovering a valuable deposit, they have a right to locate and remove the minerals. Reserved mineral estate is also subject to the location of mining claims, whereas acquired mineral estate and outstanding mineral estated are not. On acquired mineral estate, all minerals are leasable, whereas the Forest Service assumes the role of any other surface owner for those lands with outstanding mineral estate. Based upon past practice, the surface estate over these lands will be managed consistent with the principles of 36 CFR 228. Forest Service control over these activities is legally limited to minimizing or reducing impacts to other resources. Plans for development and operation are reviewed to ensure that adequate environmental standards and resource protection measures are provided. Provisions for prompt reclamation or restoration of disturbed lands are routinely included as part of the operating plan approval process.

Leasable minerals are those mineral commodities which may be acquired under the Mineral Leasing Act of 1920, as amended by the Federal Onshore Oil and Gas Leasing Reform Act of 1987. Those occurring on the Forest appear to be limited to a moderate potential for oil and gas and a very limited potential for geothermal resources. These minerals are subject to exploration and development under leases, permits or licenses granted by the Secretary of Interior, whose authority is administered by the Bureau of Land Management (BLM). Although Forest Service authority for management of these leasable minerals is still oriented toward surface protection, its control of prospecting and development activities is considerably stronger than it is for locatables. Table III-41 summarizes the mineral leasing responsibilities of the Forest Service (FS) on the public lands it administers.

Table III-41. Mineral Leasing Responsibility

Commodity	Public Domain Administered by the Forest Service	Acquired Lands Administered by the Forest Service	Preliminary Prospecting Permits 1/
Oil and Gas	BLM requests FS consent for leasing and FS concurrence for permit to operate	BLM requests FS consent to lease and FS concurrence for permit to operate	FS has authority to issue a permit.
Hardrock Minerals	Locatable-Non-discretionary	BLM requests FS consent to issue a prospecting permit, to lease and to operate	
Geothermal	BLM requests FS consent to lease and FS concurrence to operate	BLM requests FS consent to lease and FS consent to operate	FS has authority to issue a permit

1/ Permits are nonexclusive, do not allow removal of minerals for other than sampling, and do not lead to a preference-right lease.

Recommendations for mineral leasing are based on whether mineral development activities could be implemented on National Forest lands and meet the direction in management strategies in the Forest Plan.

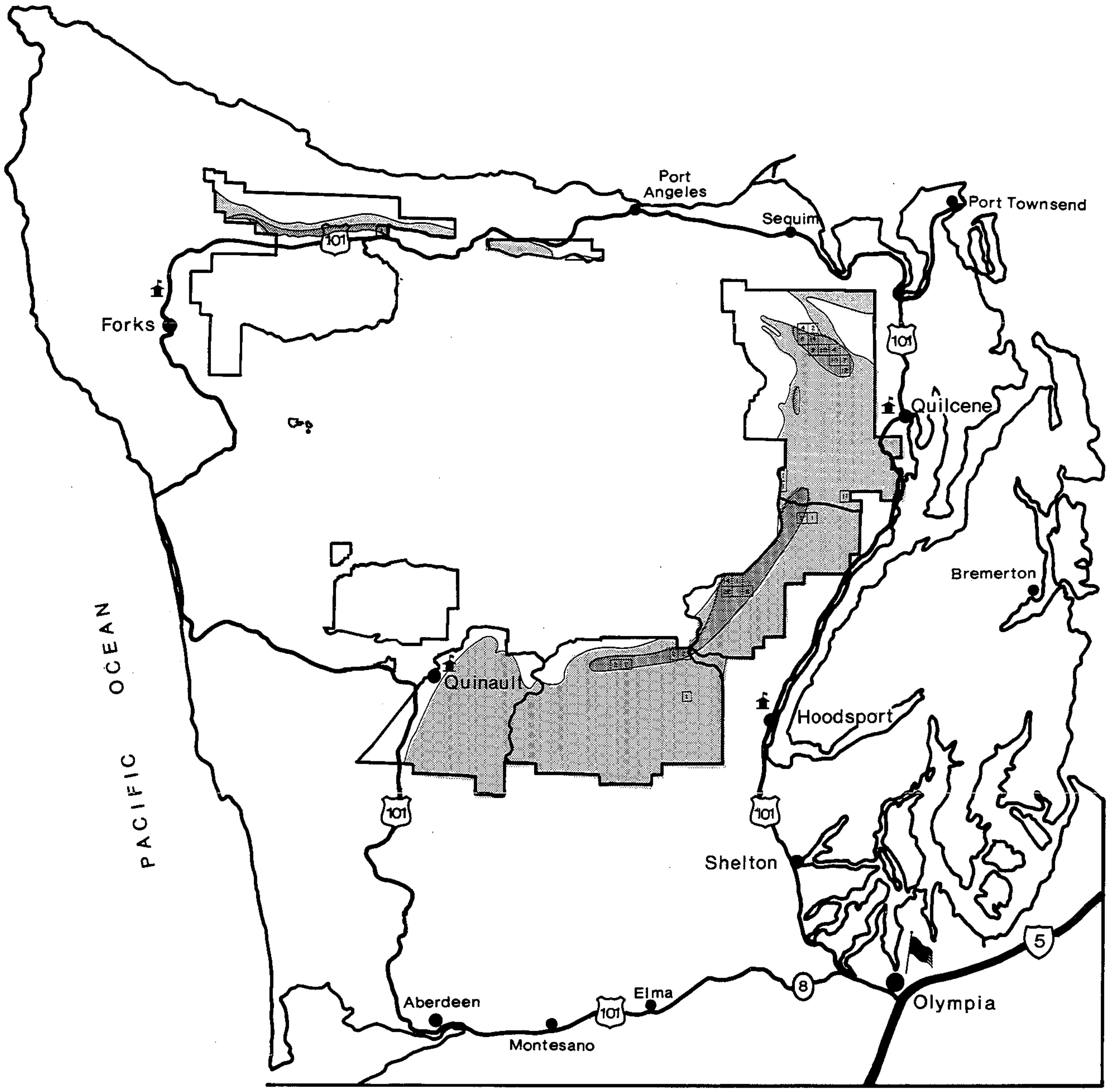
The policy and procedures by which mineral use authorizations for Federally owned leasable minerals are to be processed are established in the Interagency Agreement between the Forest Service and the Bureau of Land Management dated June 19, 1984. The agreement calls for the Forest Service to participate with BLM in the formulation of site-specific terms and conditions in the operating plans. The plans must provide appropriate mitigation measures to insure that adverse impacts on surface resources will not exceed applicable environmental protection standards. Implementing regulations may be found at 36 CFR 228, Subpart E.

Salable minerals are common varieties of sand, gravel, stone, pumice, pumicite, cinders and clay. In general, these minerals are of widespread occurrence, relatively low unit value, and are usually used as construction materials and for road building purposes. These minerals are disposed of under the authority of the Materials Act of July 31, 1947, as amended by the Act of July 23, 1955. Disposal of salable minerals from public lands administered by the Forest is totally at the discretion of the Forest Service (see regulations in 36 CFR part 228). Management of operations on permit areas is similar to the management of leasable mineral activities. Salable minerals occurring on the Forest appear to be limited to sand and gravel and various types of sedimentary, volcanic and igneous rock. It is assumed that most of the limestone on the Olympic is of a common variety making it also a salable mineral.

CURRENT SITUATION

LOCATABLE MINERALS

A mineral resource evaluation has been prepared to assess the present and future potential for the development of locatable mineral resources on the Forest. The evaluation is based on a literature search. For this reason, the geologic favorability for the occurrence of mineral resources which has been assigned to various areas is considered a probabilistic assessment. It indicates, on a relative scale, the odds of successfully finding mineral resources that can be profitably developed.



LEGEND

[2] Recorded Mining Claims

Mineral Deposits - low potential for development

Mineral Deposits - moderate potential for development

Figure III-15. MINERAL POTENTIAL AND EXISTING CLAIMS

Based on this evaluation, it appears that the only known locatable mineral commodity of interest is manganese. At present only small and relatively isolated areas appear to have a "moderate" potential, at best, for future development. Reports of other locatable mineral commodity occurrences are of interest, but pending future exploration and evidence indicating otherwise, these occurrences are not considered to have more than a nominal potential for development. In most cases, these other minerals are associated with the manganese deposits, and would be produced as a by-product of future manganese production.

Manganese deposits of interest generally occur as tabular bodies, from a few inches to several tens of feet thick and up to hundreds of feet long. In general, the deposits are concentrated along two basalt-limestone contact zones two to three miles wide. Even though they are scattered and disconnected, there is believed to be good potential for discovering additional resources throughout the zone should future demand justify the expense of exploring the area. Currently, there is no manganese production on the Forest and no apparent interest in developing the resource.

Reported occurrences of nonmetallic, locatable minerals are limited to barite and possibly limestone. Neither is known to have any economic significance.

Even though there appears to be little interest in development of the locatable mineral commodities on the Forest, BLM records (January 23, 1985) indicate that 14 placer claims, 152 lode claims, and 1 millsite claim have been located on the Forest and properly recorded. Assessment work on these claims was also properly recorded with BLM through 1984. It is not known whether these claims have been located and maintained in hopes of renewed interest and demand for the manganese resource, or whether they have been located for other locatable minerals of which we have little knowledge.

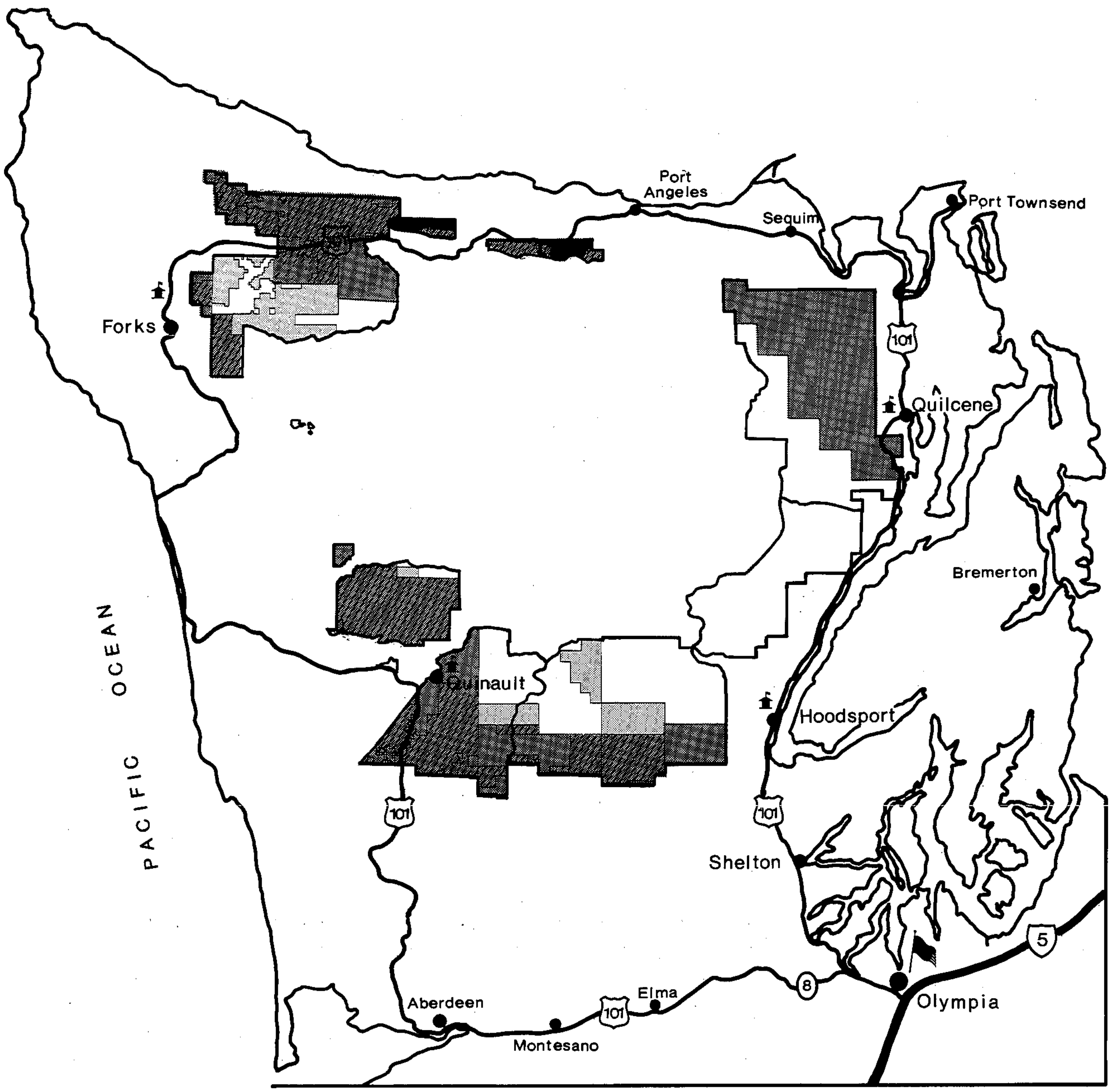
LEASABLE MINERALS

Leasable mineral potential has not been assessed in the same manner as locatable minerals. However, areas have been classified by the Bureau of Land Management (previously U.S. Geological Survey and Mineral Management Service) as being "prospectively valuable" for oil and gas resources. Areas classified "prospectively valuable" for leasable mineral commodities are considered to have at least some potential for experiencing exploration and development activities in the future.

At present, activity related to oil and gas on the Forest is limited to existing leases and applications for leasing. As of May 1982, 96 separate applications were received from 10 different companies. These covered approximately 300,000 acres on the south and west sides of the Forest. Of this area, leases were issued for approximately 232,000 acres. Only four totaling 3,741 acres, remained under lease as of April 1985. Eight leases (32,650 acres) are open for simultaneous leasing. Revenues produced from mineral leasing on the Forest during FY 1984 were $4,328, of which $1,943 was returned to the State. This represents rental returns only. Should production ever begin, royalties would increase this revenue substantially.

The Forest is not known to have occurrences of other leasable commodities, nor is it classified as "prospectively valuable" for any other leasable commodities. There are, however, several thermal springs in the northern part of Olympic National Park. One of these is being considered for on-site use by the National Park Service. Whether a similar potential exists at depth on National Forest lands is not known. Based upon available information, it appears no geothermal resource of significance occurs on the Forest.

Disposal of "hard rock" minerals on acquired lands is subject to permit and lease under Reorganization Plan No. 3 and the Mineral Leasing Act for Acquired Minerals. To date, there has been no prospecting permit or lease application filed for those lands, and none are anticipated.



LEGEND

Forest Service lands classified "Prospectively Valuable"

Existing Oil and Gas Leases

Previously leased lands within areas classified "Prospectively Valuable"

Previously leased lands not within areas classified "Prospectively Valuable"

Figure III-16. OIL AND GAS POTENTIAL

SALABLE MINERALS

Supplies of common variety minerals have received growing attention in recent years. Extensive investigations have been conducted to identify material sources and available volumes. Common-variety mineral materials are mostly utilized in the construction of all-weather roads for timber sales. Except for some locations on the west side of the Forest, these materials are currently plentiful. At times, adjacent landowners need these materials and they are sold, if surplus to National Forest needs. Total annual quantities sold generally do not exceed 5,000 cubic yards. Substantial quantities are used annually in construction and maintenance of National Forest system roads.

AREAS RESTRICTED OR WITHDRAWN FROM MINERAL ENTRY

The area of the Forest is approximately 632,324 acres. Of these, 108,545 have been withdrawn from mineral entry. As of March 11, 1985, these include the following:

Forest Service	Number	Acres	Percent of Forest
Admin. and/or Rec. Site	108	4,997	0.7
Research Natural Areas	1	1,468	0.2
Other	1	149	<0.1
Power Withdrawal	11	10,632	1.6
Wilderness	5	91,229	14.0

HISTORIC TRENDS

LOCATABLE MINERALS

The manganese minerals occurring on the Olympic Peninsula are said to have been discovered in the late 1800's, but there has been only sporadic interest in the deposits since then.

Even though manganese is considered to be a strategic and critical mineral necessary for the production of iron and steel, the U.S. produces only about two percent of what it consumes annually. The remainder comes from foreign sources or government stockpiles. When foreign sources become unavailable, government stockpiles are reduced, or industrial demand significantly increases, the demand for domestically produced manganese increases appreciably. This is reflected in the history of production, which had surges in the 1924-26, 1941-46 and 1952-53 periods.

Activities related to other varieties of locatable minerals have been limited to prospecting only.

LEASABLE MINERALS

Past leasable mineral efforts have concentrated primarily on oil and gas exploration. Most activities have been conducted on adjacent private land in areas considered most favorable for discovery potential. Drilling tests began as early as 1901, and have continued sporadically ever since. Some of the exploration has shown potential. In view of the record, it would be premature to suggest that potential for discoveries on Forest land are likely. There have been some positive indicators, however, and the geology of the Forest provides the environment where petroleum resources may occur.

SALABLE MINERALS

Sales of common-variety minerals have been fairly stable in recent years. Utilization of this mineral commodity is closely tied to fluctuations in road construction activity. While substantial quantities of these materials are used by the Forest in its own construction program, sales to other users have been low and of little consequence.

FUTURE TRENDS

LOCATABLE MINERALS

Future interest in manganese will depend on the currently unpredictable availability from foreign sources and in demand for the exceptionally pure form capable of being produced in this area. Considering the costs of mining, milling, and expected return from this area, it appears that development will not be justified within the next 10 to 20 years.

LEASABLE MINERALS

There has been a minor amount of gas and oil exploration on the Olympic Peninsula over the years. Most drilling, seismic work, and leasing activities have been minor and have occurred on lands other than the National Forest. The energy crisis of the early 1980's resulted in increased leasing activity which has since subsided. Leases have been allowed to expire, discoveries were of minor consequence, and no development of these resources has occurred. In view of these circumstances, there would appear to be limited potential for future development of gas and oil resources on the Forest.

SALABLE MINERALS

Demand for common-variety materials is relatively low and stable. Use of these materials for road surfacing, building stone and revetment material, combined with depletion of private reserves, has made the Forest's supply increasingly important. Since the primary use of the material is for road reconstruction and construction associated with timber harvest, future Forest timber harvest activities will have a direct bearing on future availability of rock and aggregate resources.

ENERGY

This section is limited to discussion of hydropower and fuelwood energy resources. Other energy resources, such as oil, gas and geothermal energy, were presented in the previous section ("Minerals") because they are considered to be leasable mineral commodities.

THE ROLE OF ENERGY

Wood was the principal source of fuel in the Pacific Northwest for domestic heating and cooking until electricity and fossil fuels became cheaper and more readily available.

Following World War II, the relative abundance of inexpensive hydroelectric power became a dominant energy factor in the economic development of the Pacific Northwest. Hydroelectric power sources have historically been supplemented by relatively inexpensive, abundant fossil fuels with the thought, until recently, that nuclear power would become the power source of the future. More recently, however, concerns have arisen about the high environmental and other costs of nuclear power and how much increased energy will be needed in the future. The costs of electricity and fossil fuels have fluctuated in the past decade, particularly when supplies of oil were almost cut off during the early 1970's due to OPEC manipulations of supply. Currently, relatively abundant supplies of oil are available at favorable prices. As costs increased, there was a "whitewater gold rush" to locate and develop hydropower sites. Also, there was a reawakened interest in use of wood for domestic heating and as a commercial fuel for heating and generation of electricity. This enthusiasm slackened in the late 1980's, but there is still a substantial potential for use of excess biomass for fuel.

CURRENT SITUATION

HYDROPOWER

The major, existing hydropower dams on the Olympic Peninsula were built early in this century without provision for fish passage. While they have been successful as power producers, changing perceptions and recognition of other values affected by these projects, particularly with respect to anadromous fisheries, have led to substantial criticism of the existing facilities and opposition to installation of new ones. None of the existing power producing dams are located on Olympic National Forest lands.

The Wynoochee Dam, completed in 1972, was built for flood control and water supply regulation on the Wynoochee River. It was also built without installed fish passage facilities. However, a fish capture facility installed below the dam permits hauling mature, returning adult anadromous fish past the dam to the lake and streams above it. Current proposals to install generating facilities in the Wynoochee Dam will alter its operating purpose, but should not increase its fishery impacts.

A 1979 study by the Washington Water Research Center indicates that stream reaches located within Olympic National Forest have the potential to provide about 3,295.3 Gigawatt hours of power (3,840.5 billion BTUs) per year. The current and proposed installations utilizing waters from the Forest will produce about 7.6 percent of that potential.

About 57 percent of the potential hydropower capability of the Forest sites is in stream reaches that have been identified as meeting eligibility criteria for designation as Wild and Scenic Rivers in the National Wild and Scenic Rivers System. This designation would foreclose their development for hydropower production.

Currently, there are five active hydropower license applications or functioning projects on the Forest:

FERC #	Project Name	Project Output	Current Status
3783	Rocky Brook	7.0 GWh	Operating
6002	Elkhorn	49.8 GWh	Licensing in process.
6287	Lena Creek	23.4 GWh	License denied 6/29/87. Being appealed.
6842	Wynoochee	42.14 GWh	Project licensed. Retrofit of existing dam.
460	Cushman	459.0 GWh	Relicensing of existing project. (Not located on National Forest lands, but affects them.)

FUELWOOD

Presently, about 2.5 percent of the biomass available as excess woody residues over three inches in diameter is being utilized. This constitutes a major underutilized resource of the Forest. While these "surplus" residues are evaluated here as potential energy fuels, they also have value for pulp chips and other industrial raw materials that are occasionally utilized when the economic situation permits.

Present use of wood as an energy source is largely limited to home heating. The Forest has a permit program allowing people to purchase firewood from National Forest land. Issuance of firewood permits appears to closely correlate with other fuel costs. In the 1980-82 period, 5,900 permits were issued. At an average of three cords per permit, this was equivalent to 2.3 million cubic feet of firewood.

HISTORIC TRENDS

HYDROPOWER

Hydropower has been a part of Washington's energy picture since the beginning of the century. The first hydropower plant in the State began operation at Snoqualmie Falls in the Cascade foothills in 1898. The Electron Plant, on the Puyallup River, began operating in 1904. The Nooksack Falls project was completed in 1906.

On the Olympic Peninsula, the Elwha project was built in 1911, Glines Canyon in 1929 and Cushman in 1924. After the large Columbia River projects came on line in the 1930's and 1940's, many smaller hydro projects ceased operation. Improvements in electrical technology added to the small plant shutdown, but also helped increase the demand for power.

About 80 percent of the electricity consumed in the Pacific Northwest is produced by hydropower.

FUELWOOD

Use of the Forest's vegetation as a source of fuelwood increased as the cost of fossil fuels went up. A reduced supply of fuelwood from private and State lands, which are closer to population centers, has also contributed to this increase in demand.

Until spring of 1983, the Forest issued free use permits for up to 10 cords of fuelwood per year per family. (See Table III-42 for a summary of fuelwood permits issued.) The establishment of charges for this material led to a sharp drop in the number of permits issued. For the 1984-1989 period, 1,100 permits were issued annually. This translates into approximately 3,100 cords of firewood each year for family use. This is about 75 percent of the estimated 4,000 cords removed. The remaining 25 percent went to commercial firewood cutters.

Table III-42. Annual Fuelwood Permits Issued

	Number of Permits by Ranger District						
Year	Hoodsport	Quilcene	Quinault	Shelton	Soleduck	Total Permits	Estimated Cords Removed
1980	490	1,373	209	1,668	411	4,151	12,453
1981	1,043	2,064	333	1,853	555	5,848	17,544
1982	1,009	1,863	679	3,459	790	7,800	23,400
1983 1/	650	1,831	324	550	794	4,149	19,041
1984	325	588	111	568	102	1,694	5,082
1985	360	440	130	267	49	1,246	3,738
1986	287	410	158	203	12	1,070	3,210
1987	215	492	159	2/ 29	9	904	2,712
1988	187	454	61	0	16	718	2,154
1989	183	479	82	0	9	753	2,259

1/ Includes some free use, converted at three cords per permit, and some pay permits at actual cordage bought.
2/ Records from the former Shelton Ranger District were not listed in TSSAs.

FUTURE TRENDS

Demands for energy will probably continue to increase. As costs of electricity and fossil fuels increase, people will look to alternative energy sources. Fuelwood and waste wood may be used to fuel steam plants as alternatives to hydropower facilities.

The Forest has not been extensively explored for other energy resources. The marine sediment-originated rocks in the north and west parts of the Peninsula may contain undiscovered oil and gas deposits. Also, the ongoing uplift of the Peninsula and its frequent earthquakes are characteristics common to areas with geothermal potential. Despite these possibilities, the known hydropower and fuelwood resources appear to be the most likely near-term, future sources of energy. (See also "Minerals.")

HYDROPOWER

Identified Olympic National Forest hydropower potential is associated primarily with relatively small, run-of-the-river type facilities. Their feasibility is based on large, consistent volumes of water flowing down relatively steep river gradients, and their relatively low cost compared with high dams and impoundments.

As the current energy surplus shrinks and the cost of electric power increases we expect renewed interest in some projects that have currently been dropped. Small, run-of-the-river projects can be designed to have minimal impacts on other resources and values; pipelines can be buried or tunnels can be used; transmission lines can be buried in existing rights-of-way; diversions and powerhouses can be blended into the landscape. The primary potential for impact appears to be on the aquatic habitat within the project area and affected instream flows. Effects on these are often difficult to mitigate and must be carefully evaluated prior to development. It is expected that hydropower will only be able to meet part of the area's future energy needs.

Until a project is proposed, it is considered an undeveloped potential resource. The specifics of the proposed project determine its potential impacts on the soil, water and other affected components of the Forest. The references to hydropower projects in the Standards and Guidelines (S&G's) of Appendix D are used in identifying factors of the Forest's resources that might be affected by the project. The Forest Service S&G references are used when the Forest Service has legal responsibility in project design evaluation.

Hydropower development of sites on National Forest land is an appropriate use under Federal law. Before a site can be developed application must be made to the Federal Energy Regulatory Commission (FERC) and the proposal evaluated to meet FERC requirements. These project evaluations involve FERC, the Forest Service (where National Forest lands are involved), the Department of the Interior, the Department of Energy, State and local governmental agencies, and other affected parties. Many of the sites identified under the Federal Power Act were designated many years ago. While they probably have the same power production potential now, costs and other changed factors may have altered their viability. An Environmental Analysis (EA) is prepared for all proposals.

FUELWOOD

The supply of fuelwood is potentially very large because of the Forest's growth potential. As new wood-use technology and markets are developed, the competition for woody material for all uses will increase.

The trend in tightening air quality standards in urban areas is also expected to affect the amount of domestic fuelwood consumed.

LANDOWNERSHIP PLANNING

THE ROLE OF LANDOWNERSHIP PLANNING

Landownership planning is the process of determining which lands are most suitable for National Forest System purposes and which are not needed for management of the resources and uses desired. The process identifies parcels of land within and adjacent to Forest boundaries that could be either acquired or disposed of by the Forest Service to improve management efficiency and/or goal attainment.

CURRENT SITUATION

Five broad categories have been established to identify land parcels in the planning process. These are:

Category I: This category includes lands where Congress has either directly or indirectly instructed the Forest Service to retain ownership and acquire non-Federal lands for a designated purpose, such as Wilderness.

Category II: This category includes lands allocated to management categories by the Forest Service through a land management planning process. Direction is to retain ownership and acquire private lands as the opportunity arises. The basic assumption behind acquisition is that National Forest goals and objectives permit the desired management, while other owners are unable (or have no incentive) to manage the land in the desired manner. Examples include potential Wild and Scenic River corridors and lands being managed for primitive dispersed recreation.

Category III: These lands are commonly referred to as general forest. Their management is usually aimed at commodity production. They also constitute the bulk of the lands normally involved when considering land exchanges with other landowners.

The two primary landownership objectives in this category are:

a. To rearrange ownership patterns to benefit commodity production goals and improve the efficiency of management.

b. To provide a source of lands available for exchange with other landowners when the Forest Service desires to acquire lands in Categories I or II.

Category IV: Small, isolated tracts of National Forest land are normally included in this category. These tracts are costly to administer and do not have any special resource features. The objective in assigning lands to this category is to make them available to other landowners when the Forest Service pursues acquisition of lands in Categories I, II, or III. An example of this category is the National Forest land in the Hoh River drainage on the west side of the Peninsula.

Category V: This category is established as a catchall for lands where more information or study is needed. Decisions can then be made to assign these lands to one of the first four categories. The primary factor determining the need for additional information or study is the necessity for close involvement with local and/or State governments. This category often includes lands potentially affected by private expansion near Forest-managed land. Examples are residential or community growth, industrial expansion, or conversion of forest land to more intensive agricultural purposes.

The Forest is currently operating under a landownership plan prepared in 1980. The following general summary describes the kinds of areas within the Forest assigned to the above-described categories.

Category I: The five existing Wildernesses.

Category II: All developed recreation and administrative sites, the Quinault Research Natural Area, Dennie Ahl Seed Orchard, and all areas allocated to some form of "special management" through the previous unit planning process on the Forest are to be retained. As the opportunity arises, acquisition of lands will be pursued near Wynoochee Lake, within the South Fork Skokomish River corridor and for the adjacent private lands needed for expansion of developed recreation facilities near Hood Canal.

Category III: All remaining areas not assigned to Categories I and II above or Category IV below. If the opportunity arises, acquisition of the following lands will be pursued: the Cottonwood area in the Upper Quinault Valley and isolated tracts of private land in the Humptulips and Cook Creek drainages. Consolidation of ownership in other areas of the Forest, through exchange of parcels of land, will be considered. The following areas in this category are available for exchange: the Queets Block and the Mt. Baldy-Storm King-Madison Creek area.

Category IV: Hoh River Blocks.

Category V: None.

SUSTAINED YIELD UNITS

THE ROLE OF SUSTAINED YIELD UNITS

The Sustained Yield Forest Management Act of 1944 authorized establishment of sustained yield units. The purpose of the Act was: (a)"... to promote the stability of forest industries, of employment, of communities, and of taxable forest wealth, through continuous supplies of timber; (b) in order to provide for a continuous and ample supply of forest products; and (c) in order to secure the benefits of forests in maintenance of water supply, regulation of streamflow, prevention of soil erosion, amelioration of climate, and preservation of wildlife..." The Olympic National Forest has two of these units--the Shelton Cooperative Sustained Yield Unit (Shelton CSYU) and the Grays Harbor Federal Sustained Yield Unit (Grays Harbor FSYU).

Beyond the primary role (promoting the stability of employment, communities, and forest industries), the contexts of these Units are somewhat different. The Shelton CSYU is an agreement with a single corporation (Simpson Timber Company) and the communities of Shelton and McCleary (where this company's manufacturing facilities are located). The Grays Harbor FSYU includes all purchasers and their associated manufacuring facilities within Grays Harbor County.

CURRENT SITUATION

The two Units limit the marketability of logs from about 252,000 acres (40 percent) of Olympic National Forest land, and from about 220,400 acres owned by Simpson Timber Company. The annual National Forest timber harvest level from the two Units was about 121 million board feet for the period 1980 to 1989. This is about 50 percent of the total Forest harvest and 7 percent of the total Olympic Peninsula harvest.

SHELTON CSYU

The Shelton Cooperative Sustained Yield Unit was formed in 1946 and is the only one of its kind in the United States. It was established for the purpose of stabilizing the economy of Mason County. Management is guided by the terms of a 100-year Cooperative Agreement between Simpson Timber Company and the Forest Service, and affects about 111,043 acres of National Forest land, all within the Hood Canal District, and about 250,000 acres of Simpson Timber Company land. Under the provisions of the Sustained Yield Forest Management Act and the terms of the Agreement signed by the Chief of the Forest Service and Simpson Timber Company, these lands are managed cooperatively to provide timber from the Unit. The harvest levels for each landowner are determined on the basis of the timber inventories, stand characteristics, and productivity of both ownerships. The last calculation of the harvest level was displayed through the environmental statement for the Timber Resource Management Plan, Shelton Cooperative Sustained Yield Unit and the record of decision signed on November 28, 1978.

Only Simpson Timber Company may purchase mature timber from National Forest land within the Unit. Salvage and thinning material may be sold to purchasers other than Simpson Timber Company, but only after the Company has exercised its right of first refusal.

The Agreement also requires that a minimum volume equal to 80 percent of the timber volume removed from the Unit (both ownerships) must be processed within a ten-mile radius of the towns of Shelton and McCleary. Section 16 of the Agreement provides flexibility in making changes in land allocation to respond to new information indicating that different management strategies and or intensities are desirable to better serve the public. These changes are to be considered according to the original intent of the Unit. They are not to "sufficiently reduce the allowable cut of the Unit to appreciably affect employment or community stability." A copy of the Agreement is available at the Forest Supervisor's Office in Olympia or the District Ranger's Office in Hoodsport.

GRAYS HARBOR FSYU

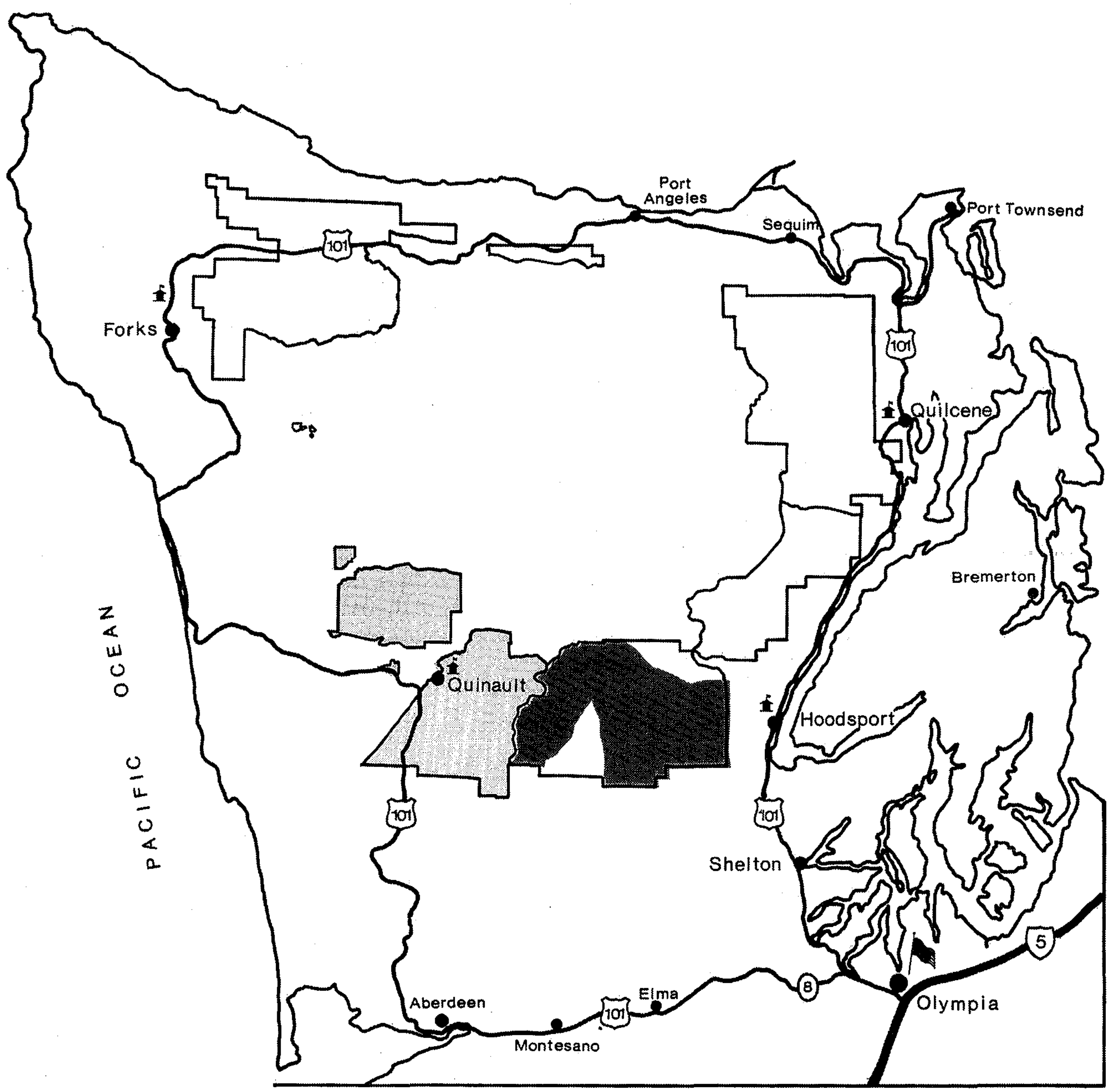
The Grays Harbor FSYU is one of four active Federal sustained yield units in the United States. It includes all National Forest land managed by the Quinault District (about 140,500 acres). Under the provisions of the Sustained Yield Forest Management Act and the terms of the Policy Statement covering the Grays Harbor FSYU, only National Forest lands are affected. As currently provided, at least 50 percent of the timber removed from the Quinault District must receive primary manufacturing within Grays Harbor County. The amount of timber volume offered for sale within the Grays Harbor FSYU is determined through the normal Forest Service planning process and will be established for the next period through the Forest Plan. Land and timber other than National Forest located within the county are not affected.

Timber offered for sale within the Grays Harbor FSYU can be purchased by any interested party. The purchase price is established through competitive sale offerings, with minimum bids established by the Forest Service. The only restriction applies to the 50 percent that must receive primary manufacturing within Grays Harbor County. The Policy Statement, developed after public hearings and consultation with Grays Harbor County communities, manufacturers, and individuals, does not discuss land allocations for timber or other resources management activities. The intent of the Act is clear as stated in the opening paragraph of this section. A copy of the Policy Statement is available at the Forest Supervisor's Office in Olympia or the District Ranger's Office in Quinault.

HISTORIC TRENDS

SHELTON CSYU

Timber harvesting on the south end of the Olympic Peninsula began in the late 1880's. By the 1940's, mature timber on privately owned forest land was essentially depleted in this area. The extensive young-growth timber on the private lands was too small to sustain existing mills. The communities of Shelton and McCleary faced bleak economic prospects. Meanwhile, there was extensive National Forest timber nearby. This timber was of the size and quality needed by local mills for the markets that prevailed at that time. Sustaining these local mills and dependent communities would require accelerated harvest of National Forest timber. In order to justify such action, the communities, mill owners, and Forest Service elected to cooperatively manage privately owned young-growth timberland with lands on the then Shelton Ranger District. The result was the Shelton Cooperative Sustained Yield Unit, where ownerships are pooled for the purpose of determining the sustained yield harvest level. Timber harvest was concentrated on National Forest land after 1946, but the transition to harvesting on private land began about 1980. Table III-43 displays the average annual allowable harvest levels for the Shelton CSYU, and the actual amount of timber removed in each of the preceeding decades.



LEGEND

Grays Harbor Federal Sustained Yield Unit

Shelton Cooperative Sustained Yield Unit

Figure III-17. SUSTAINED YIELD UNITS

Table III-43. Shelton CSYU Average Annual Timber Harvest (million board feet)

Year	Harvest	National Forest	Simpson Timber Co.	Total Unit
1947-56	allowable	-	-	1/ 100.0
	actual	54.2	46.4	100.6
1957-66	allowable	116.0	19.0	135.0
	actual	98.3	35.4	133.7
1967-76	allowable	116.0	19.0	135.0
	actual	102.4	22.2	124.6
1977-86	allowable	115.7	111.3	227.0
	actual	75.1	99.9	175.0
1987-90	allowable	-	-	2/ 227.0
	actual	7.1	182.2	3/ 189.3

1/ The annual allowable harvest level set in 1946 for the period 1947 through 1956 was for the total Unit. Later, volume targets were assigned to individual ownerships.
2/ The total Unit harvest volume was extended through 1990 (four years).
3/ Average annual data from 1987 through 1989 (three years).

As allowed in the Agreement, Simpson Timber Company can buy, sell, and exchange its lands within the Unit boundary. In 1946, when the Agreement was signed, Simpson Timber Company committed about 159,000 acres to it. Today, Simpson Timber Company has about 250,000 acres committed to the Shelton CSYU while the National Forest acreage has not changed.

GRAYS HARBOR FSYU

The Grays Harbor FSYU was established November 2, 1949. Because of the "boom and bust" nature of the forest products market, private lands were being harvested in irregular cycles causing a disruptive effect on the local economy. The FSYU was seen as a means of providing a steady flow of raw material to area manufacturers and, therefore, a start at stabilizing the area's economy.

When first established, the Grays Harbor FSYU included a large part of Grays Harbor County to which the restriction of primary manufacturing applied. Over the years, the Policy Statement has been amended to extend the Unit boundary to include most of the county. It has also been amended to include special requirements for the sale of timber, degree of manufacturing, and tenure of the Unit. The 1981 Policy Statement changed the primary manufacturing restriction standards. It also allowed a 10 percent per year increase in the amount of timber that could leave the Unit without primary manufacture. This percentage was to increase for five years, until 50 percent could leave the Unit without primary manufacturing. The 50 percent level was reached in 1985.

One of the objectives included in the Policy Statement is to sell the full allowable harvest. A review conducted by the University of Washington in 1978 indicated that 847.7 million board feet of timber had been sold, or 92 percent of the allowable harvest of 925 million board feet. The Forest had also offered 65.1 million board feet that was not purchased. Had this volume been purchased, the total amount sold would have been 99 percent of the allowable harvest. See Table III-44 for allowable harvest and actual harvest since 1950.

Table III-44. Grays Harbor FSYU Average Annual Harvest Levels (million board feet)

Years	Allowable	Actual
1950-1954	60.0	75.3
1955-1968	78.0	79.7
1969-1979	92.5	61.1
1980-1989	89.2	1/ 75.9
1990-	79.9	

1/ Average annual data from 1980 through 1989 (10 years).

FUTURE TRENDS

SHELTON CSYU

When the Shelton CSYU was established, it was expected to be operational for 100 years. Management is periodically reviewed, and new harvest levels established every 10 years. This will continue until the 100-year period is over in 2046, unless the Shelton CSYU Agreement is modified in the meantime.

At present, harvest of Olympic National Forest timber is nearing completion, while much of Simpson's timberland is reaching harvest age. The shift in harvest emphasis from National Forest land to Simpson land has begun, and will accelerate in the near future. Volume flow from the Olympic National Forest will be quite low for the next 50 years, while harvest from Simpson land will increase substantially. As displayed in Table III-44, the total volume harvested from this Unit has been increasing. This increase is attributable to management of the timber resource in a manner that has substantially improved the growth of the trees, and the addition of more than 91,000 acres to the Unit by Simpson since 1946. This trend in harvest levels is not expected to continue, since most of the overmature trees have now been converted to younger stands, and both the growth rates reflected in current calculations and the land base are now fairly stable.

The Forest Service role for the balance of the agreement period will change from being the principal supplier to one of monitoring and verification of agreed management practices and intensities, while Simpson Timber Company will become the primary supplier.

GRAYS HARBOR FSYU

The Grays Harbor FSYU does not have a termination date included in its Policy Statement, or in any other document associated with its management. The Policy Statement is reviewed periodically, and revisions are made in response to changing conditions as they relate to the purpose of the FSYU. No projections are made at this time regarding tenure of the Grays Harbor FSYU.

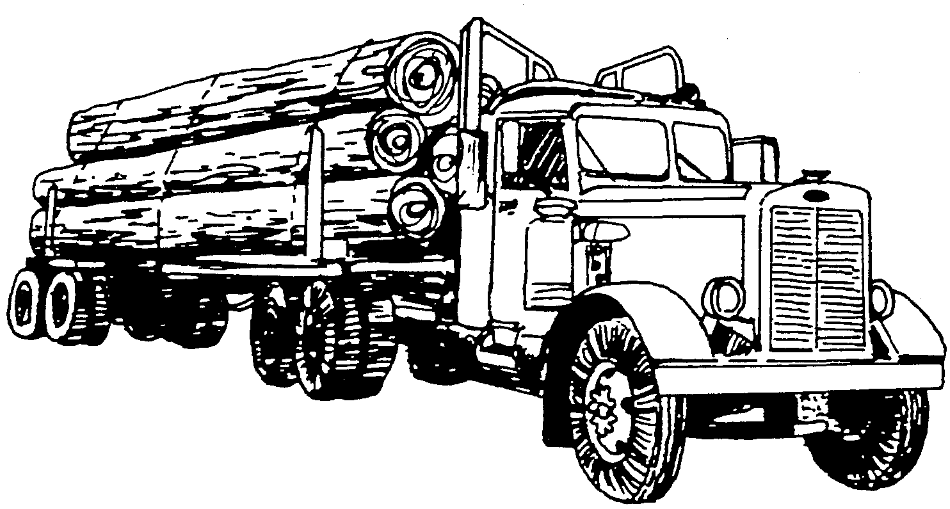
It is expected that future policy changes will be made to accommodate changing conditions, objectives, or need, in a context of public interest. The timber harvest level will continue to be determined through the forest planning process, as required by the National Forest Management Act.

PLANS OF OTHERS

Road construction, timber harvest, and other silvicultural practices occurring on Simpson's ownership within the Shelton CSYU are subject to State forestry laws and regulations. Certain laws, such as Washington's Forest Protection Act, Forest Practice Act, Shoreline Management Act, and Hydraulics Code directly regulate Simpson's forestry practices through their requirements for prior government approvals. Other State laws, such as Washington's Clean Air Act, Water Pollution Control Act, and Environmental Policy Act, set broad policies and standards which indirectly affect Simpson's forestry activity.

State legislation directly or indirectly governing Simpson's forestry programs is aimed at protecting public resources (air, water, fish, wildlife, and capital improvements of the State or its political subdivisions) from unacceptable levels of pollution or damage. State laws do not require private landowners like Simpson to manage lands for public recreation purposes. Treaty tribes of western Washington have expressed their concerns about fishery habitat degradation. Simpson Timber Company lands are not considered to have "open and unclaimed" status under the terms and conditions of Federal treaties negotiated with Indian tribes (refer to the section on American Indians in this chapter).

Indian treaty interpretation and litigation have been clarified and established. The reserved rights to the taking of fish include an inherent consideration for protection of associated habitats. To meet fish habitat protection concerns of the Tribes, the State of Washington has developed a series of standards, referred to collectively as Best Management Practices (BMPs) which regulate forest management activities on State and private land. These BMP standards were incorporated in the Forest Practices Act, which govern Simpson's forest management activities. The 1987 Timber, Fish, and Wildlife Agreement also affords protection measures for fishery habitat through standards and requirements administered by the State of Washington.



LOCAL ECONOMY

THE ROLE OF THE OLYMPIC NATIONAL FOREST IN THE LOCAL ECONOMY

The principal social and economic effects of Forest activities are felt in the four counties that comprise the Olympic Peninsula: Clallam, Grays Harbor, Jefferson, and Mason. The Peninsula is essentially rural, with population centers generally small and scattered. The principal towns are Port Angeles (Clallam County, population 17,500) and Aberdeen-Hoquiam (Grays Harbor County, population 26,250). Other important population concentrations include Shelton (Mason County), Port Townsend (Jefferson County), and Forks (Clallam County). About 35 percent of the Peninsula's population is located in these five centers, with the remainder in smaller settlements and unincorporated areas. Virtually the entire population lives on the Peninsula's perimeter, along or close to the Highway 101 corridor. The mountainous core, consisting primarily of National Forest and National Park lands, is essentially uninhabited.

The economic bases of the Peninsula are closely tied to the natural resources of the area. Much of the land is highly productive forest land. As a result, the management, harvest, and processing of timber form a dominant component of the economy. Outdoor recreation opportunities are abundant and diverse, making recreation and recreation-related enterprise a second major component of the Peninsula economy. The Peninsula has an extensive saltwater shoreline (Hood Canal, Strait of Juan de Fuca, Pacific Ocean). As a result, commercial fishing and aquaculture are important. These three natural resource-related enterprises form the foundation of the Peninsula economy.

In terms of basic employment figures, four sectors account for the vast majority (over 80%) of total Peninsula employment. These are government (23.8%), wholesale and retail trade (23.3%), services (18.1%), and wood and paper products manufacture (17.5%) (Washington State Employment Security Department, 1989). The first three of these are essentially service and support industries, with employment largely dependent on the three basic industries mentioned above. Much of the employment directly generated by recreational activity, for example, is recorded as occurring in the retail trade or services sectors. The remainder of this discussion will focus on the Peninsula's principal basic industries: timber, recreation, and fisheries.

Timber harvest and processing is the principal extractive industry on the Olympic Peninsula, and serves as one of the area's economic mainstays. Over 40 percent of Peninsula employment is directly or indirectly generated by the timber industry. Timber harvest from National Forest lands (including Simpson Timber Company lands within the Shelton CSYU) presently accounts for over 20 percent of the total harvest on the Peninsula. Because National Forest timber output forms a significant proportion of the local timber industry, it is an important factor in the overall economy.

The role of Forest timber in the local economy goes beyond the employment and personal income generated by harvest. Twenty-five percent of the receipts from timber sales are returned to county governments in the form of payments in lieu of taxes, with the remainder of these receipts going to the Federal treasury. Harvest from Simpson Timber Company land within the Shelton CSYU does not affect county and treasury receipts, but the company's property tax and yield tax payments also contribute to the flow of capital into government treasuries.

Employment and income generated by recreation is not as easily identified as that related to timber harvest, since there is no one economic sector which can be labeled as the "recreation industry." It is estimated that roughly 25 percent of total Peninsula employment results from all forms of recreation. Less than 10 percent of estimated total recreation employment is attributable to National Forest recreation, making this a relatively minor component of the overall Peninsula economy. As with timber, receipts from

National Forest recreation for which a fee is charged (developed recreation, including special uses) contribute to county and Federal treasuries.

The role of commercial fishing and aquaculture in the Peninsula economy is likewise difficult to pin down. Much of the employment and income generated by the fisheries resource is recreational (sport fishing), and is included in estimates of recreation sector employment. Remaining fishery-related employment and income comes from two principal sources: commercial anadromous fishing and the shellfish industry. Perhaps 5 to 10 percent of total Peninsula employment is generated in these sectors.

The role of National Forest management in the commercial fishery is as a supplier of fish habitat. This habitat produces catchable adult anadromous fish, thereby increasing the supply base of the commercial fishing industry. The economic effects of the Forest's contributions to the fishery are not limited to the Peninsula, as the fish are harvested throughout Puget Sound and in the Pacific Ocean. Although its effects spread beyond the confines of the Peninsula, the importance of the Forest's fishery outputs in the overall economy is negligible. Only a small proportion of the total commercial catch in the Puget Sound area originates from Forest habitat.

Beyond the borders of the Peninsula, the social and economic importance of Forest activities diminishes greatly. The Forest does have some direct economic effect on Thurston County (directly southeast of the Peninsula), as about six percent of the Forest's timber is processed here. Also, the Forest Supervisor's Office is located in Thurston County. These two factors combined, however, form only a small proportion of the County's total economy. The principal Forest effects outside the Peninsula center around the recreational opportunities and visual amenities provided by the Forest to the urban populations of Thurston, Pierce, King, Snohomish, and Kitsap Counties. Many of the residents of these areas enjoy outdoor recreation activities on the Forest (particularly the eastern portions), and many more are sensitive to the scenic attractiveness of the eastern slopes of the Forest as seen from urban areas (especially Seattle and Tacoma). These are the principal concerns when considering the social and economic effects of Forest activities within the urban counties of western Washington.

Although at the regional (i.e. the Pacific Northwest as a whole) and national levels, the influence of Forest activities on social and economic well-being is small. The wood products contribute to the overall supply of housing materials and paper products, and the recreational opportunities provided by the Forest attract visitors from outside western Washington. The Forest contributes a small percentage to the total supply of wood products and recreation opportunities at the regional and (especially) national levels. For example, the Forest's share of total Forest Service harvest in Region 6 is roughly 6 percent; nationally, the share is 3 percent. The proportions for recreation are even lower.

CURRENT SITUATION

EMPLOYMENT AND PERSONAL INCOME

Table III-45 displays the dependency of each Peninsula county's labor force on wood and paper products. The "Direct Employment" column indicates the number of person-years employed specifically in the wood products industry, while the "Total Employment" figures show estimates of the overall employment, including service and support jobs, generated by the wood products industry. The "NF Employment" column displays the estimated number of person-years of total employment generated by National Forest harvest, based on the average harvest level from 1980 through 1988. Harvest during this period averaged 380 million board feet, including harvest from Simpson Timber Company lands within the Shelton Cooperative Sustained Yield Unit (Mason County).

Table III-45. Employment - Wood Products Industry (1988)

County	Total Labor Force (Person-Years)	Direct Employment	Percent Labor Force	Total Employment	Percent Labor Force	NF Harvest-Related Employment	Percent Labor Force
Clallam	16,630	2,590	15.6	6,190	37.2	1/ 1,185	7.1
Grays Harbor	22,170	4,670	21.1	10,090	45.5	1/ 1,430	6.4
Jefferson	5,040	760	15.1	1,840	36.5	2/ 160	3.2
Mason	7,970	1,050	13.2	3,010	37.8	2,305	28.9
TOTAL PENINSULA	51,810	9,070	17.5	21,130	40.8	5,080	9.8

1/ Probably a slight overestimate, due to necessary harvest disaggregation assumptions.
2/ Probable underestimate, due to disaggregation assumptions.

As can be seen, over 40 percent of Peninsula employment is either directly or indirectly dependent upon the wood products industry. It is difficult to estimate the proportion of the labor force which is dependent upon the second important industry, recreation. Estimates place the figure at roughly 25 percent. While it is difficult to develop a reliable estimate of the total importance of recreation to the Peninsula economy, it is possible to assess the contribution of National Forest recreation.

Table III-46 displays total employment (including service and support jobs) related to recreation (developed and dispersed combined) on Forest lands, based on 1986 use levels. The low proportion of the labor force (2.1 percent) which is dependent on National Forest recreation is not surprising, given the variety of recreational opportunities on the Peninsula as a whole. The principal natural attractions are the shoreline and Olympic National Park. Both of these attract more people than the Forest. In addition, tourist attractions in the Port Townsend-Sequim-Port Angeles area generate considerable employment, as do services to retirees and commuters ("recreationists" in the sense that they reside on the Peninsula for its natural amenities). When considered in the context of the overall recreation picture on the Peninsula, the Forest's role as a source of recreation-related employment is relatively minor.

Table III-46. Employment Resulting from National Forest Recreation (1988)

County	Total Labor Force (Person-Years)	Total National Forest Employment	Percent Labor Force
Clallam	16,630	1/ 105	0.6
Grays Harbor	22,170	325	1.5
Jefferson	5,040	2/ 295	5.9
Mason	7,970	1/ 365	4.6
TOTAL PENINSULA	51,810	1,090	2.1

1/ Probably a slight underestimate, since the employment estimates are directly related to numbers of recreation visitor days (RVDs) experienced in each county and many of the services provided to recreationists on NF land in Jefferson County are actually purchased in Clallam and Mason Counties.
2/ Probable overestimate for reason stated in footnote 1.

In Tables III-45 and III-46, "Total Labor Force" and "Direct Wood Products Industry Employment" data were taken from employment estimates for 1988 provided by the State of Washington Employment Security Department. The remaining estimates were derived using employment and income multipliers generated by the Region 6 Input-Output Model. This model is based on 1977 employment and income data for each county, and provides the most reliable set of multipliers currently available. Applying multipliers determined under 1977 conditions to 1988 employment figures may lead to slight distortions in the estimates. Since all employment and income factors are estimated using the same set of data, the relative changes are comparable and the accuracy of the estimations is considered acceptable.

Patterns in personal income generated by the timber and recreation industries predictably follow employment patterns very closely. These are displayed in Table III-47, which includes the same type of information breakdown as the employment tables. The footnotes included for Tables III-45 and 46 also apply to this table.

Table III-47. Personal Income (1982 dollars), Timber and NF Recreation (1988)

County	Total Pers. Inc. (Thousand $)	Timber: Direct Income	Percent Total	Timber: Total Income	Percent Total
Clallam	319,700	68,070	21.3	130,050	40.7
Grays Harbor	469,940	121,980	26.0	227,490	48.4
Jefferson	79,440	22,050	27.8	40,660	51.2
Mason	136,880	26,540	19.4	57,070	41.7
TOTAL PENINSULA	1,005,960	238,640	23.7	455,270	45.3

County	NF Timber: Total Income	Percent Total	NF Rec.: Total Income	Percent Total
Clallam	24,510	7.7	1,390	0.4
Grays Harbor	31,530	6.7	4,250	0.9
Jefferson	3,220	4.1	3,090	3.9
Mason	43,660	31.9	4,770	3.5
TOTAL PENINSULA	102,920	10.2	13,500	1.3

Precise data for commercial fishery employment, and its direct and indirect effects on total employment in the Puget Sound area are not available. A rough estimate of the Forest's potential contribution to employment in this sector has been derived using the current estimated potential commercial fish output from Forest habitat (1.12 million pounds). In doing this, the 1982 dockside value of $1.05 per pound is doubled as a conservative estimate of direct personal income derived from this industry. The Peninsula average of $19,400 in personal income per person-year of employment (1982 dollars) is used to convert this income estimate into employment. Finally, an estimate of two service and support jobs for every basic industry job (a standard assumption when precise information is not available) is used to estimate total employment.

The above assumptions yield an estimate of approximately 360 person-years of employment per year (throughout the Puget Sound area) generated by the Forest's potential commercial fishery output. This is equivalent to 0.7 percent of the total Peninsula labor force. The same procedure was used to estimate the production potential of off-Forest fish habitat which is influenced by Forest activities. It has associated with it an additional 4500 to 5000 jobs (including service and support jobs), equivalent to roughly 9 percent of the total Peninsula labor force. These potential jobs are scattered throughout the Puget Sound area rather than limited to the Olympic Peninsula.

From the above discussion of employment and personal income factors, it is possible to draw several conclusions which are meaningful in the assessment of Forest effects on the local economy. These are:

1. With respect to stability of employment and income, changes in Forest timber output would have more significant effects than changes in recreation output or fishery productivity.

2. Because the Peninsula economy depends so heavily on timber and recreation, it is strongly responsive to regional and national economic conditions. Demand for both wood products and outdoor recreation tends to fluctuate more strongly with economic cycles than does overall demand. For this reason, when the broader economy is strong and expanding, the Peninsula economy could potentially "boom." Conversely, stagnation or recession in the larger economy is likely to result in serious downturns in the Peninsula economy.

3. Because timber harvest and recreation are the principal economic bases, employment is normally sporadic and seasonal. Both industries are most active during the summer months, and are highly responsive to economic cycles. Consequently, periods of unemployment and/or reduced income are familiar phenomena to many Peninsula residents, and may be somewhat less disruptive here than in an economy in which constancy is the usual condition.

TIMBER INDUSTRY CHARACTERISTICS

Timber industry in the four-county Peninsula area had the following makeup in 1986 (Washington State Department of Natural Resources, *1986 Washington Mill Survey*): 10 sawmills with annual single-shift capacity of 40 MMBF or more, 7 veneer and plywood mills, and 5 pulp mills (the total number of operations is less than 22, as more than one mill type may be present at a given site). In addition, there are numerous small sawmills and shake/shingle mills. In 1986, Peninsula sawmills averaged 213 operating days per year. This is up considerably from the 1982 average of 165, and reflects the resurgence of demand for western Washington wood products in the late 1980's.

About three-quarters of the larger mills and most of the small mills depend on "outside" sources for raw materials. The remainder have timberland holdings of their own and are somewhat independent from outside supply sources (provided their land contains sufficient harvest-age timber). According to the *1986 Washington Mill Survey*, approximately one-quarter of both the large sawmills and the veneer and plywood mills relied on National Forest timber as a major source of supply (at least two-thirds of total milled volume) in 1986. The complete breakdown of Peninsula mill supply sources in 1986 is shown in Table III-48.

In addition to timber milled on the Peninsula, a high proportion (43.4 percent in 1986) of the annual log harvest is exported, mostly to Japan. About 70 percent of the export volume comes from private land, with the remainder from State of Washington and American Indian lands. This large export volume intensifies competition among Peninsula mills for that timber which remains available for local processing, and also leads to reduced employment opportunity within the Peninsula timber industry. The export of raw logs generates fewer jobs per million board feet of harvest than does complete processing of logs into lumber and other wood products. It should be noted that National Forest timber may not be exported in log form.

Table III-48. Olympic Peninsula Mill Supply Sources 1/

Source	Percent of Total Milled Volume	Percent of Total Export Volume	Percent of Total Harvest 2/
National Forest	25.8	0.0	14.6
State of Washington	16.6	22.8	19.3
Other Public Land	1.5	5.1	3.1
Forest Industry Land 3/	48.5	61.9	54.4
Small Private Holdings	7.6	10.2	8.7

1/ *1986 Washington Mill Survey*, Washington State DNR. Because of the way the survey is compiled, the above data include Pacific, Lewis, and Thurston counties. The figures should still be fairly representative of the four Peninsula counties alone.
2/ Milled and export volumes combined.
3/ Includes harvest from Simpson land within the Shelton CSYU.

PAYMENTS TO COUNTIES AND TREASURY RECEIPTS

One quarter of total National Forest cash income is paid to local counties in lieu of property tax. While the sale of National Forest timber is by far the largest contributor to these payments to counties, all revenue-generating activities (campground fees, special use fees, oil and gas lease payments, etc.) on the Forest play a part in providing income to county governments.

The system used to distribute payments to counties is based on total Federal ownership within each county. The 25 percent fund is pooled and then divided among the five counties containing National Forest land (Clallam, Jefferson, Mason, Grays Harbor, and Thurston) on the basis of a fixed percentage rate, regardless of the amount of income generated in each county. This system was devised at the time Olympic National Park was created because those counties with a large proportion of Federal land in the Park (which generates relatively little income per acre) would receive disproportionately small payments relative to total Federal acreage. Therefore, in the interest of equity, the fixed proportion system was implemented.

The remaining 75 percent of National Forest income is used in two ways. Some of it is allocated to the income-generating activity in order to cover direct operations costs. For example, the 25 percent county share of timber sale receipts is based on *gross* receipts, including purchaser credits for road construction. Since the Forest receives its purchaser credit "income" in the form of a road rather than cash, it is essentially a direct cost of timber harvest. After direct costs such as this have been defrayed, the remaining income is deposited in the Federal treasury. Payments to counties and treasury deposits for the 1980-1989 period are displayed in Table III-49.

Please note that the Treasury deposits shown in Table III-49 are *not* equivalent to the net receipts displayed in Chapter II. Treasury deposits are calculated by subtracting direct costs and payments to counties from total receipts, and represent actual deposits from the Forest to the Treasury. Net receipts are the difference between total receipts and total Forest budget, and represent overall net cash flow resulting from Forest operations.

Table III-49. Payments to Counties and Treasury Deposits

	Payments to Counties (Million $): 1/					
Year	Clallam	Grays Harbor	Jefferson	Mason	Total	Treasury Deposits (Million $)
1980	2.95	0.91	3.99	0.94	8.79	19.0
1981	2.16	0.67	2.92	0.69	6.43	11.2
1982	1.38	0.43	1.87	0.44	4.12	6.0
1983	1.12	0.34	1.51	0.35	3.32	3.9
1984	1.58	0.49	2.13	0.50	4.70	6.6
1985	1.12	0.35	1.51	0.35	3.33	8.8
1986	1.53	0.47	2.07	0.49	4.56	12.3
1987	1.59	0.49	2.14	0.50	4.72	13.8
1988	2.35	0.72	3.17	0.74	6.98	24.2
1989	2.57	0.79	3.46	0.81	7.63	26.8
Ave.	1.83	0.57	2.48	0.58	5.46	13.3

1/ Payments to Thurston Co. are minimal (0.046% of the total), and are not included in table.

When income from a timber sale or sale program is less than associated sale costs ("sales below cost") it can have a significant effect on returns to the treasury. Interest and concern about such conditions has been increasing in recent years. On the Olympic, where both timber values and volumes per acre are generally high, this has not been a problem. Sale income reliably exceeds sale costs each year. A comparison of costs and returns associated with the timber programs of the early 1980's is shown in Table III-50. The recent upswing in the Peninsula timber market has made annual sale programs since 1985 even more positive, with average volume (1985-89) at 238 million board feet and average value $16.6 million.

Table III-50. Sale History (1980-84)

Year	Volume Harvested 1/ (Million bd. ft.)	Value 2/ (Million $)	Sale Costs 3/ (Million $)	Asset Value 4/ (Million $)
1980	293	30.688	4.366	9.766
1981	228	18.373	4.729	10.007
1982	163	11.155	4.918	10.866
1983	244	10.314	4.341	7.488
1984	310	16.299	5.747	5.867

1/ National Forest only; harvest from Simpson land not included.
2/ Total value, including all collections and purchaser road credits.
3/ All operations costs associated with the timber sale program.
4/ Road-related costs, including purchaser credits. Once the road is constructed, it is considered to be an asset.

While income from Olympic National Forest timber sales has usually been well above cost, there are two situations in which a sale may not fully cover the associated costs. The first of these occurs when sale conditions (generally difficult terrain and/or increased environmental sensitivity) result in unusually high combined road construction and yarding costs. Expensive yarding systems, such as helicopter or multi-span skyline, are often involved. Stumpage values of such sales are very low, and often do not cover management costs (which are often higher than normal for these operations). In some of these cases, high access costs may cause the initial sale in a given area to be "below cost", but the returns to future sales served by the same access system eventually recover the initial investment. In other cases, the rationale for such sales is social rather than economic: by putting such timber into the flow of the economy, employment levels are enhanced.

The second situation arises from the extensive acreage of overstocked "doghair" stands on the Forest. Recently, an experimental program has been developed to test the economic feasibility of converting these areas into productive timber stands. From 1980 to 1989, this program has resulted in the logging of close to 2,500 acres of doghair as low-grade pulping material. Thus far, the economic success of this experiment has been negative. Although payments received have generally failed to cover operations costs, previously unproductive stands of doghair have been transformed into viable plantations. Present plans will continue the doghair program until termination of the present harvesting contract (1990).

THE SHELTON COOPERATIVE SUSTAINED YIELD UNIT

The Shelton Cooperative Sustained Yield Unit is discussed here because of the significant role it has played in the economy of Mason County since it was formed in 1946. See the discussion of "Sustained Yield Units" in this chapter for explanation of the structure and function of the Unit and additional information.

In 1946, Simpson land on the south Peninsula was essentially cutover. Little timber of harvest age was available, and Simpson's sawmills in Mason County were without a log source. The former Shelton Ranger District of the Olympic National Forest (now part of the Hood Canal Ranger District), on the other hand, contained extensive acreage in old-growth timber. Under nondeclining flow policies applicable to National Forest timber, the Shelton District old-growth could not have been sold at a rate fast enough to provide the volume needed to keep Simpson's mills operating at their customary level. In order to avoid a significant disruption of the Mason County economy, the Sustained Yield Unit was created.

Since it was formed in 1946, the Unit has been successful in accomplishing its purpose. The economy of Mason County has remained quite stable, and potentially disruptive timber supply shortages did not materialize. The present importance of the Unit to Mason County is demonstrated by the proportion of total county employment (28.9 percent) dependent upon timber harvest from the Shelton CSYU.

HISTORIC TRENDS

The modern-era economy of the Olympic Peninsula was originally based almost exclusively on the harvest and processing of timber. Beginning in the early 1900's, Peninsula industry and the associated communities developed as harvest progressed. Through the 1950's, timber retained its position as the primary factor dominating the Peninsula economy. In the 1960's, recreation began to play a more important role in the overall economic picture, as an increasingly mobile society discovered the scenic and recreational attractions of the area. Although in the recent past, the relative importance of timber in the local economy has decreased, while that of recreation has increased, the timber industry still forms the largest component of the Peninsula's economic base.

In the early 1980's, a significant reduction in demand for Pacific Northwest timber resulted in a decline in Peninsula employment, income, and overall economic health. Total employment in 1984 was approximately 9 percent below the 1977 level (based on comparison of Region 6 Input-Output model data (1977) with State of Washington Employment Security Department estimates for 1984). Employment in the wood products industry dropped as much as 24 percent during the same period. In the late 1980's, however, demand for local timber has recovered strongly, with average annual Peninsula harvest volume increasing 35 percent from the 1980-84 period to the 1985-88 period. This recovery in economic activity has probably been a major factor in the 9.5 percent increase in total Peninsula employment between 1984 and 1988.

The Olympic National Forest's role in the local economy has paralleled the development of the economy itself, with the exception of the timing of timber harvest expansion. Until the mid-1940's, the Forest was essentially a preserve rather than a supplier of products, and played only a minor role in the economy. In the mid-1940's, harvest volume from the Forest began increasing markedly, reaching current levels by the 1970's. The Forest's contribution to the supply of recreation opportunities became important in the 1960's, when the Peninsula recreation industry as a whole began to achieve significance.

FUTURE TRENDS

Anticipated levels of future supply of, and demand for, the Forest's economic outputs are discussed in detail in the individual resource discussions in this chapter. The discussion here is limited to broad trends which may affect major shifts in the nature of the local economy.

The trend which is most likely to affect the Peninsula economy in the future is a probable decline in the relative importance of the timber industry. The projected timber supply picture on the Peninsula (see "Vegetation" in this chapter) serves as the basis for this projection. In addition, economic development planners for the State of Washington are now predicting that timber harvest and other extractive industries will decline in importance. They say that increased emphasis on other forms of economic activity will be needed if the State's economy is to remain healthy. Tourism and recreation are among the industries identified as being vital to the future of the State. They also present the most likely opportunity for expansion of the Peninsula economy.

A potential scenario for the future of the Peninsula economy includes eventual stabilization of the timber industry at a production level substantially below that of the late 1980's. The adjustments necessitated by such a shrinkage would affect employment and income for some time to come, especially if continued improvements in sawmill and pulp/paper mill efficiency reduce the number of workers required per unit of production. Growth in the recreation and tourism sector could compensate for at least some of these effects, especially if the population of retirees and commuters continues to expand (see "Population Trends" in the "Local Communities" section of this chapter). In summary, it seems most likely that the economic base of the Peninsula will shrink to some extent over the next twenty to thirty years, with the importance of the timber industry decreasing while that of the recreation industry increases.

LOCAL COMMUNITIES

THE ROLE OF THE OLYMPIC NATIONAL FOREST IN LOCAL COMMUNITIES

The activities and outputs of the Olympic National Forest occur in the context of the values and lifestyles of the surrounding communities. Every Forest action has the potential to be either consistent or in conflict with the goals, preferences, and desires of community members. As a general rule, actions pleasing to some are displeasing to others, since there is much variability in values within the Peninsula society.

Because the Forest is a source of employment, a supplier of recreational and aesthetic opportunities, and a component of the overall pattern of American Indian traditional values, it can affect community members in a variety of ways. The lifestyles, values and traditional beliefs, cohesion, and even stability of local communities can be disrupted or enhanced by the management of the Forest. Because goals and desires differ, and because increases in one output or resource quality generally entail changes in another, there is no single factor by which to gauge the compatibility of Forest activities with the surrounding communities. It is the *mix* of outputs and resource qualities, considered in the context of individual community values and desires, that determines the nature of the Forest's role within its community environment.

Much of the following discussion is based on information and guidance found in two key documents. General instruction regarding assessment of the effects of Forest activities on local communities was taken from Chapter 1970 ("Economic and Social Analysis") of the Forest Service Manual. This document outlines the basic analytic approach to be used and key variables to consider. Specific information regarding community characteristics has come largely from the "Socio-Economic Overview of the Olympic Peninsula" prepared in 1980 by Eleanor Y. Adelman. This document covers the characteristics of Olympic Peninsula communities and identifies trends in community values and beliefs. The information contained in this overview, supplemented with knowledge provided by Forest personnel familiar with local communities, is the foundation of the description and analysis of the Forest's role within its community environment (see also Chapter IV, "Direct and Indirect Effects of the Alternatives on Local Communities").

CURRENT SITUATION

COMMUNITY CHARACTERISTICS

The goals, values, and lifestyles of communities affected by Forest activities vary greatly as one travels around the Peninsula and its environs. While individual concerns and desires are highly varied, it is possible to group those related to Forest management into two distinct lifestyle types and value sets: those most closely tied to forest products and timber harvest, and those oriented toward recreation and/or conservation of natural resources.

Close ties with timber harvest are characteristic of those who perceive their employment and/or income to be dependent upon the timber industry. Harvest is also an important consideration to many long-term Peninsula residents who are not directly involved in the industry, but hold values which have evolved in an environment dominated by the "timber ethic" (a set of beliefs which places high value on the timber-oriented lifestyle). The orientation toward recreation and conservation is generally held by newer residents and non-Peninsula residents who perceive no direct economic dependency on the timber industry (or recognize some dependency but deem it unimportant), and by many whose livelihood is perceived to be tied to the recreation or fishing industry.

Given these two value sets and their geographic distribution within the areas of concern, five separate community groups have been identified to serve as the basis for discussion of social considerations and effects. Each of these community groups is sufficiently uniform in characteristics to be analyzed as a unit, and each is distinct from the others. They are discussed individually below.

The Eastside Community Group: Geographically, this community group includes the northeastern and eastern portions of the Peninsula, from Port Angeles in the north to Hoodsport in the south. It is a highly diverse set of communities, characterized by a good deal of conflict between timber-related lifestyles and values and those tied most closely to recreation and conservation.

The population can be divided into four major components: (1) retirees and commuters, (2) persons whose employment is most closely tied to recreation, fishing, or aquaculture, (3) younger urban emigrants who have chosen the Peninsula's more peaceful lifestyle, and (4) persons whose employment and/or value systems are tied to the timber industry. Of these, the first three tend to be strongly oriented toward recreational/conservational concerns, while the fourth is equally strong in its timber orientation. Both groups are deeply concerned about land management issues, and the timber-oriented segment in particular feels quite vulnerable to disruptive changes in lifestyle. In sum, it can be concluded that the Eastside community is an area of divergent value systems with high potential for conflict regarding Forest management.

The Westside Community Group: Included in this community group is the western half of the Peninsula, from Forks in the north to Aberdeen/Hoquiam in the south. Unlike the Eastside, this area is characterized by uniformity of interest. Some retirees and younger persons have moved here from other areas, and recreation plays a meaningful role in the Westside economy. In addition, the Peninsula's most productive fisheries lie in this zone, and fishing is a factor in the area's economic base. Even with the role fishing and recreation play, the primary source of employment and income is the timber industry, and the overwhelming majority of the population has grown up with the timber ethic and lifestyle. Due to this relative uniformity of goals and values, conflict regarding land management practices is minimal within the Westside community.

The Shelton CSYU Community Group: Most of Mason County (everything south of Hoodsport) and the eastern part of Grays Harbor County (the McCleary area) are included in this group. The Shelton Cooperative Sustained Yield Unit (Shelton CSYU) is an important economic feature in this area. With respect to social characteristics, this set of communities can be considered as a transition between the Eastside and Westside community groups. Here, as on the Westside, the timber industry is the principal source of employment, and the majority of the population is attuned to the timber ethic. In Mason County, however, there is a growing retiree/commuter population with a strong recreation/conservation orientation. In addition, the recreation industry is expanding in importance in the county economy, increasing the proportion of the population which perceives recreation as its economic mainstay.

These changes in the demographic and economic characteristics of the community have resulted in increased potential for conflict concerning land management goals and values. In this regard, the primary difference between the Eastside and Shelton CSYU community groups lies in the relative importance of each of the divergent orientations. The recreation/conservation orientation is, at least at present, a minority position within Mason County, while on the Eastside it is becoming (or has perhaps become) the dominant value set.

The Urban Community Group: This includes the urban populations of Thurston, Pierce, King, Snohomish, and Kitsap Counties (particularly the cities of Seattle, Tacoma, Everett, Bremerton, and Olympia). While this area is much too large and diverse to be treated as a unit in most respects, it can be considered as such with respect to its relationship to management of the Olympic National Forest. Generally, the members of this community group are concerned with two aspects of land management--recreation opportunity and scenic quality. Many Puget Sound urbanites frequently visit the Forest for outdoor recreation. Many more view the eastern slopes of the Forest from their homes, and are quite sensitive to changes in the landscape. The values and concerns of the urban community group are strongly oriented toward recreation and overall environmental quality, and the importance of Forest activities to the typical member of this community group is relatively minor when contrasted with their significance to Peninsula residents.

The American Indian Community Group: Unlike the others, this community group is culturally rather than geographically defined. Its members live throughout the Peninsula, both on tribal reservations and within the general population. The relationship between this community group and Forest management is multi-faceted due to the varying values and needs of its members. American Indians on the Peninsula rely on the recreational and commercial fishing industry and the timber industry for much of their employment and income, making them concerned with both the maintenance of timber harvest and the protection of fishery habitats. Subsistence fishing is particularly important, both as a cultural activity and as a source of sustenance. In addition, traditional values and beliefs (centered around fish, wildlife, and old-growth cedar) form the basis for a high interest in the protection and conservation of natural resources. Closely associated with this is the concern held by American Indians that treaty rights must be fully protected and preserved. Because of these varying concerns, there is potential for conflict regarding Forest management within this community group.

The existence of treaty rights reserved to members of this community group is an important aspect of managing the Forest. All Peninsula tribes have certain rights extended to them in perpetuity through treaties with the United States. Typically, these treaties assure the right to hunt, fish, and gather food in "usual and accustomed places." Most include some additional provisions, which vary somewhat from treaty to treaty. In addition, parts of the Forest (specific locations have not usually been identified) are considered religiously significant by individual tribal members and organizations.

For specific details on treaty rights and cultural and religious concerns, please refer to the sections presented earlier in this chapter titled "Historical and Cultural Resources" and "American Indians." Forest management must be conducted to assure that American Indian treaty rights and religious traditions are protected.

POPULATION TRENDS

Population dynamics of the Olympic Peninsula are closely related to its natural resources. Historically, Peninsula population has fluctuated in concert with the economic cycle of the timber industry, growing in "boom" periods and shrinking during "busts." More recently, the natural amenities of the area have generated a population boom in the eastern portion of the Peninsula. The area was "discovered" by retirees and commuters (to jobs in the urban counties of Puget Sound) alike in the late 1960's. This led to rapid population growth in all but Grays Harbor County (see Table III-51). This influx has continued into the 1980's, although at a substantially slower rate. Population estimates from the State of Washington Employment Security Department (1989) indicate that between 1980 and 1989 the combined population of Clallam, Jefferson, and Mason Counties has increased 13.3 percent, while the population of Grays Harbor County has decreased 4.1 percent. Once the retiree/commuter population has stabilized, population trends may again become most dependent on the economic health of the timber industry.

Table III-51. Olympic Peninsula Population Trends

County	Population			Percent Change		Percent of Pop. 65+ Years of Age
	1970	1980	1989	70-80	80-89	
Clallam	34,770	51,648	55,200	48.5	6.9	16.2
Grays Harbor	59,553	66,314	63,600	11.4	-4.1	14.5
Jefferson	10,661	15,965	19,200	49.8	20.3	17.8
Mason	20,918	31,184	37,500	49.1	20.3	14.4
TOTAL PENINSULA	125,902	165,111	175,500	31.1	6.3	15.4
STATE OF WASHINGTON	3,413,244	4,132,156	4,660,700	21.1	12.8	12.0

Racial and ethnic minorities constitute 6.6 percent of the total Peninsula population. The principal component of this minority population is the American Indian community. The Olympic Peninsula is home to many Pacific Northwest American Indian tribes, with a combined population of approximately 6,300 (about 3.6 percent of the total population). As discussed previously, the American Indian community has a very strong tribal orientation, with traditional beliefs and values playing a key role in the lifestyles of many of its members. This cohesive and distinctive cultural group is an important component of the overall fabric of Olympic Peninsula society.

TRENDS IN COMMUNITY VALUES

The development of Olympic Peninsula community characteristics has closely paralleled the economic development of the area. Initially, the predominant value system throughout the Peninsula centered around timber harvest and the "timber ethic." As recreation began to increase in importance in the 1960's, so did the importance of the recreation/conservation orientation in community value systems. This change was accelerated by the influx of retirees and commuters into the eastern areas of the Peninsula. It is anticipated that, as recreation continues to increase its relative importance in the local economy, the trend toward greater importance of recreation (and conservation in general) in community value systems will continue as well. This generalization does not apply to the American Indian community. This group has traditionally had a strong conservation orientation as well as a substantial link to the timber industry.

Chapter IV

Environmental Consequences

Olympic National Forest

CHAPTER IV

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

Through display and discussion of environmental consequences, this chapter provides the scientific and analytic basis for the comparison of alternatives presented in Chapter II. Environmental consequences are the estimated physical, biological, social, and economic effects that would result from implementing each of the alternatives.

As was done for Chapter III, this chapter is organized by environmental component. Because of the significance of the vegetation component in the determination of the effects of the alternatives on many other environmental components, it will be discussed first.

An overview is presented for each component, followed by a discussion of the relevant significant interactions among components. The focus of this section is on those component interactions which are likely to be influenced by the alternatives. The interactions discussion provides a lead-in to the projected direct, indirect, and cumulative effects of the alternatives. These "effects" sections focus on the most likely consequences of implementing the activities and land allocations associated with each alternative. Information is drawn from the resource relationships described in Chapter III and the program outputs displayed for the alternatives in Chapter II. This Chapter also discusses the measures necessary to mitigate adverse environmental consequences and the expected effectiveness of these measures. Relationships with the plans of other agencies and landowners are presented for each environmental component.

The environment (e.g., water quality) can be directly changed by the activities (e.g., road construction) associated with an alternative. These changes may trigger indirect effects on other components of the enviroment (e.g., decreased water quality may affect fish habitat quality). Cumulative effects are the result of the total actions on Olympic National Forest lands and neighboring lands for the foreseeable future. Mitigation measures are activities planned to prevent, rectify, or reduce projected adverse effects on the environment. Some effects are described quantitatively while others are described in qualitative terms.

In the following discussions of environmental consequences, the degree to which the environmental effects of Alternative NC are evaluated depends largely on the level of information on that resource in the timber management plans. Where output or effect levels are specified, precise estimates are possible. In most cases, however, it has been necessary to project potential effects by estimating, given the land allocation and harvest level of Alternative NC, the most probable degree of effect on the environment. Such projections sometimes take the form of qualitative statements regarding the general range into which outputs or effects will fall.

Tables, figures, and text often refer to the first decade and several subsequent decades. The first decade is the period covered by the Forest Plan. Estimates for subsequent decades represent effects if activities and outputs of the alternatives were continued beyond the first decade.

CHANGES BETWEEN DRAFT AND FINAL

- All Forest acreages have been updated to reflect boundary adjustments with the Olympic National Park and the Quinault Indian Nation.

- Discussion of visual prescription acres has been removed. Viewshed condition by alternative has been substituted as the scenery effect to be assessed. Visual prescriptions will be applied during viewshed scheduling and project planning.

- Cumulative effects assessments and mitigation measures have been included for some resources which did not include these in the DEIS.

- Fish habitat capabilities are reported in numbers of smolts rather than numbers of adults as in the DEIS.

- The text has been structured to focus more on environmental consequences rather than the program outputs detailed in Chapter II. Also, more information on interactions among environmental components has presented in this chapter.

- The process used to estimate mileage of road construction by alternative has been revised. The initial procedure underestimated the proportion of total construction mileage that would occur in the early decades (especially the first).

- The analysis of total traffic flows by alternative has been modified to incorporate a more generalized approach to the subject.

- The projection of road use management by alternative has been updated to incorporate the current maintenance and management situation on the Forest and the most recent projections of future road management trends.

- The analysis of the effects of alternatives on cumulative timber supply has been updated to reflect the most recent projections covering non-National Forest supply availability and demand for Olympic Peninsula timber.

- The assessment of employment and personal income effects by alternative has been expanded to include all forms of recreation in the analysis. This provides a more complete development of potential changes affecting the local economy.

- Employment and income effects are now projected for the first decade only. In the original analysis, such projections spanned the 50-year planning horizon. The high degree of uncertainty associated with long-term employment estimates makes such 50-year projections extremely speculative.

- The discussion of employment and income effects has been expanded to include the importance of American Indian subsistence fishing in the overall fabric of the Peninsula economy.

- Because employment changes are no longer projected over the 50-year planning horizon, the discussion of cumulative employment effects by alternative has been modified. This discussion is now more general in nature.

- A discussion of potential measures for mitigating employment and income effects has been added.
- The discussion of effects on the American Indian community group has been expanded to more thoroughly cover all aspects of the factors affecting this segment of the Peninsula community.
- A discussion of potential changes in population associated with implementation of the alternatives has been added.
- A discussion covering potential means of mitigating adverse effects on local communities has been added.

Please refer to the "Changes Between Draft and Final EIS Common to All Alternatives" at the beginning of Chapter II for additional information.

ENVIRONMENTAL CONSEQUENCES

The following section discusses the likely environmental consequences expected to result from implementing the six alternatives described in Chapter II. The consequences are discussed as they relate to various components of the physical, biological, social, and economic environment. Cross-referencing with Chapter III is desirable to fully understand the enviromental components which are affected. Reference should also be made to Chapter II for a detailed display of resource program outputs associated with the alternatives.

This section includes a brief overview of each component, a description of significant resource interactions which affect the environmental component, and a discussion of direct, indirect, and cumulative effects of these interactions resulting from each of the alternatives. Mitigation measures and the relationship with the plans of other government or private entities are discussed.

It is important to understand that this section is organized to separately present the effects of the alternatives on each environmental component. The section on road access will not present the effects of roading *on* the other environmental components, it will present the effects of the alternatives and the associated component changes *on* road access. Effects of roading on other resources, e.g., water quality, are appropriately presented within the discussion on the Water component, not the Road Access component.

VEGETATION

OVERVIEW

There are several aspects of vegetation which are affected by the management alternatives. Of particular concern are the effects on: old-growth forest stands, sensitive and unusual plant species and communities, dead and down vegetative material, forest timber stand structure and vegetative diversity.

SIGNIFICANT INTERACTIONS

GEOLOGY

Changes in geologic processes can change the vegetation cover in the short term and, to some extent, alter long-term vegetation development. Major increases in mass movement, erosion, or flooding can eliminate short-term vegetative growth. In areas where soils are completely removed due to these processes, vegetation may not be reestablished for decades or longer. Changes in erosional base level by damming, as a result of natural or human activity, may eliminate a vegetation type formed in an erosional environment and replace it with a type suited for wetland areas.

CLIMATE

Climate affects plant species, size, longevity, location and diversity. Major climatic elements are precipitation, temperature and wind. None of the alternatives proposed will change the basic climate, but the climatic conditions on harvested areas (micro-climate) or other areas where vegetation is manipulated, will be changed for a period of time. Also, wind patterns can be changed by regeneration harvesting. Large clearcuts can funnel winds, causing an increase in wind speed. High winds, and turbulent winds on the lee side of ridges, will cause trees to blow over.

WATER

The presence or absence of water affects vegetation. Some species of plants need areas that are wet year around, some need seasonal wet periods and others need nearly dry conditions. Road construction and timber harvesting can change the location, movement, and concentration of water. As these change, so will the mix of associated plant species.

SOIL

Soil depth, water-holding capacity, nutrients and topographic position all affect species composition and growth rates. Temporary changes in productivity may occur when fertilization is applied. Some plants, such as Douglas-fir, will show a short-term increase in growth rate (for less than 10 years) due to nitrogen fertilization, while the growth rates of other species may not change. Harvesting activities, primarily yarding, may compact the soil, thereby reducing productivity. Some soils will remain compacted longer than others. Some activities, such as scarifying and ripping the soil, can increase vegetative diversity of weedy species.

VEGETATION

As plants reproduce, grow and die, there is a constant change in the size, species mix, location and diversity of vegetation. Some plants will shade out other plants, and some change the availability of nutrients in the soil, thereby affecting the growth of other plants. Some plants must die to provide a favorable habitat for the reproduction of others.

These changes, or natural succession, will continue in all alternatives. Some alternatives will interrupt these gradual, natural changes more than others as timber harvest and other activities are implemented. Instead of the natural succession continuing through to climax vegetation, it will be interrupted by the harvest of timber. Alternatives that involve more timber harvest will have larger areas in the early successional stages (grass-forb through young trees) than alternatives involving less harvest. This will increase diversity of seral stages, at least until the old-growth proportion is reduced substantially. It will also reduce the amount of dead and down material, since this material is usually removed during yarding operations or burned following the harvest activity.

Timber harvest, with the associated yarding and road construction, has the greatest effect on vegetation. Timber harvest prevents the natural succession of plants from reaching the climax association. It removes most vegetation from the harvest area, as well as some dead standing and down material. Commercial thinning removes some vegetation from the harvest area and may affect species diversity. Yarding systems will crush, break, or pull out vegetation. Yarding systems that drag most or all of the log will have a greater effect on soils and residual vegetation than those which suspend the entire log.

Seeding and/or planting, whether for wildlife habitat, soil erosion control or reforestation, will have an effect on vegetation. Generally, seeding and/or planting will increase diversity of weedy and nonnative species, while generally decreasing diversity of native species. Seeding also increases the risk of unintentionally introducing species, such as tansy or other noxious or undesirable weeds. Planting will also increase the potential for introduced species, such as noble fir.

Release of tree species from competing vegetation is not often a necessary activity on this Forest. The general lack of competing vegetation makes release unnecessary when planting areas have been adequately prepared. Release has an effect on vegetation by reducing species diversity. Precommercial thinning has dual effects on vegetation -- species diversity is reduced by removal of some species, but increased by the release of others. Vegetation is also affected by fertilization. Generally this effect is short-term (less than 10 years), and consists of increased growth of the plants fertilized.

WILDLIFE

Wildlife can affect the growth and quantity of plants. Some wildlife eat the tops of plants, causing them to become bushy with reduced height growth while others eat the whole plant. In severe situations, a plant species might be eliminated. Some wildlife feed only on the bark of plants. This either slows growth or kills affected plants. The resultant exposed cambium material is favorable habitat for disease organisms and insects. Some wildlife expose cambium material as they excavate for insects. The growth of vegetation is also affected as wildlife defecate or die. Control of browsing animals, such as deer, elk, and mountain beaver, reduces their effect on vegetation growth. Generally, this increases plant species diversity and height. Birds distribute plants by disseminating seeds into new areas.

INSECTS

Insects affect vegetation by aiding in the pollination and reproduction of species. Other insects reduce the vigor of plants, making them susceptible to disease or occasionally causing their death. Insects sometimes transport diseases from one plant to another. By controlling epidemic attacks of insects, vegetation is maintained, although species and community diversity may decrease over time.

DISEASE

Disease affects vegetation by reducing the vigor of plants, making them susceptible to insects or causing their death. Some diseases, such as root and butt rots, cause plants to decay at a faster rate. This increases the rate at which nutrients are returned to the soil. Certain root rots are persistent in dead roots or stumps, and can infect newly established stands of susceptible species. By controlling the natural spread of diseases, vegetation is maintained, although species and community diversity may decrease over time.

FIRE

Wildfires generally burn in a mosaic across the landscape, increasing species, community and structural diversity. The frequency and intensity of natural fires vary with vegetation zone and plant association. Fire, both natural and human-caused, reduces some vegetation to ash while charring other vegetation. Species differ in their adaptations and resistance to fire. Charring generally lengthens the time it takes for dead material to decay. Depending on its intensity, fire can interrupt the succession of plants and communities, and begin the successional process again. This interruption generally increases the diversity of plant species and sizes. Sometimes fire weakens plants, providing an opportunity for insects and/or disease to become established. Fire in managed stands disrupts harvest schedules and generally reduces the quantity and value of timber products.

Fire has been excluded from many forest stands since early in the twentieth century. Fire exclusion results in major changes to vegetation. Fire suppression may slow natural succession, change species composition, and increase fuel accumulations, which increases the risk of a catastrophic wildfire. The highest risk of major wildfire events is in alternatives that have the greatest acreage where timber management activities are not permitted.

Wildfire also changes forest vegetation. The effect is the opposite of fire exclusion. A wildfire produces many of the same effects as does the harvest of forest trees with even-aged management. Depending upon fire severity, burned areas may be converted from forest vegetation dominated by trees to grasses and forbs.

FUEL TREATMENT

Treating fuel (the material left after logging) by burning, rearrangement, and/or removal affects vegetation. The effects of burning are similar to those described for fire. The method of rearrangement of fuels, more than rearrangement itself, affects vegetation. In some cases, fuels are crushed and/or chipped. This reduces the time for decomposition. In other cases, the material is dragged to a new location. The dragging generally causes some vegetation to be crushed, broken or pulled out, but the amount of vegetation and the length of the decomposition period remain the same. Removal of material from the area affects vegetation by reducing the amount of decomposing material, and the nutrients it provides. If the material is dragged, the dragging will crush, break or pull out other vegetation.

RECREATION

Recreation facilities, such as campgrounds, picnic areas, parking lots, trails, roads, resorts and recreational homes, all have effects on vegetation. The greatest effects result from those activities that remove or trample plant life. Recreation facilities tend to attract and concentrate people. This often reduces the air quality (due to dust) and increases the potential for fire. People also affect vegetation by cutting, burning, pulling out by the roots, crushing, compacting the soil, and planting or seeding. Often, new species of plants are introduced by recreationists.

SCENERY

Management of scenic areas affects vegetation. If a view into the forest is desired, then low-growing vegetation, small trees, and some larger trees may be removed. To maintain this view, repeated removal of vegetation is necessary. If a vista is desired, then all or most of the vegetation may be removed. Repeated removal of vegetation is necessary to maintain this view. In either case, the removal of vegetation can reduce species and seral stage diversity. If a natural-appearing background (no visible activities) is needed, then little or no vegetation will be removed. This continues the natural process toward climax species and old-growth conditions.

ROADS

Road construction affects vegetation by removing it from the road prism. Often the excavated area cannot support vegetation of any kind or, if it can, it is either kept cut back or eliminated. Roads also increase the potential for introduced species, such as tansy ragwort. Road closures affect vegetation by limiting access. This reduces the amounts of firewood, ferns, boughs and other forest products that are removed from the forest.

ENERGY

The exploration for, and development of energy resources can lead to removal of all vegetation from localized areas. Due to the relatively low number of energy developments (i.e., hydro, geothermal, oil, gas, solar, coal, and wind) on the Forest, the effects of energy on vegetation have been minor, and are not anticipated to increase appreciably during the planning period. The largest potential effect due to energy development occurs when a reservoir is needed in conjunction with hydropower development.

Firewood gathering and use of wood fiber for commercial energy (hog fuel), on the other hand, are of great interest on this Forest. The amount removed each year has increased. The removal of this material has an effect on vegetation through removal of wood fiber that would otherwise decompose, providing nutrients to the soil and habitat for plants and animals.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON VEGETATION

The greatest effects on Olympic National Forest vegetation are due to vegetative manipulation, specifically timber harvesting. (Refer to Chapter II for a detailed discussion of the timber management programs associated with each alternative). In understanding the environmental consequences of vegetative manipulation, the acres of harvesting activity over time are of particular importance. Tables IV-1 and IV-2 present the acres of clearcutting and commercial thinning for each alternative. This data, in concert with the timber program information of Chapter II, provides much of the basis for assessing effects on the Forest's vegetation.

Table IV-1. Total National Forest Annual Clearcut Acres (In thousands) 1/

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Decade 1	6.3	4.1	6.6	2.4	1.6	0.2
Decade 2	4.6	3.5	6.8	3.0	2.0	0.8
Decade 5	4.1	2.6	2.3	2.4	2.5	2.1

1/ Includes National Forest land within the Shelton CSYU.

Table IV-2. Total National Forest Annual Commercial Thinning Acres (In thousands) 1/

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Decade 1	4.5	0.4	0.6	0.6	0.6	0.6
Decade 2	3.1	0.0	0.0	0.0	0.0	0.0
Decade 5	5.3	2.0	2.8	1.1	1.1	0.8

1/ Includes National Forest land within the Shelton CSYU.

OLD-GROWTH

As noted throughout this document, the question of how much old-growth should be harvested has emerged as a major issue on the Forest. Old-growth is directly affected by the amount of clearcutting associated with each alternative; the greater the rate of clearcut harvest, the smaller the acreage of old-growth remaining. Refer to Table IV-1 for the acreage to be clearcut in each alternative.

There are many areas of old-growth which will not be harvested in any alternative. These occur on lands not suitable for timber production (see "Vegetation," Chapter III) and within existing Wildernesses and the Quinault Research Natural Area. In addition, the alternatives also include varying acreages allocated to management prescriptions that do not include timber harvesting. Table II-6 displays the acres of old-growth that are allocated to no harvest prescriptions for each alternative. As a result of these varying land allocations and management emphases, the acres of old-growth which will be harvested (and subsequently the acres remaining) will vary among the alternatives as indicated in Table IV-3. Figure IV-1 displays the acres of old-growth that will remain at the end of the first, second, and fifth decades.

Table IV-3. Old-Growth Acres Harvested (thousands of acres) 1/

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Old-Growth Harvested in:						
Decade 1	68.9	37.1	63.2	22.0	14.3	0
Decade 2	50.3	30.6	37.8	21.8	12.5	0
Decade 3	20.8	10.8	14.3	18.2	10.3	0
Decade 4	0	11.0	0	16.7	9.0	0
Decade 5	0	3.6	0	3.1	1.8	0

1/ Includes National Forest land within the Shelton CSYU.

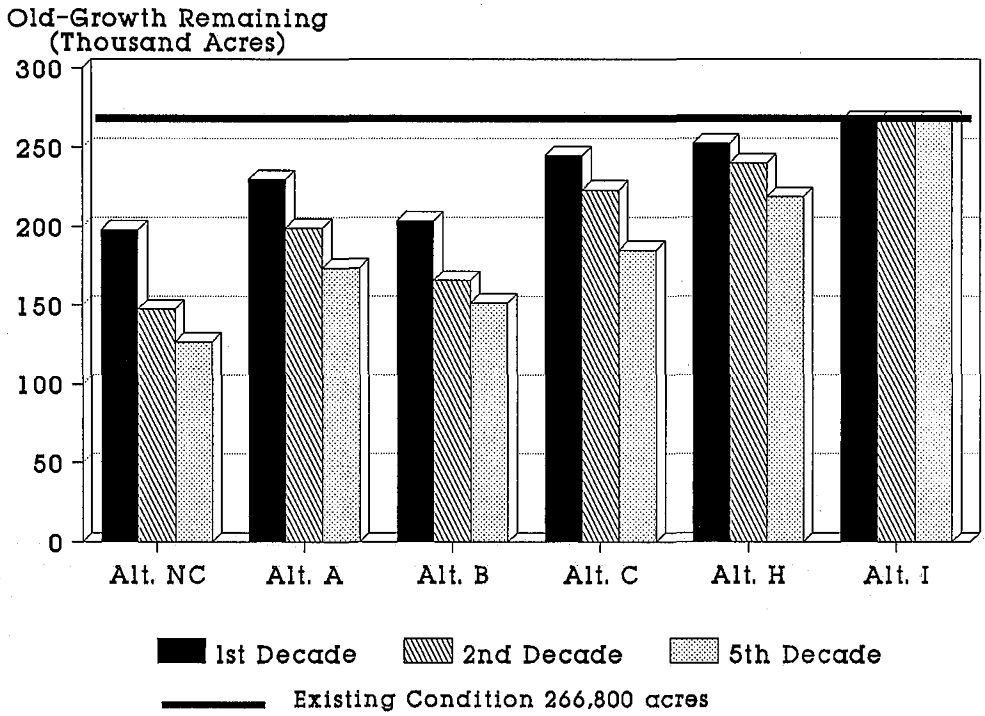
As indicated in Figure IV-1, all alternatives will have some old-growth remaining at the end of the planning horizon (fifth decade). Alternative NC harvests the most old-growth while Alternative I does not harvest any old-growth during the 50-year period. Since the Forest Plan will only be implemented for the next 10 to 15 years before being revised, it is important to note the rate of old-growth harvest over the first two decades (refer to Table IV-3). What is left after that time will be the starting inventory for future planning efforts. With no harvest under Alternative I, 100 percent remains after two decades, followed by Alternative H (Modified) at 90 percent, and Alternative C-Preferred (Modified) at 84 percent. The remaining alternatives provide substantially less old-growth at the end of the second decade with NC providing the least, 147,600 acres, or 55 percent of the currrent inventory.

One of the environmental concerns of cutting old-growth is the reduction of the gene pool, or storehouse of genetic variability within a species. This becomes more important as management moves toward genetic tree improvement with limited parent trees. Published minimum viable acres for genetic variability are not available. However, with the projected amount of old-growth left at the end of the fifth decade in all alternatives, and with Olympic National Park as an additional gene pool on the Peninsula, it is expected that adequate genetic variability can be maintained.

The old-growth areas of the Forest provide critical habitat for some species of wildlife, including the northern spotted owl. The effects of old-growth removal on the spotted owl and other animal species are presented in the "Wildlife" section of this chapter.

Another aspect of old-growth which is affected by the alternatives is the aesthetic and recreational values associated with old-growth forests. Substantial reductions in old-growth, as in Alternatives NC and B-Departure (Modified), will result in the greatest reduction of the aesthetic and recreational qualities provided by these old stands. Refer to the "Scenery" and "Recreation" sections of this chapter for detailed discussion of the consequences of the alternatives on scenic, aesthetic, and recreational resource components.

Figure IV-1. Old-Growth Acres Remaining



Since timber harvest is an important generator of jobs and personal income, harvest of old-growth is also linked to the environmental components discussed in "Local Economy" and "Local Communities." Please refer to these sections of this chapter for an assessment of these additional environmental consequences of old-growth harvest.

DIVERSITY OF VEGETATION

As noted in Chapter III, the definition of diversity applicable to this FEIS is, "the distribution and abundance of plant and animal species and communities to meet its overall multiple-use objectives."

The effect on diversity, as measured forest-wide, is not expected to vary greatly by alternative. All alternatives, except NC, are designed to meet the legally mandated levels of diversity. Alternative NC does not contain MRs, but does provide a level of management to provide for diversity. Wilderness areas, RNAs and BAs provide a source of reservoirs of vegetative diversity (Wilcover 1988). Other land allocations and management guidelines, such as SOHAs, River Corridors, and Undeveloped Recreation areas, provide areas of minimum disturbance which contribute to diversity on the Forest.

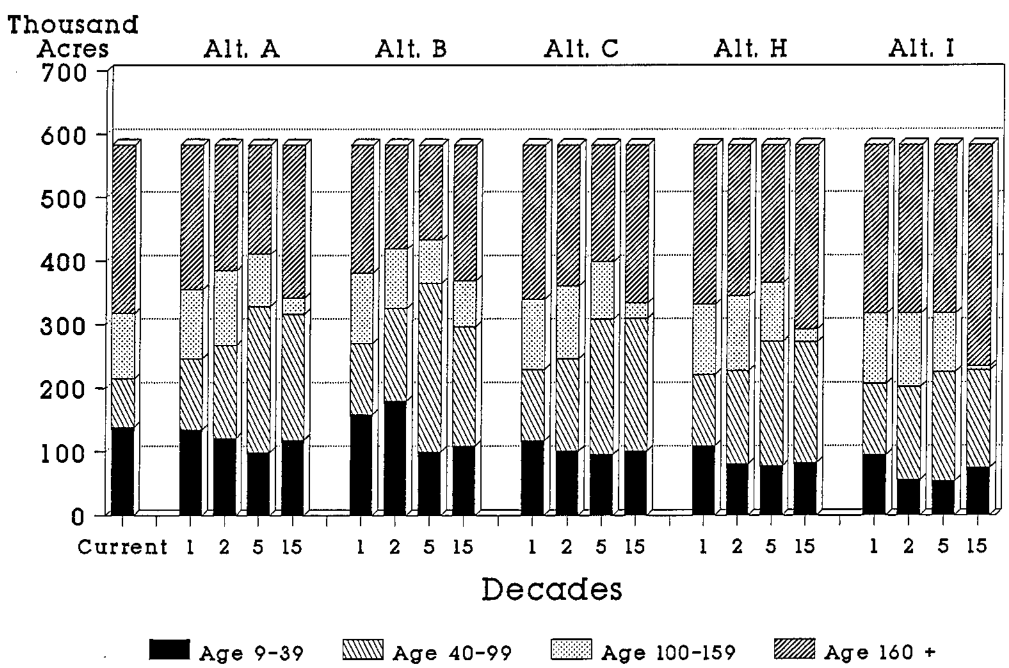
Management activities, such as timber harvesting, reduce mature and old-growth forests and increase younger aged forests. The overall effect is one of shifting from a landscape that is relatively homogeneous over large areas, but relatively diverse within any one patch, to a landscape that is heterogeneous in size classes, but less diverse within each class.

Forested areas outside of Wilderness and other no-harvest allocations are the areas where most changes in vegetative conditions would occur. Despite these changes, no significant change in kind and amount of plant species which are present across the forest is expected during the next decade or beyond. However, change in structure and age of vegetative communities will occur as a result of human activity, wildfire, and forest insects and diseases.

The alternatives effect the Forest's vegetation by changing the species mix and and size mix. This mix is an important aspect of Forest vegetative diversity. In general, those alternatives that are the extremes, Alternative B-Departure (Modified) and Alternative I, tend to reduce size class diversity by reducing the proportion of older or younger trees in the Forest. Those alternatives that fall in the midrange tend to provide the widest range of diversity in both species and age class. Therefore, diversity can be tailored to fit the objectives of an alternative. See the sections titled "Wildlife" and "Scenery" in Chapter III and in this chapter for additional discussions of diversity. Alternative NC is not included in this figure, due to the lack of complete data regarding age class changes through time. It is likely that the age class distribution of this alternative will be similar to that of Alternative B-Departure (Modified) but with a more substantial reduction of the old-growth component.

Expected age class diversity, by alternatives, is indicated in Figure IV-2. Acres by age class are displayed for the first, second, fifth and fifteenth decades to show the trend most likely to occur if implementation of the alternatives were to last that long.

Figure IV-2. Age Class Distribution



Alternatives NC and B-Departure (Modified) will result in a relatively large reduction of the mature and overmature components of the age class mix, due to the large acreage in the harvest base and the high level of early decade harvest. Over time, these alternatives can be expected to have the greatest effect on age/size class diversity. Alternative A-Current Direction will result in a relatively large acreage in managed stands and a relatively small proportion of the forest in the mature and overmature seral stages. Alternatives H (Modified) and I will result in a relatively slow rate of change, with the proportion of mature and overmature timber remaining relatively high, due to the reduced rates of harvest in these age classes associated with these alternatives. However, those species of trees needing more light (such as alder) will be crowded out by existing stands, thereby reducing some aspects of diversity. The level of management associated with Alternative C-Preferred (Modified) will result in a relatively even distribution of size and age classes.

Another aspect of vegetative diversity concerns the degree of protection for sensitive, threatened, endangered, or unusual plant species and communities. It is expected that those alternatives with the largest number of Research Natural Areas (RNAs) and Botanical Areas (BAs), i.e., Alternatives C-Preferred (Modified), H (Modified), and I, will offer the greatest assurance that the diversity provided by unusual plant species or communities will be protected in the future. See below for additional information on Research Natural Areas and Botanical Areas.

DEAD AND DOWN MATERIAL

The major effect of timber harvesting on this aspect of vegetation is the removal of dead and down material from the area. This has been particularly true in the past when the large majority of the logging residue was burned on the site. Cutting records for the Olympic National Forest show a direct relationship between the amount of sound material removed (generally not dead or down) and the amount of dead and down material removed or burned.

Total existing amounts of dead and down vegetation in the Forest are not known, nor can quantitative estimates of the volume of dead and down be determined for the alternatives. However, given the above inverse relationship between timber volume removed and dead and down retained, those alternatives, such as NC and B-Departure (Modified), which have the highest levels of timber production, would result in the lowest volume of dead and down material available on the Forest. (See Chapter II for a comparison of the timber programs associated with each alternative). Volume of dead and down would increase as you move to Alternatives A-Current Direction, C-Preferred (Modified), H (Modified), and I. Alternative I is somewhat different from others because very little overmature timber is harvested. Therefore, the proportion of dead and down material removed in relation to timber harvested is less. Timber harvested in Alternative I is generally from younger stands that have not had the time necessary to build up large quantities of dead and down material.

There are several important indirect effects associated with the volumes of dead and down material retained on the Forest. This vegetative material is important for nutrient recycling in the soil and as a vital component of habitat for some wildlife species. Dead and down material can also result in the build-up of fuel for possible large-scale fires. This effect is discussed in the "Fire" section of this chapter.

Salvage of dead or dying trees or removal for firewood may reduce habitat for some snag dependant species of wildlife. It may also increase public safety where dead and dying trees are harvested near campgounds, trails, and other areas heavily used by the public. Where large numbers of merchantable trees are killed by insects, diseases or by other causes, salvaging the timber may reduce the hazard of catastrophic wildfire. The degree of such salvage and firewood removal are again directly related to the degree of timber management and associated roading activity for each alternative as noted above.

SENSITIVE PLANTS

The alternatives are not expected to have any significant direct, indirect, or cumulative effects on species of plants with sensitive status. However, the risk of such effects occurring is considered to be higher in those alternatives, such as NC and B-Departure (Modified), which include high levels of timber management activities. Planning for site-specific projects will include investigations for these plants and appropriate protective actions will be taken if they are found. (Refer to the Forest-wide Standards and Guidelines in Chapter IV of the Forest Plan.) Additional protection is afforded by management area allocations which prohibit management activities such as timber harvest or roadbuilding. Research Natural Areas and Botanical Areas are two means of highlighting the importance of protecting these species. The alternatives vary in the amount of these allocations as noted in Table IV-4.

UNUSUAL OR SPECIAL FOREST PLANT COMMUNITIES

A number of areas on the Forest contain plant species or communities which are noteworthy for a variety of reasons ranging from their relative rarity to their unusual size. Means of highlighting and providing a high level of protection for these areas include designation as Research Natural Areas (RNAs) or Botanical Areas (BAs). The degree to which these areas are protected by land allocation varies by alternative. Table IV-4 displays the number of areas and associated acres of RNA and BA for each alternative.

Table IV-4. Research Natural Areas and Botanical Areas 1/

	Alternatives					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Research Natural Areas						
Number	1	1	1	2	3	3
1000 Acres	1.5	1.5	1.5	2.6	5.7	5.7
Botanical Areas						
Number	2	2	0	12	11	11
1000 Acres	.5	.5	0	6.2	3.1	3.1

1/ Acreage shown is **total** area within RNAs and BAs. Discrepancies with Table II-2 are due to cases where RNA or BA acres are within more restrictive allocations such as Wilderness. In such cases, Table II-2 reports these acres as B1 (Wilderness) rather than J2 (RNA) or J3 (BA).

CUMULATIVE EFFECTS OF ALTERNATIVES ON VEGETATION

Harvesting of timber and subsequent regeneration results in a changing mosaic of vegetative cover. Over time these changes may alter the ecological relationships among species and between species and their environment.

Vegetative changes on State, private, and American Indian land adjacent to the Forest have been rapid and widespread. Most of the old growth timber has been removed and some species (e.g., western red cedar) have been greatly reduced. Alternatives such as NC or B-Departure (Modified) which emphasize timber production would generally result in greater cumulative effects on vegetation than those alternatives which maintain more areas in existing species and age class composition.

The relative magnitude of these effects is indicated by the total acreage harvested and planted on the Olympic Peninsula and by the portion of those acres which are planted with a single or few tree species. Alternatives with the most lands harvested and planted with a limited number of species would have the greatest cumulative effects on vegetation. Refer to Chapter II for a detailed discussion of the timber programs associated with each alternative.

The vast Olympic National Park, which is largely Wilderness, combined with other ownerships in various stages of management on the Olympic Peninsula, results in a large area of diverse and abundant plant and animal communities.

The cumulative effects of timber harvest removal on the overall timber supply of the Olympic Peninsula are displayed in the section of this chapter on "Local Economy."

MITIGATION MEASURES AND EFFECTIVENESS

The National Forest Management Act requires that diversity of plant and animal communities and tree species diversity be maintained or enhanced within a planning area. This requirement is met on the Forest by allocation of some areas to management emphasis with no development, providing standards and guidelines for areas with active management, and by monitoring species and habitats throughout the Forest.

Forest-wide Standards and Guidelines apply to all alternatives and help maintain diversity of plant and animal communities and tree species. The Forest-wide Standards and Guidelines and the management area allocations provide requirements which address various aspects of diversity, i.e., protection of native plant and animal species, restrictions on management activities, retention of old-growth and mature forest habitats, protection of RNAs and BAs, etc. These allocations and Standards and Guidelines are expected to be effective in maintaining the diversity prescribed by the National Forest Management Act.

Mitigation measures are contained in the Forest Plan, Chapter IV, Forest-wide "Standards and Guidelines" and in Appendix J, "Best Management Practices". Adverse effects of management activities can be mitigated in several ways. Some activities may be modified, prohibited, or scheduled to reduce or eliminate adverse impacts. Planting or seeding following completion of management activities may be done to promote rapid recovery of forest vegetation, and to prevent unwanted effects.

Silvicultural activities can be modified to reduce the effects on vegetative diversity. Examples include: planting Douglas-fir in areas which were predominantly western hemlock versus planting more western hemlock; precommercial thinning and commercial thinning leaving only one species versus a mix of species; varying lengths of timber rotations to vary species mixes and size classes; and retaining some components of old-growth stands on the site after harvesting. When properly applied, such techniques can be very effective in mitigating the diversity-reducing effects of timber management.

RELATIONSHIPS TO PLANS OF OTHERS

The Forest Land Management Program, Draft Environmental Impact Statement, Washington State Department of Natural Resources issued in 1979, projects the sustainable harvest level from State-owned or administered lands for the next 100 years. The Statewide goal for timber to be sold for the years 1980 to 1989 was 805 million board feet annually. This amount increases to a high of 896 million for the years 2000 to 2009, then declines to 762 million board feet by the years 2020 to 2029. The Olympic Area (generally Olympic Peninsula) shows a different harvest rate as indicated in Table IV-5.

Table IV-5. Washington State Timber Flow - Olympic Area

Decade	Timber Volume (MMBF)	Percent Change
1980-1989	338	-31
1990-1999	232	-30
2000-2009	162	-2
2010-2019	159	+9
2020-2029	173	

Since publication of the draft statement, there have been numerous changes in the management objectives applicable to DNR timberland on the Peninsula. A new Forest Land Management Program is currently being developed to incorporate these changes. At present, tentative projections of future DNR harvest levels from the Olympic Area indicate a fairly stable harvest flow, averaging roughly 225 million board feet per year, over the next five decades.

The Draft Statement also included an insect and disease program with objectives to protect and preserve the forest resources of Washington State against destructive forest insects and diseases. The goal is to reduce damage and loss to tolerable levels as determined by the resource values involved. The State has an agreement with the Forest Service (not just the Olympic National Forest) to share the cost of prevention, protection, evaluation and technical assistance in detecting insects and diseases.

The Washington Forest Resource Plan, Washington State Department of Natural Resources, issued in 1985, provides the framework for the State to cooperate with nonindustrial private forest landowners. The goals are: to increase productivity of nonindustrial private forest land and encourage retention of these lands in forestry; to expand public education about forest resource management; and to improve harvest efficiency for increased wood fiber recovery. No projected timber harvest flow was presented, but the potential is thought to be great. Nonindustrial private forest land is 26.2 percent of the total commercial forest land in Washington State. As a comparison, the total National Forest land in the Washington State is 26.3 percent.

The Olympic National Park Proposed Master Plan and Final Environmental Statement, published in 1976, does not display a timber harvest level. Several research projects are proposed. One would provide a baseline data survey of Park ecological resources, including vegetation maps.

The Botanical Areas and Research Natural Areas proposed in some alternatives are intended to be part of a regional network of preserves and protected areas involving Federal (RNA and Special Interest Areas), State (Natural Area Preserves) and private holdings (The Nature Conservancy). The primary objective of this system is to preserve natural ecosystems and gene pools of typical or rare and endangered plants and animals. The Forest works in cooperation with the Pacific Northwest Research Natural Area Committee (comprised of several federal agencies); the Washington State Department of Natural Resources, under direction of the Natural Heritage Plan (DNR 1989); and The Nature Conservancy to ensure that regional needs are met and that duplication of effort is avoided. The Wet Weather Creek area which is proposed as a Research Natural Area in Alternatives C (Modified), H (Modified), and I fills two cell needs as identified in Research Natural Area Needs in the Pacific Northwest (Dyrness et al. 1975): "Typical Douglas-fir/Western Hemlock forest on slopes, east side of peninsula," and "Subalpine fir forest in northeastern portion of Olympic Peninsula."

WATER

OVERVIEW

Water is an important component of the forest ecosystem. Uses of this resource, both on-Forest and off-Forest, could be affected by changes in water quality and quantity which result from management activities.

Effects of the alternatives on water are directly related to the amount and location of timber harvest and the road use, construction, and reconstruction that is proposed. Those alternatives with high timber harvest levels will generally affect water more than those with lower harvest levels.

There are many management activities that can affect water. Chemicals could be used more frequently in those alternatives emphasizing timber harvest. Fertilizer which is used to accelerate tree growth is the most likely chemical to be used since competing vegetation is not normally a problem with reforestation on the Olympic National Forest. Timber harvest levels in alternatives could cause minor changes in total water yield and runoff timing in streams on the Forest. Vegetation removal along streamside zones can cause stream temperature increases. Timber harvest and road-related activity can affect water quality by increasing sediment levels in streams.

SIGNIFICANT INTERACTIONS: Water Yield and Runoff Timing

VEGETATION - TIMBER HARVESTING

Snow accumulation is markedly affected by timber harvesting. Increases in the maximum snow accumulation in cutover areas on the Forest can range from 15 to 20 percent. Often, excess snow in openings is a redistribution of tree canopy snow, and is partly counterbalanced by a decrease under the trees.

Evapotranspiration is reduced in proportion to the area of the timber stand which is harvested. The reduction integrates less interception and transpiration from the tree canopy and is offset partially by a small increase in evaporation from the more exposed forest floor. The reduction in evapotranspiration occurs principally during the initial seasons after vegetation is removed from an area.

A 25 percent increase in surface water yield can result after an area is logged on the Forest. Most of this increase is due to less evapotranspiration by trees and higher base flow during the summer and early fall when evapotranspiration losses have been reduced. The duration of increased water yield should persist for 15 to 20 years (Anderson, Hoover, and Reinhart 1976). Increased base flow during the summer months is beneficial to fisheries, since it provides more rearing habitat. It has been estimated that at least 20 percent of a watershed would need to be clearcut to produce a significant increase of water yield.

The reduced evapotranspiration and higher soil water content in a clearcut means that, at the beginning of the fall rainy season, less precipitation is needed to recharge soil water storage to the point at which runoff begins. This results in higher peak flows during initial fall storms. These initial peak flows are generally of little consequence in terms of channel erosion, because they tend to be much smaller than the later flows that occur during November through March. By the time these larger peak flows occur, soil water content of unlogged areas has been raised to that of logged areas so that both logged and unlogged areas behave similarly, hydrologically. However, when soil compaction by logging, road building, or slash disposal occupies more than 10 to 12 percent of the total watershed, large, winter peak flows can be increased up to 20 percent. Recent research analysis indicates the possibility that peak flows during some rain-on-snow events may be of sufficient magnitude to trigger increased mass movement, surface erosion, and stream channel erosion. However, the significance in terms of adverse effect is presently unknown (Harr 1985).

Higher sediment loads of streams draining from the Forest could increase flooding if it reduces stream channel capacity. The upland streams on the Forest have very steep gradients and enough energy to transport sediment through the river system on the Forest. The lowland sections of these streams and their mouths are often prone to deposition of sediment loads which reduce the capacity of the channel to pass flood flows. Aggradation of the lower sections of wide, low-gradient streams is a natural process which may be aggravated by increased sediment loads. Most of the streams on the east side of the Forest have steep gradients almost to their mouths and have a low to moderate susceptibility to aggradation.

FIRE

Following a hot fire, the development of a nonwettable layer slightly below the soil surface can cause a decrease in soil infiltration rates which results in increased surface runoff. This water-repelling effect is normally of minor importance on the Olympic National Forest, and occurs only when there is an extremely hot fire in combination with low soil moisture content.

ROADS

Road surfaces have virtually no infiltration capacity, and road cut slopes may intercept subsurface flow and rapidly transport water to streams via the road ditch system. As a result, peak flows for streams may be substantially increased when roads occupy more than 10 to 12 percent of the total watershed.

ENERGY AND WILD AND SCENIC RIVERS

Development of reservoirs or run-of-the-river hydroelectric projects can affect streamflow. Run-of-the-river hydroelectric projects consist of a small diversion dam with no storage capacity. Reservoirs reduce downstream floodwater, providing higher flows during late summer. Run-of-the-river projects result in less streamflow in the channel between the diversion and powerhouse. Minimum flows are generally established to maintain fish habitat. Recommendation of a river for inclusion in the Wild and Scenic Rivers System would preclude hydropower development.

SIGNIFICANT INTERACTIONS: Water Quality

VEGETATION - TIMBER MANAGEMENT

A major effect of timber harvest is the loss of root systems of harvested trees and affected shrubs and herbs over time. This can result in an acceleration of mass wasting and soil erosion on slopes greater than 50 percent, which increases sedimentation to stream systems. Normally, fine roots lose their strength within one or two years after a tree is cut. It may take about 20 years for the larger roots to lose their strength. Usually, slope stability problems related to timber harvest occur within three to five years and are a combination of fine and larger root strength loss. Root strength approaches prelogging levels 15 to 20 years after an area is revegetated. Streamside zones on the Forest are particularly prone to this type of instability, since they are typically steep and possess much subsurface water. Normally, timber harvest activities upslope from streamside zones do not have a significant effect in increasing slope instability. However, in areas of the Forest underlain by glacial material or sedimentary rock, instability may be greatly increased.

In general, timber harvesting accounts for approximately 10 percent of increased sediment from all activities. Usually, sediment from this source will approach background levels in 10 to 15 years (Swanston and Swanson, 1976; Reid 1981).

The yarding system used to log an area can have a significant effect on sediment levels in two ways: (1) actual physical disturbance to the soils, and (2) road density as determined by yarding systems. As will be discussed later, roughly 80 percent of increased sediment levels resulting from Forest Service activities is from roads. The following yarding systems are listed in order, from highest ground disturbance, road density, and sediment production to lowest: tractor, high-lead, skyline, helicopter.

Concentrations of dissolved oxygen may be reduced in the intergravel space of a streambed if fine organic debris accumulates there. The effects of high biological oxygen demand will persist until the organic material is removed. Low dissolved oxygen is not a problem on the Forest since there is much aeration due to the steep gradients of most streams. Small streams with low gradients are more susceptible to reduced dissolved oxygen levels. Few streams on the Forest fall into this category.

Timber harvesting near streams can raise the water temperature enough to reduce fish populations. The increase in summer water temperature is in direct proportion to the amount of increased sunlight that reaches the water surface. Smaller streams are usually more susceptible; however, water temperature increases in streams on the Forest are not significant since the streams usually have cool water temperatures and are fast flowing.

Water temperature monitoring in the headwaters of the West Fork of the Humptulips River, showed a maximum increase of two to three degrees F. as the stream passed through a clearcut approximately 1,200 feet long. The highest water temperature at the downstream edge was 55 degrees F., and lasted two days before decreasing (Stephens 1974). This temperature was well below the maximum optimum temperature for fish, which is 65 degrees F.

Thus, shade removal from timber harvest activities along streams on the Forest should not be critical where water temperatures are at or below optimum levels. Along anadromous and resident fish streams, trees are left to provide a future source of woody debris to the stream channel. These trees help minimize water temperature increases.

The Olympic Peninsula has two distinct situations relating to water temperature effects. Water temperature data from the U.S. Geological Survey shows that the lower reaches of eastside streams are at or below optimum water temperatures and can accommodate effects of shade removal by timber harvest activities. Raising temperatures slightly as the result of shade removal might make them more productive. It could enhance the feeding and growth of fish. Shade removal should not significantly affect streams on the east side due to their steep gradients and short, lowland reaches. The westside streams, however, have lower gradients and velocities with wide channels where they flow in the long, lowland reaches. Thus, the water in these streams is exposed to large amounts of solar radiation in the downstream reaches. Water temperature data from the U.S. Geological Survey shows that the lower reaches of west side streams occasionally have water temperatures above optimum levels, which makes these reaches poorer areas for anadromous fry rearing and migration. Partial upstream shade removal is not significant relative to the insolation that the streams are exposed to downstream. Vegetation is able to shade these wide channels only along the streambanks.

FERTILIZATION

In the past decade, urea fertilizer has been frequently applied to areas on the east side of the Forest. Water monitoring showed that urea, ammonia and nitrate levels were almost always less than 1 ppm (parts per million) after fertilizer application (Stephens 1976). Concentration levels above 1 ppm were recorded once after direct application of fertilizer into a buffered stream, and again after application onto snow which resulted in fertilizer being released to streams during snowmelt. Nitrate levels were well below 10 ppm, which is the U.S. Drinking Water Standard. If buffer strips (100 to 300 feet) are left along streams, nitrogen complexes can be kept from entering streams during application of fertilizer.

Climatic conditions are important in determining the total level of nitrogen losses to streams. If the fertilizer has several days to enter the soil zone before runoff occurs, the nitrogen losses will not be great. Nitrogen enters the soil zone and is immobilized by clay particles and organic material. If the fertilizer is applied under wet conditions, there are higher nitrogen losses to streams.

HERBICIDES

The risk of contaminating streams from herbicide application is a legitimate cause for concern. However, the hazard of herbicide use in the forest environment is low when tested procedures are followed. Entry of herbicides into streams can be held to a minimum by avoiding direct application into stream courses or during windy conditions.

Herbicides have not been used on the Olympic National Forest to control undesirable vegetation in clearcuts. Herbicides have been used to control roadside vegetation. Water samples were collected for chemical analysis from small streams adjacent to roadside spraying. No herbicides were found, even at lowest detection limits. EPA-registered chemicals have been used, and future uses will be in accordance with State and Federal regulations.

FIRE

Broadcast burning is a common practice used to prepare sites for planting and/or to reduce fire hazard. Fires result in increased erosion potential and release of soil nutrients. The effects of fire depend on the characteristics of the fire itself, as well as physiographic characteristics of the site, soil properties and climate. These all relate to vegetative recovery of the site after burning. If soil temperatures reach the point where litter and organic material in the surface layers are consumed, the stability of the soil is altered and erosion hazard is increased. Soil moisture content is the most important soil property that controls soil temperatures during a fire.

Fire may also affect changes in the nutrient content of soils. Volatile elements such as nitrogen, sulfur and phosporus are lost from soils when temperatures exceed the temperature of volatilization. Other nutrients may be lost by leaching and surface erosion. Nutrient losses from the site are important if they cannot be resupplied to meet requirements for optimum plant growth. Productivity can be so reduced that revegetation is slowed, with the site remaining susceptible to surface erosion for a longer period.

In general, levels of nutrients in streams have been low after burning of slash. The exception may be nitrate levels in small streams. When organic material is burned during a slash burn, nitrogen is released into the soil and atmosphere. The nitrate ion is the predominant form of nitrogen in the soil from this source. When the nitrate ion enters the soil it becomes attached to clay particles by ion exchange processes. However, during periods of high soil moisture, the nitrate ion is leached into the subsurface water zone. The ion can then enter a stream course when the subsurface water seeps into the stream channel. After slash burning along a small stream, there is usually a flush of nitrate during the initial fall storms. Streams on the Forest normally have nitrate concentrations less than 0.1 parts per million (ppm). A research study in Oregon showed a 30-fold increase in nitrate in a small stream following slash burning (Anderson, Hoover, and Reinhart, 1976). In a worst case situation, a normal small stream on the Olympic National Forest could have a nitrate concentration as high as 3.0 ppm after slash burning. This effect would be a short-term increase during the initial fall flush. This level is well below the U.S. Drinking Water Standard of 10 ppm. Fish can tolerate much higher levels. Nitrate that enters a small stream is rapidly decreased by biological activities in the stream. Concentrations are further reduced by dilution in downstream movement.

ROADS

Unvegetated logging road cut and fill slopes are the primary Forest sources of sediment into streams. Approximately 80 percent of increased sediment from Forest Service activities is attributed to roads (Reid 1981). The primary mechanisms by which sediment from roads reaches streams are mass movement and surface erosion. The construction of roads across steep slopes can increase initiation of slope failures, depending on such variables as soil type, slope steepness, presence of subsurface water, and road location.

Erosion from road surfaces also contributes sediment to streams. Up to 25 percent of fine sediments (less than two millimeters) in stream systems are derived from the road surface (Reid 1981). Vehicle traffic during wet weather greatly increases sediment from this source.

Sediment production from logging roads can be both substantial and prolonged. Permanently closing a road can significantly reduce sediment levels in future years (Megahan, Platts, and Kulesza 1980). Roads are being permanently closed on the Forest, particularly in the Shelton CSYU area.

The volume of timber harvested has a direct effect on the amount of sediment originating from forest roads. When more timber is harvested, there is an increase in new road construction and reconstruction, road maintenance and vehicle usage. All of these activities result in increased sedimentation in streams.

ENERGY AND WILD AND SCENIC RIVERS

Run-of-the-river hydroelectric projects result in less sediment transport in the section of channel between the diversion and the powerhouse, due to lower streamflow. Construction of access roads, diversion structures, and powerhouses can result in short- or long-term increases of sediment levels. Recommendation of a river for inclusion in the Wild and Scenic Rivers System will preclude hydropower development.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON WATER

Each of the alternatives has the potential to affect the quantity and quality of water on the Forest. Differences among the alternatives are strongly correlated to the intensity of timber harvest, road construction and usage, timing of activities, and slope stability within the Forest.

The total amount of additional water yield produced by timber harvest activities is not significant in large drainages. Changes to water yields and peak flows resulting from management activities should have insignificant effects on water resource values in major drainages on the Forest. The effect of changes between the alternatives should not be detectable.

Water temperatures of streams on the Forest are expected to remain within acceptable levels in all alternatives due to: (1) cool summer climate on the Olympic Peninsula, (2) steep gradient of most streams, (3) retaining vegetation along fish-bearing streams (see Forest Plan, Chapter IV: Management Prescription F2). Along some nonfish-bearing streams there will be removal of vegetation during timber harvest activities. The alternatives that have the greatest potential to increase water temperature will be those alternatives which have the highest timber harvest levels within riparian areas (see Figure IV-4).

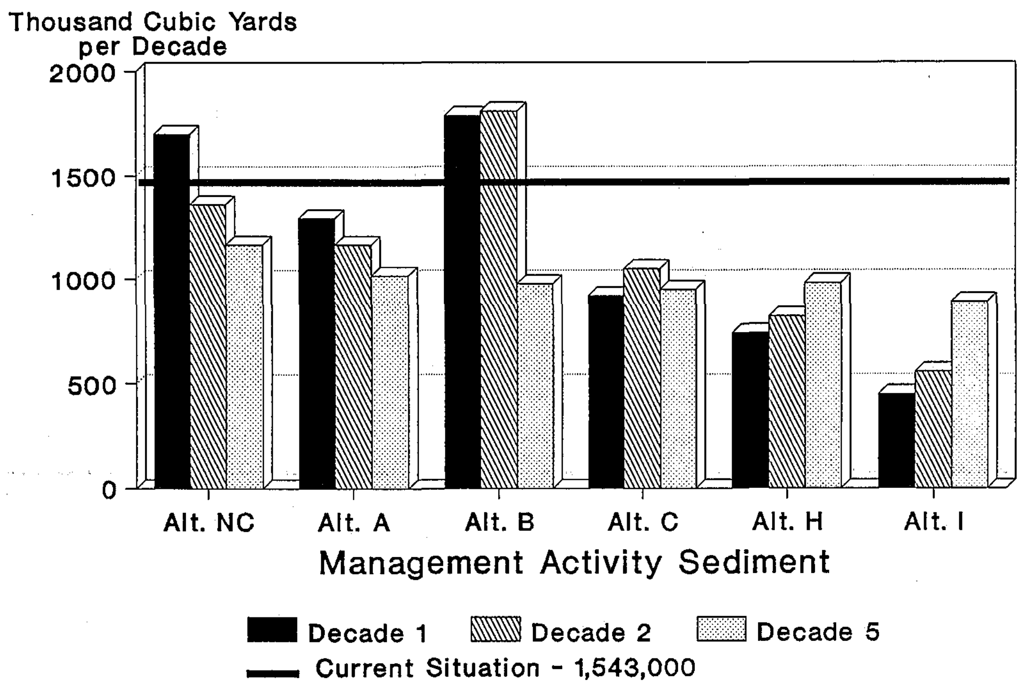
Ground disturbance from road usage (vehicle traffic), road maintenance, road construction and reconstruction, timber removal, log yarding, and burning increase sediment levels in streams. The intensity of these activities is largely dependent on the level of timber harvest activity. Thus, the alternatives with the highest timber volumes will have the highest sediment yield indices.

Permanent road closures can result in a substantial reduction of sediment levels within a decade. Seasonal and gated closures can also result in a reduction of fine sediments from the road surface. It was not feasible to include road closures in the sediment yield model. Thus, the sediment yield indices that were estimated will be high depending on the type and amount of road closures implemented in each alternative. See the section on "Road Access" in this Chapter for the miles of roads gated or closed for the alternatives.

The sediment model (Stephens 1984) described in Chapter III of this document was used to calculate sediment yield indices for all alternatives. The sediment yield indices are the total of both suspended and bedload sediment. It must be remembered that the purpose of the sediment indices is to show relative differences between alternatives and how these relate to natural and current sediment rates. *The sediment yield indices are not actual amounts that can be measured, but are indices for making relative comparisons between alternatives and risk assessment.* For project level applications, sediment values would need to be developed from existing data, monitoring, site-specific conditions, and project activities.

Figure IV-3 shows total sediment yield indices for the Forest in the first decade, second decade and average for the first five decades. The natural sediment yield index is 901,400 cubic yards per decade and is constant for all alternatives. To help give perspective to the indices, an average dump truck can carry approximately 10 cubic yards. The sediment yield index for the current situation (1988) is 2,444,000 cubic yards per decade and serves as a baseline for comparison of alternatives. (Table IV-6 was developed from the Forest-wide sediment yield indices and can be used to compare the alternatives as to their relative risks of affecting watershed values on the Forest.)

Figure IV-3. Forest-Wide Sediment Indices 1/



1/ Natural Sediment - 901,000 cubic yards per decade.
Thousands of cubic yards per decade. These indices are from Forest activities only and do not include background levels.

Table IV-6. Ranking of Alternatives for Relative Risk of Affecting Water Uses 1/

	Highest Risk to Lowest Risk					
Alternatives	B-Dep (Modified)	No Change	A-Current Direction	C-pref (Modified)	H (Modified)	I
Risk Index 2/	1.00	.85	.68	.55	.43	.28

1/ Based on Forest-wide sediment yield indices for decades 1 and 2.
2/ Sediment yield indices for each alternative divided by Alternative B- Departure (Modified).

Alternative NC-No Change

Implementation of this alternative for the first two decades would result in approximately 1 percent (13,052 cubic yards/decade) less sediment (see Figure IV-3) than the current situation (1988). Thus, the risk of a potential increase in sediment to beneficial water uses is negligible since there is a slight improvement in comparison to existing conditions. This alternative has the second highest relative risk that sediment levels will impact water uses (see Table IV-6).

Timber harvest activities in riparian areas (see Figure IV-4 in the Riparian Areas, Wetlands and Flood Plains section of this chapter) will increase approximately 15 percent for the first two decades in comparison to current situation (1988). As a result, more solar energy will reach stream courses and water temperatures in a few localized streams and could be increased above recommended levels for optimum fisheries use.

Alternative A-Current Direction (No Action)

Implementation of this alternative for the first two decades would result in approximately 20 percent (315,000 cubic yards/decade) less sediment than the current situation. The risk of a potential increase in sediment to beneficial water uses is negligible since there is significant improvement in comparison to existing conditions. This alternative has the third highest relative risk that sediment levels will impact water uses.

Timber harvest activities in riparian areas will decrease approximately 27 percent for the first two decades in comparison to current situation. Thus, water temperatures should be within recommended range for optimum fisheries use.

Alternative B-Departure (Modified)

Implementation of this alternative for the first two decades would result in approximately 17 percent (258,000 cubic yards/decade) more potential sediment than the current situation. There is moderate risk that increased sediment levels could effect water quality to the point that fisheries values would be periodically impacted. There would be a significant potential for water quality violations, particularly, in drainage where the erosion hazard is high. This alternative has the highest relative risk that sediment levels will impact water uses.

Timber harvest activities in riparian areas will increase approximately 30 percent for the first two decades in comparison to the current situation. As a result, more solar energy will reach stream courses and water temperature in some westside streams could be increased above recommended levels for optimum fisheries use.

Alternative C-Preferred (Modified)

Implementation of this alternative for the first two decades would result in approximately 36 percent (561,000 cubic yards/decade) less sediment than the current situation. Thus, the risk of a potential increase in sediment to beneficial water uses is negligible since there is significant improvement in comparison to existing conditions. This alternative has the third lowest relative risk that sediment levels will impact water uses.

Timber harvest activities in riparian areas will decrease approximately 47 percent for the first two decades in comparison to current situation. Thus, water temperatures should be within recommended range for optimum fisheries use.

Alternatives H (Modified) and I

Implementation of Alternatives H (Modified) or I for the first two decades would result in approximately 49 and 67 percent (763,000 or 1,041,000 cubic yards/decade) respectively, less sediment than the current situation. Thus, these alternatives have a negligible risk that a potential increase in sediment will impact beneficial water uses, since there is significant improvement in comparison to existing conditions. Alternatives H (Modified) and I have second and lowest relative risk that sediment levels will impact water uses.

Timber harvest activities in riparian areas for Alternatives H (Modified) or I will decrease approximately 66 and 91 percent, respectively, for the first two decades in comparison to current situation. As a result, water temperatures should approach levels that would exist under pristine conditions.

The effects of the varying sediment levels of the alternatives on fisheries habitat is presented in the "Fisheries" component section of this chapter.

CUMULATIVE EFFECTS OF ALTERNATIVES ON WATER

Water yield, runoff timing, and stream temperature increases are not expected to be noticeably changed in any alternatives. However, the cumulative effect of timber harvest activities on sediment in streams could be significant and is discussed below.

The analysis of cumulative effects takes into account past, present, and future impacts on National Forest and adjacent lands. Nineteen major drainages were used to assess cumulative effects of sediment. The evaluation took place at the mouths of each streams. National Forest land comprises 25 to 30 percent or more of all drainages. Aerial photographs taken in 1982 were used to estimate the amount of timber harvest that occurred in the previous decade on State and private lands within the 19 drainages. This data was then used to estimate sediment yield indices for off-Forest ownership using adjusted values from the sediment yield model for the Olympic National Forest.

For future decades, it was assumed that timber harvest levels on State and private lands would occur at the same level as in the past decade. In actuality, there probably will be more harvesting in off-Forest areas in future decades than shown in the 1982 aerial photographs, since most areas are young forests nearing harvest age. Therefore, sediment yield index estimates from off-Forest areas may be a bit conservative. The cumulative effect of sediment from timber harvest-related activities in the 19 drainages was estimated by adding sediment yield indices from National Forest, State, and private lands. Natural sediment yield indices for these drainages were estimated and totaled for all ownerships, including Olympic National Park. The topography and erosion potential in major drainages on the Olympic Peninsula are significant factors in determining cumulative effects of sediment in the streams. Most Olympic National Forest land is steep with high erosion potential, while off-Forest land is usually gentle with low erosion potential. In the 19 drainages that were analyzed for cumulative effects, the majority of sediment from timber harvest was usually from National Forest lands. Table IV-7 shows the percent increase above natural sediment yield indices for timber harvest generated sediment for on- and off-Forest lands for the first decade. *The sediment yield indices are not actual amounts that can be measured, but are indices for making relative comparisons between alternatives and risk assessment.* (Table IV-8 displays the risk of cumulative effects in the individual watersheds as produced by the alternatives on Forest land and other ownerships. This assessment was based on percent sediment yield indices that are shown in Table IV-7.)

Table IV-7. Increase in Sediment Levels in Major Watersheds 1/

	Alternatives					
Drainage Name	No Change 2/	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Calawah River	N/A	79%	113%	64%	48%	27%
Soleduck	N/A	33	62	45	41	36
East and West Twin River, Deep Creek	N/A	61	166	111	96	66
Dungeness River	N/A	15	23	22	20	17
Jimmy-Come-Lately Creek	N/A	44	74	124	44	50
Snow Creek	N/A	59	72	92	59	62
Little Quilcene River	N/A	53	69	80	68	53
Big Quilcene River	N/A	51	142	86	81	51
Dosewallips River	N/A	12	25	26	25	13
Duckabush River	N/A	10	36	13	14	15
Hamma Hamma River	N/A	27	57	47	43	32
Skokomish River	N/A	307	347	124	124	89
Main Fork Satsop River	N/A	146	159	111	102	99
West Fork Satsop River	N/A	150	148	116	106	104
Wynoochee River	N/A	147	156	67	49	43
Humptulips River	N/A	224	236	125	92	52
Salmon River	N/A	254	254	145	123	51
Matheny Creek	N/A	258	256	143	119	43
Sams River	N/A	226	226	123	103	35

1/ Values are percent increase of management-induced sediment over natural levels for the first decade at the mouth of each drainage.
2/ Analysis by major watersheds is not available.

Table IV-8. Cumulative Effects Risk Assessment 1/

	Alternatives					
Drainage Name	No Change 2/	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Calawah River	N/A	Slight	Slight	Slight	Unlikely	Unlikely
Soleduck	N/A	Unlikely	Slight	Unlikely	Unlikely	Unlikely
East and West Twin River, Deep Creek	N/A	Slight	Possible	Slight	Slight	Slight
Dungeness River	N/A	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Jimmy-Come-Lately Creek	N/A	Unlikely	Slight	Slight	Unlikely	Unlikely
Snow Creek	N/A	Slight	Slight	Slight	Slight	Slight
Little Quilcene River	N/A	Slight	Slight	Slight	Slight	Slight
Big Quilcene River	N/A	Slight	Slight	Slight	Slight	Slight
Dosewallips River	N/A	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Duckabush River	N/A	Unlikely	Unlikely	Unlikely	Unlikely	Unlikely
Hamma Hamma River	N/A	Unlikely	Slight	Unlikely	Slight	Unlikely
Skokomish River	N/A	Possible	Possible	Slight	Slight	Slight
Main Fork Satsop River	N/A	Slight	Possible	Slight	Slight	Slight
West Fork Satsop River	N/A	Slight	Slight	Slight	Unlikely	Slight
Wynoochee River	N/A	Slight	Possible	Slight	Slight	Unlikely
Humptulips River	N/A	Possible	Possible	Slight	Slight	Slight
Salmon River	N/A	Possible	Possible	Slight	Slight	Slight
Matheny Creek	N/A	Possible	Possible	Slight	Slight	Unlikely
Sams River	N/A	Possible	Possible	Slight	Slight	Unlikely

1/ Risk Assessment:
Unlikely = Potential of significant cumulative effects unlikely. The beneficial uses of water are expected to be maintained or improved. Water quality standards are expected to be met. Increase in sediment over natural = 0% - 50%.
Slight = Potential of sigificant cumulative effects slight. The predicted change in sediment or turbidity results in increased risk to beneficial uses without significant impacts. There is a slight risk of exceeding water quality standards on a short-term, localized basis. Increase in sediment over natural = 51% - 100%.
Possible = Potential of significant cumulative effects possible. The predicted change in sediment on turbidity has potential for impacts to beneficial uses. Water quality standards for an identified use may be exceeded. Increase in sediment over natural = > 151%.

2/ Analysis by major watersheds is not available. Alternative NC is expected to produce effects between Alternatives A-Current Direction and B-Departure (Modified).

It is anticipated that the long-term cumulative sediment indices of Alternative NC (no analysis by watershed available) will fall between Alternatives A and B-Departure (Modified), with first decade levels probably close to Alternative B-Departure (Modified).

The highest risk of significant cumulative effects occur in Alternatives NC, A-Current Direction, and B-Departure (Modified), and these would have the greatest potential impact on the Peninsula's western and southern drainages. Alternative C-Preferred (Modified), H (Modified), and I should have the lowest risk.

The risk of cumulative effects could be significant in southern drainages for those alternatives with high timber harvest levels. In the Wynoochee, Satsop, and Skokomish River drainages, the risk of cumulative effects are in the Slight or Possible category for Alternatives A-Current Direction and B-Departure (Modified). These drainages are in the Slight or Unlikely category for Alternatives C-Preferred (Modified), H (Modified), and I. Since Alternative NC includes the highest harvest level of all alternatives from this area (Shelton CSYU), it is likely that risk of cumulative effects in this area would be higher for this alternative than for any of the others.

In most westside drainages of the Peninsula, timber harvest activities are occurring throughout the basins on National Forest, State, and private lands. Cumulative effects risks are relatively high and can be significant in some drainages. For example, in Matheny Creek and the Calawah, Salmon, Sams, and Humptulips Rivers, the cumulative effects risk is Possible for Alternatives NC, A-Current Direction, and B-Departure (Modified). These drainages are in the Slight or Unlikely categories for Alternatives C-Preferred (Modified), H (Modified), and I.

Most streams on the east side of the Peninsula should not have significant cumulative sediment effects in any of the alternatives. A portion of the land in these drainages is in Wildernesses and Olympic National Park. For example, the Dosewallips, Duckabush, Hamma Hamma, and Dungeness Rivers have cumulative effects risk assessment ratings of Unlikely in all alternatives except the Hamma Hamma River which has a rating of Possible in Alternative B-Departure (Modified) (see Table IV-8).

Table IV-9. Cumulative Effects Summary

Risk Category 1/	No Change 2/	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Possible	N/A	5	8	--	--	--
Slight	N/A	8	8	14	12	9
Unlikely	N/A	6	3	5	7	10

1/ Values presented are the numbers of watersheds in each category in the first decade.
2/ Data is not available. Alternative NC is expected to produce effects between Alternatives A-Current Direction and B-Departure (Modified).

Table IV-9 summarizes by alternatives the information presented in Table IV-8. Alternatives NC, A-Current Direction, and B-Departure (Modified) have the greatest risk of significant cumulative effects to water resources since they have approximately one-quarter to one-half of the watersheds in the Possible risk category. Alternatives C-Preferred (Modified), H (Modified), and I have the least risk with all watersheds in the Slight or Unlikely category. Alternatives H (Modified) and I are very similar with about one-half of the watersheds in the Unlikely category, while Alternative C-Preferred (Modified) has approximately one-quarter of the watersheds in the Unlikely category.

MITIGATION MEASURES AND EFFECTIVENESS

Mitigation measures are used to prevent or restore direct, indirect and cumulative effects previously discussed. An agreement (Memorandum of Understanding) between the Forest Service and Washington State Department of Ecology establishes the use of Best Management Practices (BMPs) by National Forests as the means to control nonpoint sources of pollution from silvicultural activities. The agreement is authorized under the Federal Clean Water Act (Public Law 92-500 as amended). BMPs (see Appendix J) will be implemented on National Forest lands to comply with State requirements for protection of waters in Washington State.

Standards and Guidelines contained in the Forest Plan (Chapter IV) have been designed to minimize impacts to water resources and provide protection to beneficial uses of water. Examples of applicable Standards and Guidelines are: maintaining soil cover, avoiding or restricting activities in areas of potential mass instability, maintaining riparian vegetation, and minimizing disturbances along stream channels. Road closures and revegetation of road cut and fill slopes have been effective in preventing sediment from entering stream courses. Many roads on the Forest are seasonally closed during part of the fall and winter months. Road closures can greatly reduce the amount of fine sediment (less than two millimeters) which originates from road surfaces due to vehicle use. Up to 25 percent of fine sediment in a stream system can come from road surfaces. Also, good vegetation cover along roads can reduce sediment rates by 15 to 20 percent.

Activity reviews are used to assess effectiveness of Standards and Guidelines and BMPs that are used to mitigate effects on water values of management activities. For example, road construction techniques such as narrower width and steep grades have greatly reduced soil disturbance and length of a road. These factors result in significantly less sediment after road construction.

RELATIONSHIPS TO PLANS OF OTHERS

Water resource conflicts with plans of others (see Chapter III, "Water" section, subpart "Plans of Others") are not anticipated provided that Standards and Guidelines and Best Management Practices (BMPs) are implemented and effective during and following management activities. Standards and Guidelines and BMPs in the Forest Plan are generally more restrictive than requirements in the Washington Forest Practices Rules and Regulations. Water quality standards for waters in Washington State should be met through the application of Best Management Practices.

SOILS

OVERVIEW

In the short-term, soil is essentially a nonrenewable resource that can be affected by accelerated slope stability. Timber harvest, road construction, and other management activities that disturb the soil will increase soil erosion and mass movement. Timber harvest and road construction occur in all alternatives, so accelerated erosion will occur. Soil losses will eventually end up as delivered sediment in streams on the Forest. Soil loss can affect water quality, fisheries, and timber production.

SIGNIFICANT INTERACTIONS

WATER

Precipitation and runoff of water affects the surface erosion rate of soils. Water has a force, either from direct raindrop impact or the force of running water, which can dislodge and move individual soil particles. This can result in sheet erosion or rill erosion, but rarely will it develop to the gully erosion stage.

Soils are porous, and store water internally. Plants utilize this water for their metabolic (life requirements) needs. During winters in this area, soils become charged with water and release it slowly to stream courses. During storm events, however, soils may become overcharged and the excess weight can trigger mass movement of soil. This soil erosion mechanism represents the most significant soil degradation process on the Forest.

VEGETATION MANAGEMENT PRACTICES

Regeneration Harvest: The regeneration harvest of timber via clearcut impacts the soils in several ways. Overstory trees dominate the rooting network within the soil. When these trees are harvested, the tree roots die soon thereafter, followed by root decay. The soil cohesion given by tree roots may be a critical factor in maintaining soil stability in sensitive soil areas (US EPA 1980). A critical consideration is whether timber can be harvested without initiating mass movements.

Harvesting operations also affect the nutrient capital of the site and compact the soil. These will be discussed in sections titled "Total Biomass Removal" and "Logging Systems."

Commercial Thinning: Cable thinning operations create a lesser impact to the soils resource, but costs are high, and damage to residual (remaining) trees may be appreciable. Tractor thinning has more favorable economics, but soils are compacted to a much greater extent. In many cases, the increased yields predicted from post-thinning residual trees are wiped out by growth loss resulting from soil compaction. An important point to remember is that tillage of tractor skid trails is impractical before final harvest. The ripping of tree roots within skid trails would impact the timber yield.

Logging Systems: Logging operations affect soils in two general ways: (1) they alter the physical condition of the soil, and (2) they displace the soil and promote soil erosion. In addition, there is a strong interrelationship between logging systems selection and the transportation system, which will be discussed under "Roads Access."

All logging systems create some soil compaction. The falling operation itself compacts soils. The pertinent considerations are area and degree of compaction (light, moderate, or heavy). The degree and extent of compaction from cable systems has been within acceptable levels. However, tractor logging operations, either track or rubber tire, result in an increase in the extent of soil compaction. "Loggers' choice" skid roads have resulted, in the past, in areas of compaction in the range between 20 percent and 40 percent (Froehlich 1977). Recent efforts with designated skid trails have lowered the low extreme to 10 percent or even less. Practice indicates that 15 percent is a more representative and realistic figure.

How much growth loss is created by compaction? In a practical sense, this cannot be quantified without a monumental research effort. Simple mathematical expressions, however, have been used to estimate timber yield reduction (Adams and Frachlich 1981). The results seem realistic: high lead cable--3 percent reduction, tractor with designated skid trails--8 percent, and tractor with uncontrolled skidding and heavy compaction--32 percent (Jennings 1984).

The interaction of soil texture with the potential for soil compaction can be discussed in terms of general rules. All soil textures can be compacted. Sands and loamy sands recover quickly following compaction. Sandy loams and loams persist in their compaction, but respond well to soil tillage operations. Silt loams, clay loams, clays, and silts persist in compaction for decades and probably centuries. These soils also have many associated problems, such as poor response to tillage, puddling and increased surface erosion.

Logging systems may also be directly or indirectly responsible for soil displacement and erosion. Displacement results when soils are moved a short distance and redeposited. This problem occurs mostly on steep tractor units, or at points of inadequate deflection in cable units.

Sites that are disturbed often become erosional source areas. Compacted tractor skid trails have a much reduced water infiltration rate. Surface overflow occurs which fosters sheet and rill erosion. This typically occurs on trails with slopes greater than 15 percent. Cable yarding on steeper slopes can also promote both surface and mass erosion. Once initiated, erosional sites tend to expand. The key to stabilization is to implement erosion control measures as soon as possible after disturbance.

Broadcast Burning: The broadcast burning of leftover logging slash affects the nutrient capital at the site and at times promotes soil erosion. This interrelationship is extremely complex. It is necessary to limit this discussion to the most important points.

Plants require many nutrients, but the principal element of consideration is nitrogen. In a forest ecosystem, nitrogen is concentrated in foliage, the forest floor, and the mineral surface soil. When logging slash is burned, nitrogen tied up in complex organic solids is converted to gaseous nitrogen, or more simple inorganic and organic compounds (which typically are soluble). At low burning temperatures, significant percentages of soluble nitrogen are returned to the soil. At higher temperatures, the vast majority is lost as gaseous nitrogen (Dunn and Debano 1977). The nitrogen that is available for plant uptake is located principally within the surface mineral soil. Fire that burns into the surface soil layer may significantly impact the available nitrogen on the site. On the other hand, a light burning of tree needles and the upper forest floor will generally have an insignificant or favorable short-term effect on soils. Over several rotations, the long-term effect of burning is to lower soil productivity.

Areas that are broadcast burned may also suffer from surface soil erosion (USDA FS 1979). Burns that remove the forest floor and enter the surface soil have: (1) exposed the surface soil to direct water impact, and (2) altered the cohesive effect upon soil particles created by organic compounds.

Piling and Burning: Tractor piling and burning of logging slash can result in some severe impacts to the soils resource. In the piling stage, the tractor covers the entire area harvested. Slash piles or windrows are then burned. The end result is a hot burn and severe impact to the nutrient capital at the burn sites, with soil compaction between piles.

Total Biomass Removal: Total biomass removal of trees has minimal effects on the soils resource. The nutrient capital of the site is the primary consideration. It is important to realize that the available nutrient capital for the next rotation of trees is within the soil and not the trees removed. The total biomass removal of commercial trees at a site has no short-term negative effects. The long-term effect of total tree removal would be a nutrient capital drain on the site. This drain will take several rotations to detect, and would proceed at a very slow rate. Monitoring of the nutrient status of a site should be done to ascertain when a corrective fertilization application is needed.

Fertilization: Fertilization, as a practice, should enhance the productivity of a site. As a general rule, nitrogen is the limiting nutrient to plant growth. Other anions (negatively charged chemical nutrients), most particularly phosphorus and sulphur, may be deficient in local areas. There is some data to suggest that some micronutrients (boron, iron, and copper, in particular) may be limiting under certain circumstances. The major cations (positively charged chemical nutrients), potassium, calcium, and magnesium, are consistently in adequate supply for coniferous tree growth.

RECREATION

Use of recreational vehicles can accelerate soil erosion if it is not restricted to designed roads and trails. Soils may be displaced and vegetation destroyed. These impacts will adversely effect the productive potential of the site for both its vegetative and recreational values.

ROADS

Road construction is one of the major activities affecting soils. In locations where road cuts are made, the pattern of internal and surface water movement is changed. Soil and bedrock materials have been moved, removing support from soils from cut slopes and putting overburden on fill slopes. Following road construction, a new slope stability regime must be established. The road drainage system may periodically fail. The result can be increased mass movement and surface erosion.

On slopes of less than 35 percent, increases in soil erosion are generally not significant and, if significant increases in erosion are likely, mitigation measures are typically highly successful. On slopes above 65 percent, the bedrock and soil materials the road passes through are very important considerations in location and design of the facility.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON SOILS

WATER QUALITY - SEDIMENT

Soil erosion and stream sedimentation are strongly interrelated. Stream sedimentation is basically eroded soil that has been delivered to a stream course. The sediment yield model used to describe likely consequences to the water resource is essentially a soil erosion model that delivers the eroded soils to stream courses. Within 200 feet of a stream, the model assumes that approximately 90 percent of eroded soil is delivered to the steam, while upslope, approximately 60 percent is delivered. Based on the sediment yield model for the Olympic National Forest, approximately 70 percent of soil loss is delivered to stream courses. The sediment yield indices that were estimated can be used to judge the magnitude of soil loss for the alternatives. The indices are not absolute values and should not be used in such a context. Table IV-10 shows the sediment yield indices for each alternative. The sediment yield index for the current situation (1988) is 244,400 cubic yards per year and can be used to compare alternatives. The effect of soil loss and consequent sediment yield increase can result in: a loss of site productivity (lower timber volume yields) and lower water quality in streams which can impact fish habitat and municipal or domestic water supplies.

Table IV-10. Sediment Yield Indices 1/

		Alternatives					
	Current Situation	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
1st Decade	244	260	219	269	182	164	135
2nd Decade		226	206	271	195	172	146
5 Decade Ave.		223	206	231	196	180	157

1/ Thousands of cubic yards per year.

Timber harvesting and broadcast burning can result in long-term nutrient capital loss in Forest soils and reduce timber productivity in the long-term. In general, alternatives which result in more acres logged and burned will have higher risks of available nitrogen loss. Also, alternatives with high timber harvest levels have a greater chance of causing soil erosion or having management activities occur on sensitive soils. Table IV-11 shows acres expected to be harvested and burned for each alternative. For the current situation, approximately 5,155 acres per year are harvested and burned.

Table IV-11. Timber Harvest Activities Affecting Soil 1/

		Alternatives					
	Current Situation	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
1st Decade	5.2	6.3	4.1	6.6	2.4	1.6	.2
2nd Decade		4.6	3.5	6.8	3.0	2.0	.8
5 Decade Ave.		4.1	2.6	2.3	2.4	2.5	2.1

1/ Area clearcut and broadcast burned (thousands of acres per year).

Those alternatives with the most road construction and reconstruction will have the highest risk of causing soil erosion. Table IV-12 shows the miles of road construction. The amount of road construction/reconstruction and timber harvest are interrelated since higher timber harvest levels result in more road construction.

Table IV-12. Road Construction Affecting Soil

Alternatives	No Change	A-Current Direction	B-Dep (Modified)	C-pref (Modified)	H (Modified)	I
Road Construction (miles)						
1st Decade	183	176	283	141	92	20
5 Decade Ave.	112	92	128	83	54	20

Alternative NC-No Change

Implementing Alternative NC would result in approximately a 7 percent increase for the first decade and a 7 percent decrease for the second decade in sediment yield indices in comparison to the current situation. Thus, potential erosion and mass wasting processes should remain relatively unchanged over the two decade period. Timber harvest and broadcast burn acres would increase about 21 percent for the first decade and decrease about 11 percent for the second decade. The potential to affect soil productivity should increase slightly due to higher overall timber harvest levels. Approximately 183 miles of roads will be constructed in the first decade which gives it the second highest level and risk of increased soil loss from roads of any of the alternatives.

Alternative A-Current Direction (No Action)

Implementation of this alternative would result in approximately a 10 percent (first decade) and 16 percent (second decade) decrease in sediment yield indices in comparison to the current situation. There should be a significant reduction in soil loss from erosion and mass wasting processes. Timber harvest and broadcast burn acres should decrease approximately 21 percent (first decade) and 33 percent (second decade). Thus, there should be a significant reduction in potential to affect soil productivity due to lower timber harvest levels. Approximately 176 miles of roads will be constructed in the first decade which gives it the third highest risk of increased soil loss from roads of any of the alternatives.

Alternative B-Departure (Modified)

Management activities would have the highest risk of impacts on soil resources with this alternative. Alternative B would result in approximately a 12 percent (first decade) and 11 percent (second decade) increase in sediment yield indices in comparison to the current situation. Thus, potential erosion and mass wasting processes should be significantly increased. Timber harvest and broadcast burn acres would increase approximately 27 percent (first decade) and 31 percent (second decade). The potential to affect soil productivity should be significantly increased due to the higher timber harvest levels. Approximately 283 miles of road will be constructed in the first decade which gives it the highest risk of increased soil loss from roads of any of the alternatives.

Alternative C-Preferred (Modified)

Implementation of this alternative would result in approximately a 25 percent (first decade) and 20 percent (second decade) decrease in sediment yield indices in comparison to the current situation. There should be a significant reduction in soil loss from erosion and mass wasting processes. Timber harvest and broadcast burn acres should decrease approximately 54 percent (first decade) and 42 percent (second decade). Thus, there should be a significant reduction in potential to affect soil productivity. Approximately 141 miles of roads will be constructed in the first decade which gives it the third lowest risk of increased soil loss from roads of any of the alternatives.

Alternative H (Modified)

Implementation of this alternative would result in approximately a 33 percent (first decade) and 45 percent (second decade) decrease in sediment yield indices in comparison to the current situation. These reduced sediment levels indicate that there should be a significant reduction in soil loss from erosion and mass wasting processes. Timber harvest and broadcast burn acres should decrease approximately 70 percent (first decade) and 62 percent (second decade). There should be a very significant reduction in possible soil losses. Approximately 92 miles of roads will be constructed in the first decade which gives it the second lowest risk of increased soil loss from roads of any of the alternatives.

Alternative I

Management activities would have the lowest risk of impacts on soil resources with this alternative. This would result in approximately a 45 percent (first decade) and 40 percent (second decade) decrease in sediment yield indices in comparison to the current situation. Thus, there should be a very significant reduction in soil loss from erosion and mass wasting processes. Timber harvesting and broadcast burn acres should decrease approximately 96 percent (first decade) and 85 percent (second decade). There should be a very significant reduction in potential to effect soil productivity. Approximately 20 miles of roads will be constructed in the first decade which gives it the lowest risk of increased soil loss from roads of any of the alternatives.

CUMULATIVE EFFECTS OF ALTERNATIVES ON SOILS

Interaction of land management activities with soil resources contribute to soil and nutrient loss which may result in cumulative impacts to site productivity. Maintaining long-term soil productivity is an important part of sustained timber yield management. At present, the methodologies are not available to assess changes to long-term soil productivity. The survival and growth of tree seedlings give an indication of changes in site productivity. Any changes may not be evident until an area has been impacted several times by vegetation removal and slash disposal activities. The alternatives with the highest timber harvest and slash disposal levels would have the greatest potential to have a loss of long-term soil productivity.

Table IV-13 assesses the risk of long-term soil productivity loss based upon the amount of timber harvest and road construction during the first 5 decades. Alternatives B-Departure (Modified) and NC are similar and have the highest risk of causing long-term soil productivity loss. Alternatives A and C-Preferred have values about in the middle of the risk indexes. Alternatives H (Modified) and I have risk indices at the lower end of the range.

Table IV-13. Ranking of Alternatives for Relative Risk of Affecting Long-Term Soil Productivity

Alternatives	B-Dep (Modified)	No Change	A-Current Direction	C-Pref (Modified)	H (Modified)	I
Risk Index 1/	1.00	.97	.73	.65	.45	.22

1/ This index is a weighted average of acres clearcut and miles of road construction in the first 5 decades in comparison to the alternative with the highest values (Alternative B-Departure (Modified)). Values in Tables IV-11 and IV-12 were used to generate these indicies.

MITIGATION MEASURES AND EFFECTIVENESS

In most situations, preventing soil impacts is the most effective and feasible way of ensuring long-term soil productivity and decreasing soil loss. Determining the suitability of specific soils for timber harvest activities is important in preventing soil impacts. Timber harvest activities are not scheduled on land where there is potential for irreversible soil damage and/or the ability to ensure regeneration of forested stands within five years. Approximately 280,215 acres are currently classified as unsuitable for timber production (USDA FS February 1990).

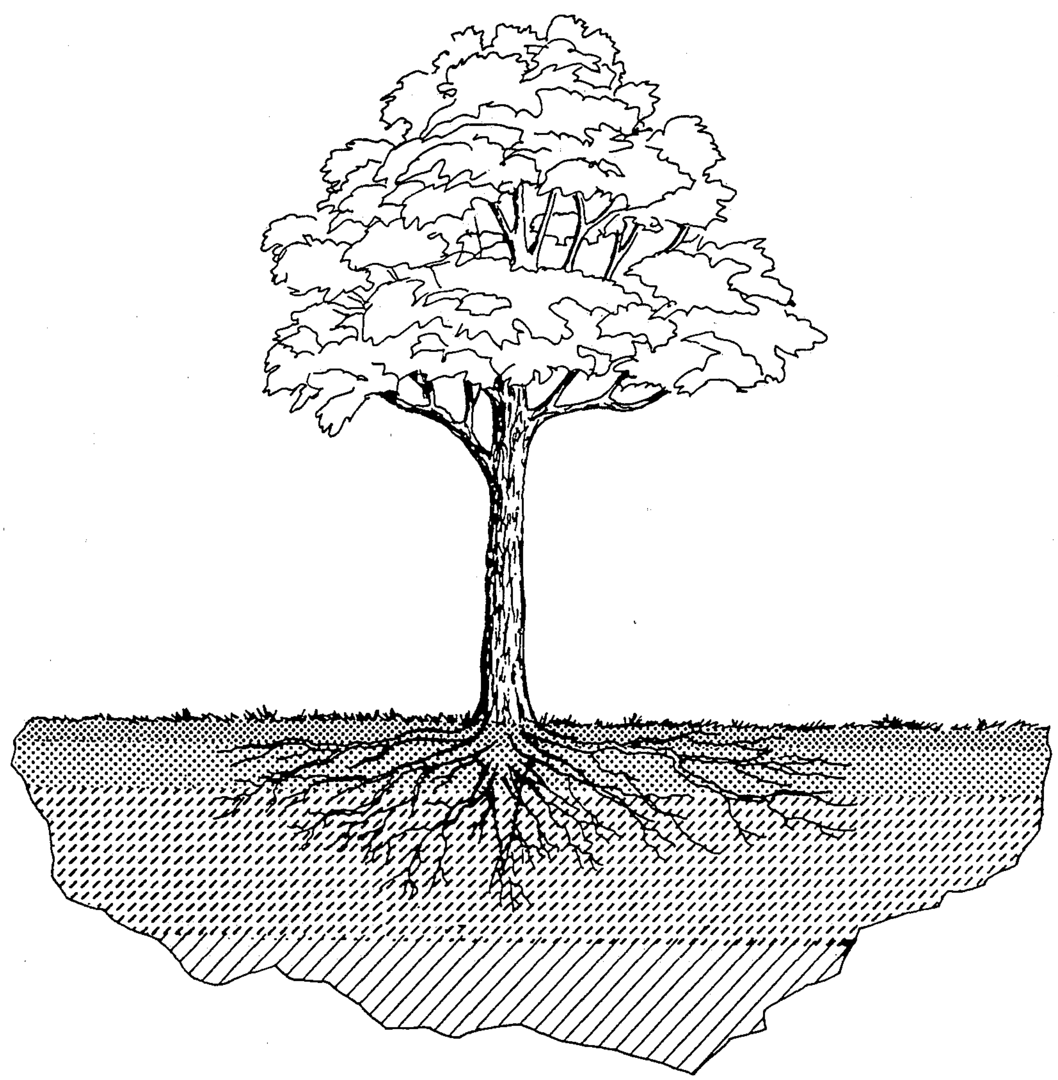
Standards and Guidelines (Forest Plan, Chapter IV), Best Management Practices (FEIS, Appendix J), mitigation activities applicable to all alternatives (FEIS, Chapter II), and soil and water projects (Forest Plan, Appendix A) are designed or have the goal of minimizing impacts to soil resources. For example, on steep slopes with sensitive soils, skyline yarding systems would be used to reduce surface soil disturbances. Loss of soil nutrients would be mitigated largely by restricting the degree of slash burning after timber harvest activities. Burning in the spring rather than the summer or fall would be emphasized. Spring burns are preferred because surface soils are moist and the effect of the burn is reduced as compared to summer or early fall burns. Also, see "Mitigation Measures and Effectiveness" of water section in this chapter for more details.

Permanent road closures can be thought of as a type of mitigation to reduce soil erosion. Up to a 90 to 95 percent decrease in soil loss from roads is possible within 10 years of road closures. When roads are closed, grass seeding of roadbeds helps reduce sedimentation of streams and accelerates stabilization of the road surface. Such seeding, in combination with the elimination of traffic (especially during wet weather), constitutes one of the most successful mitigation measures available for reducing sedimentation.

The primary factors influencing the effectiveness of an erosion control program are time and funding. Timing erosion control projects is an important factor in effectiveness of these projects. The most successful erosion control efforts are undertaken as soon as practical after the initiation of soil degradation. Grass seeding has a "window of time" in the spring and fall during which grass establishment can be successful. Management activities that are likely to initiate soil degradation may also need proper timing to coordinate with erosion control requirements.

RELATIONSHIPS TO PLANS OF OTHERS

There should not be conflicts between the effects of the alternatives on soil and the plans or policies of other State, Federal, or local agencies. Standards and Guidelines (see Plan, Chapter IV) and Best Management Practices (see FEIS, Appendix J) are generally more restrictive than required by the Washington Forest Practices Rules and Regulations. Since soil and water are interrelated, see Relationships to Plans of Others in Water section of this chapter for more information.



RIPARIAN AREAS, WETLANDS, AND FLOOD PLAINS

OVERVIEW

The vegetative condition of riparian areas can affect the beneficial uses of these areas. Along Class I and Class II streams there is a need for a supply of large woody material to maintain fish spawning and rearing habitat. In some streams, up to 50 percent of the pools are enhanced or created by large woody material.

Vegetation is important for maintaining water quality in many riparian areas because of its role in minimizing soil instability in streamside zones. Large woody material that enters a stream frequently traps sediment and slows its movement through a stream system.

Vegetative diversity in riparian areas provides habitat for many wildlife species. In the overall forest setting, riparian areas receive disproportionately higher wildlife use compared to other areas.

The amount and location of activities related to timber harvest activities are the two most important factors that can affect riparian areas, wetlands, and flood plains. Those alternatives with high timber harvest levels will generally affect these areas more than those alternatives with low levels.

SIGNIFICANT INTERACTIONS

VEGETATION - TIMBER HARVEST

The vegetative condition of riparian areas is the key factor which determines the effects of activities on riparian areas (U.S. Department of Agriculture 1985). Retaining a vegetative leave strip in riparian areas can reduce impacts on streams from upslope land-use activities and can maintain the vegetative diversity of the riparian area. Some vegetative leave strips are prone to blowdown if the adjacent slope has been recently clearcut. Selective cutting within a riparian area can provide vegetative diversity and trees for future recruitment of large, organic debris. Clearcutting provides little or none of these values for the short term.

Removal of vegetation results in loss of root strength within the soil. This can greatly increase soil instability and trigger debris avalanches, especially in small headwater streams.

Vegetative residue remaining after timber harvest can be both favorable and unfavorable to riparian values. If natural logs are scarce, leaving some downed material will be beneficial, as it adds diversity. Where residue may add significantly to the total amount and location of debris, it can be detrimental. The risk of subsequent large debris dams, avalanches or torrents may be increased.

The type of yarding system used in timber harvest can have a significant impact on riparian areas. Use of full cable suspension or helicopter yarding systems results in tree removal with almost no disturbance to soil or retained vegetation. Yarding with high-lead systems can result in significant soil disturbance, and cables that rub on trees can cause extensive damage.

Uphill falling of trees in riparian areas reduces breakage and keeps felled trees (and the associated fine organic debris) out of streams. Natural amounts of small organic debris are essential to the aquatic food chain, but excessive accumulations may deplete oxygen levels. Large organic debris in small stream channels helps expend water energy and retards sediment movement.

ROADS

Road construction can have a significant and lasting impact on riparian areas. Roads which are improperly located, constructed or maintained may initiate slope failure, which can trigger debris torrents through riparian areas. If bridges and culverts are not properly designed and sized, channel erosion and debris accumulations can lead to their failure. This results in damage to downstream riparian areas. Roads located adjacent to streams may greatly alter riparian areas by removal of vegetation during construction.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON RIPARIAN AREAS, WETLANDS, AND FLOOD PLAINS

Alternatives that represent high timber harvest levels within riparian areas could have the following effects: (1) increased soil instability in riparian areas that can cause higher sediment levels, (2) less large woody material in streams in future years, which can result in lower quality of fish habitat, and (3) less vegetative diversity, which can reduce type and abundance of animal species utilizing this habitat. Figure IV-4 shows total acres harvested on-Forest in riparian areas in the first and second decades and the average for the first five decades. Timber harvest for the current situation (1988) is 13,130 acres/decade and serves as a baseline for comparison of alternatives. Table IV-14 shows the relative risk of alternatives affecting riparian area values.

Most of the timber harvest in the alternatives will occur along Class III and IV streams. Many unstable areas along these streams have been withdrawn from timber harvest activities through the suitability determination process. There will be little timber harvest along Class I and II streams.

Table IV-14. Ranking of Alternatives for Relative Risk of Affecting Riparian Areas.

Alternatives	B-Dep (Modified)	No Change	A-Current Direction	C-Pref (Modified)	H (Modified)	I
Risk Index 1/	1.00	.89	.57	.41	.27	.07

1/ The average harvest in riparian areas for each alternative is divided by value for Alternative B-Departure (Modified) which has the highest levels.

Alternatives NC-No Change and B-Departure (Modified)

Alternatives NC and B-Departure (Modified) have approximately 23 and 27 percent more acres harvested in riparian areas for the first decade in comparison to the current situation. Alternative B-Departure (Modified) has the highest timber harvest levels within riparian areas of any alternative and will have the greatest risk of affecting fish and wildlife habitat or stream channel stability and water quality values. It is followed closely by Alternative NC. In later decades, Alternative NC falls somewhere between Alternative A and B-Departure (Modified). Riparian Management Requirements apply in all alternatives except Alternative NC. Lack of a riparian Management Requirement in Alternative NC may increase effects on riparian areas of this alternative.

Alternative A-Current Direction

Implementation of this alternative would result in approximately 21 percent fewer acres harvested in riparian areas for the first decade compared to the current situation. Alternative A has the third highest risk that timber harvest activities could affect resource values associated with riparian areas.

Alternatives C-Preferred (Modified) and H (Modified)

Alternatives C-Preferred (Modified) and H (Modified) show approximately 53 and 63 percent fewer acres harvested in riparian areas for the first decade compared to the current situation. In future decades, harvest acreage in riparian areas is approximately 50 percent or more below the current situation for these alternatives. Alternative H (Modified) has less acreage harvested within riparian areas as a result of the lower overall harvest level of this alternative and the retention of all old-growth in big game winter range. Alternatives C-Preferred (Modified) and H (Modified) have risk indices near the middle of the range and should result in significant improvement to resource values associated with riparian areas when compared to the current situation.

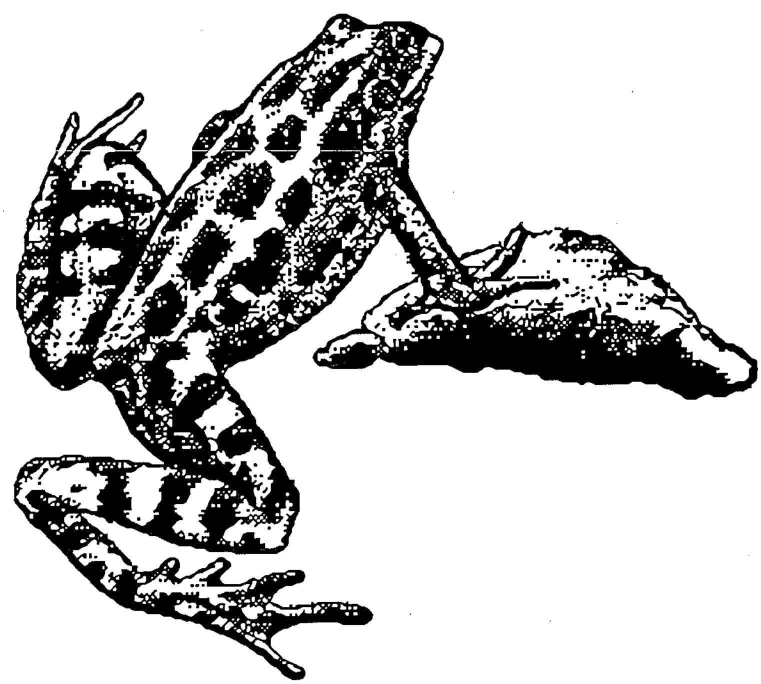
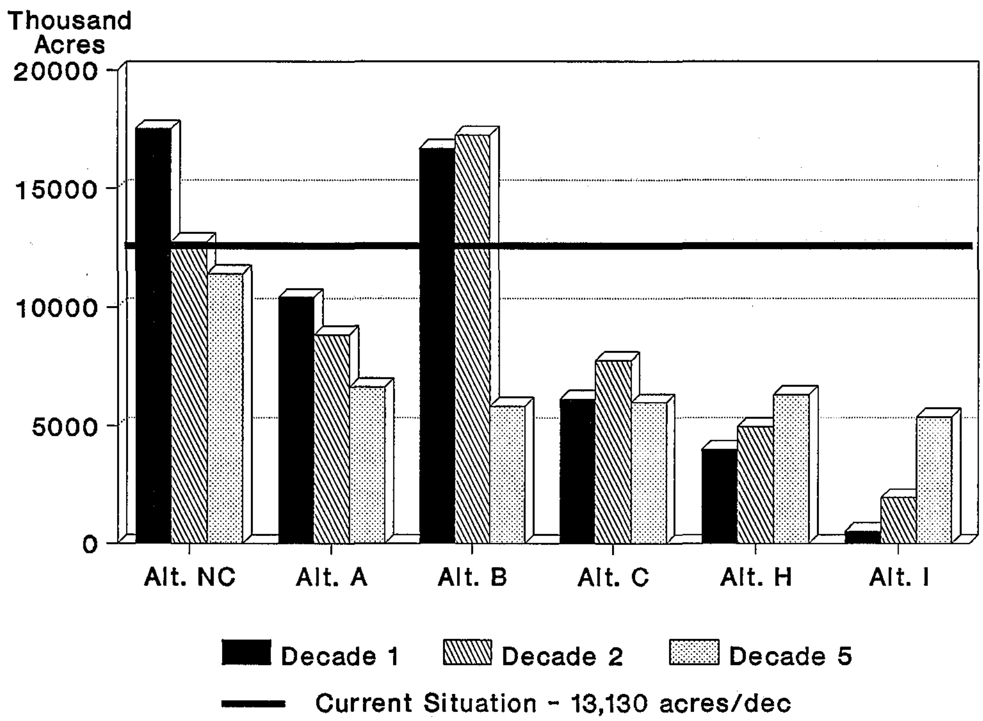


Figure IV-4. Acres Harvested in Riparian Areas



Alternative I

Alternative I represents approximately 95 percent fewer acres harvested in riparian areas in the first decade compared to the current situation. Riparian area harvest is low in this alternative due to the retention of all existing old-growth Forest-wide. Alternative I has the lowest risk that timber harvest activities will affect fish and wildlife habitat or stream channel stability and water quality values associated with riparian areas.

Flood Plains and Wetlands

Implementation of any alternative should have little effect on flood plain and wetland areas on the Forest. The Standards and Guidelines (see Plan, Chapter IV, "Management Prescription: Riparian Areas") and Executive Orders 11988 and 11990 state that management activities within or adjacent to flood plains and wetlands should be avoided. If management activities were to occur within a flood plain or wetland, the impacts to the resource values within the area would need to be insignificant or mitigated. This process should be documented by an analysis in an Environmental Assessment.

The effects of management activities in riparian areas, flood plains, and wetlands on fish and wildlife are incorporated into the environmental consequences of the alternatives. This is discussed in the "Wildlife" and "Fisheries" sections of this chapter.

CUMULATIVE EFFECTS OF ALTERNATIVES ON RIPARIAN AREAS, WETLANDS, AND FLOOD PLAINS

Information is not available for present and future conditions of riparian areas which are on private or State lands adjacent to the Forest. Therefore, cumulative effects on riparian areas will only be discussed for lands within the Olympic National Forest.

Figure IV-4 displays acres of timber harvested by alternatives. The average acres harvested for the first two decades will be used for the analysis. There are approximately 177,050 acres of riparian area within the National Forest. For modeling purposes, riparian areas were 200 feet wide on each side of Class I through IV streams. Site-specific widths may vary from that distance.

The alternatives with the highest timber harvest levels within riparian areas will have the greatest potential to adversely affect fish and wildlife habitat or water quality values associated with these areas. Alternatives NC-No Change and B-Departure (Modified) will harvest the greatest amount of riparian areas, 34,000 acres (19.2 percent) and 30,300 acres (17.1 percent), for the first two decades. These levels are higher than continuation of the current situation (26,260 acres/first two decades) and could have significant effects on the long-term quality and availability of wildlife habitat in these highly utilized areas. Timber harvest activities will increase along headwater streams (Class III and IV) which could increase the number of debris torrents and affect downstream fish habitat and water quality. Alternative A will harvest 19,300 acres (10.9 percent). Alternatives C-Preferred (Modified) and H (Modified) are very similar with 13,900 acres (7.9 percent) and 9,000 acres (5.1 percent), respectively, for the first two decades. This level of timber harvest should have slight impacts on long-term resource values associated with riparian areas particularly along Class I and II streams. Alternative I will harvest 2,500 acres (1.4 percent) which is the lowest level of any alternative. Implementation of this alternative is unlikely to affect long-term values of riparian areas.

MITIGATION MEASURES AND EFFECTIVENESS

In addition to the legal direction concerning flood plains and wetlands, riparian areas are ensured protection by Standards and Guidelines (Plan, Chapter IV) and Best Management Practices (Appendix J). Examples are: reduced harvest in riparian areas, directional falling of streamside trees, and maintenance of current and future supply of large woody debris in streams. These practices have been found to be necessary and effective in the maintenance of stream functions and productivity of the aquatic ecosystem.

There are a number of key mitigation measures that are used to minimize impacts to riparian areas. Avoiding clearcut harvesting within 100 feet of class I and II streams is an important one. The retained vegetation will reduce streambank erosion and provide a source of large organic woody debris to the stream channels. Also, activities within appropriate riparian areas should be designed to maintain vegetation both vertically and horizontally which results in the greatest plant and wildlife diversity, wildlife migration and travel corridors, and dead and decaying tree habitat.

Activity reviews are used to assess effectiveness of mitigation measures. Tree lining and selective tree removal in riparian areas has resulted in significantly less disturbance to the soils and retained vegetation.

RELATIONSHIP TO PLANS OF OTHERS

Conflicts related to riparian areas, flood plain, and wetlands are not anticipated with plans of others provided that Standards and Guidelines and Best Management Practices (BMPs) are implemented and are effective during and following management activities. Standards and Guidelines and BMPs in the Forest Plan are generally more restrictive than Washington State requirements for protection of riparian areas, flood plains, and wetlands.

WILDLIFE

OVERVIEW

All National Forest land supports wildlife in some way. Changes in habitat on this land are largely what determine effects on wildlife. Effects of the alternatives on wildlife can be measured in several different ways. The areas of major concern are: (1) changes in habitat as a result of management, (2) resulting changes in wildlife populations, (3) chances of species survival over time, and (4) opportunities for recreation that wildlife provides.

The amount and quality available of habitat varies with each alternative, as does the degree of influence other resources have on wildlife. This habitat availability affects species diversity. Some effects are easily measured, while others must be weighed based on the most current scientific information and assumptions. Because factors affecting wildlife are based on the needs of indicator species, some factors weigh more heavily than others.

Each alternative has a different effect on wildlife depending on the varying mixes of habitats that will result from management activities. These mixes are affected by land assignments made for different levels of habitat requirements for certain species, and the results of assignments made for other resources. Both result in available habitat for wildlife. The effects of these assignments include changes in habitat quantity over time, changes in quality (age, size, and number of trees) of habitat over time, and changes in the distribution of habitat over time. It is extremely important to remember that changes in habitat diversity directly affect wildlife diversity. When one habitat type is selected over another, the species associated with that habitat are positively affected while others may be impacted in a negative way.

As discussed in Chapter III, management indicator species are used to determine the effects of alternatives on wildlife. In order to assess the effects changes in habitat have on wildlife, a relationship called the Habitat Capability Index (HCI) is used to express quantity and quality of habitat in terms of animal population size (see Table IV-15).

Habitat requirements for some species are not completely understood (refer to the discussion of Management Requirements (MRs) Appendix B). Because of these MRs, effects of alternatives on some species are not only displayed as changes in habitat, but also as the chance the species has of surviving over time. The estimations of effects for each alternative was done by professional biologists familiar with the conditions on the Forest. These estimates are not intended to be interpreted as absolute measurements.

SIGNIFICANT INTERACTIONS

VEGETATION

Vegetation determines the type of wildlife habitat that is present, which in turn affects wildlife. The interspersion and types of plant communities determines the types and numbers of wildlife inhabiting an area.

Among the components of vegetation that affect wildlife are dead and down material, vegetative diversity, and old-growth. These were discussed in the section of this chapter on "Vegetation." Old-growth affects wildlife by providing critical habitat for some wildlife species, including the northern spotted owl. Old-growth also provides optimal cover for wildlife. It intercepts snow, which helps provide forage in the winter, by leaving forbes and heraceous vegetation free of snow cover. It also provides shade for cooling in the summer.

Dead and down material is useful to a large number of wildlife species. It is used by terrestrial wildlife for hiding, feeding, and denning, while standing material (snags) provides nesting, feeding, and roosting sites for birds. Snags are essential for some species of birds whose numbers are dependent on their availability.

Management activities, especially those associated with the harvest of old-growth, may have an impact on wildlife species. The impact of removing old-growth is not always directly related to total population numbers of all species combined. It may have an effect on an individual species, as in the case of the northern spotted owl. However, not all harvest activities are harmful to wildlife.

Timber activities, whether precommercial thinning, commercial thinning, or harvest of old-growth, will increase available forage for big game during critical periods of the year. The early successional stages provide for both species and habitat diversity. However the availability of forage areas can temporarily be restricted by the amount of logging slash left after an area has been harvested. Intensity of harvest, harvest scheduling, and location of units within a drainage are probably the most significant factors determining effects on wildlife. The effects of these factors may be present for decades.

WILDLIFE

Meeting the needs of certain wildlife species can affect the quality of habitat for others. This is the result of management that selects one habitat type over another. If the goal is to increase deer and elk populations, then large areas are managed to optimize different stand conditions to provide the maximum habitat effectiveness. This is done by dispersing cover and forage areas throughout the landscape and minimizing vehicular harassment of the animals. Edge is another extremely important habitat concern. This is the area where plant communities meet or where successional stages or vegetative conditions within plant communities come together (Thomas 1979). Edges provide areas where both wildlife numbers and species diversity are at their greatest.

Management for species that require large areas of habitat, like deer and elk, can benefit many species because of the variety of habitats available. While this may support large numbers of big game and increased species diversity, it is not the optimum habitat condition for species that favor large, contiguous expanses of old-growth, such as the northern spotted owl.

FISH AND RIPARIAN

Wildlife are heavily dependent on the riparian vegetation found along fish-bearing streams. As intensive management of these areas continues, the value of the remaining riparian vegetation increases for wildlife species depend on it. These riparian areas provide roosting, feeding, and nesting habitat for a large variety of wildlife species. When and if such trees are added to the stream to improve fisheries production, the loss will affect the wildlife resource. Fish also provide an important protein source for a variety of birds and animals.

FIRE

Wildfire has always been a part of the natural environment. The impact of fire is a result of the changes that occur to the habitat that the animals are utilizing. Fire sets natural plant succession back, affecting those species associated with the impacted seral stage. In high intensity fires, birds and animals may be consumed or suffocated as they seek cover from the oncoming blaze. Wildfire increases forage availability and can create new habitat.

Prescribed fire is widely used on the Forest to prepare sites for reforestation. As a result, large areas are treated each year. This may improve access to seeds and other foods for birds in certain areas, and it also improves the availability of browse for other wildlife. Fire adversely affects (through charring, consuming, or hardening) the availability of down material as food and cover, and reduces the number of snags. The type of burning applied to an area determines what types of habitat will occur after treatment. Tractor piling and burning, and low-intensity underburning of logging slash and natural fuels, produce different impacts than does large-scale broadcast burning.

FIREWOOD CUTTING

Standing dead (snags) and down trees provide important habitats for many wildlife species. This material is also a source of firewood and is actively sought by many forest users. As intensive management continues, availability of old growth will decrease. The need will increase for the U.S. Forest Service to specify how much material may be removed and from which locations.

RECREATION

Non-hunting recreationists tend to concentrate use in areas that are generally more scenic. Often these areas also tend to be the most valuable for wildlife. Riparian areas, meadows, and wetlands are the most susceptible to this type of use. There is generally not a loss of habitat, per se, associated with recreation use, but rather a loss of habitat quality due to increased harassment of wildlife. Such harassment, which may be inadvertent, occurs both in dispersed use areas and at developed sites.

Developed sites increase the number of users and concentrate their use. This decreases the amount of habitat available in the immediate area. Access of recreationists to habitat and the timing and duration of high use seasons have an effect on wildlife populations. These disturbances influence both game and nongame species. Some aspects of recreation management can also benefit wildlife. Areas reserved for primitive recreation use provide habitats where the wildlife is relatively undisturbed. Recreation use also adds to the "value" of wildlife. Wildlife is often considered to be "worth" more when it contributes to the quality of a forest user's visit.

ROADS

Road densities exceeding two miles of road per square mile of forest can adversely affect wildlife use of an area. Under intensive forest management, road densities may exceed five miles of road per square mile. Roads remove habitat, affect wildlife distribution and movement patterns, and increase the potential for outside disturbance factors.

Removal of habitat is not limited to the actual presence of the road itself. Cutbanks, accumulation of road debris, and location along the slope can all remove habitat. Road-related activities also affect many species. State laws require the felling of snags within 100 to 200 feet of roads or other areas of high public use; complying with these laws reduces the availability of habitat for snag-dependent wildlife. Big game use adjacent to roads is governed by the amount of traffic associated with each individual road. Roads in intensively managed forests may affect wildlife by increasing public accessibility, removing screening cover along edges as a result of road maintenance, creating wide rights-of-way with steep banks, and being located adjacent to or in riparian habitat. Existing roads which are closed to vehicular traffic do not contribute to significant disturbance of wildlife. These roads provide foraging and bedding sites and are used as travel lanes. Intermittent use of roads may have a greater impact on wildlife than a more consistent pattern of use. Wildlife can adapt to established patterns. Road use that is sporadic or limited to certain times of the year can "surprise" wildlife and cause both stress and displacement.

LOCAL COMMUNITIES

The wildlife resource is extremely important to some areas, because of the focus it provides for social activity. This is never more evident than when hunting seasons are in progress. In many small communities this is an important time of the year. It is a time for socializing with family and friends. This interest increases the demand for the wildlife resource near the community and, in some cases, instills the feeling that the wildlife belong to that community. Wildlife can also be affected by a protectionist attitude within a community. Such an attitude can lead to creation of a refuge, which may result in population increases for some species. In some cases, populations can increase to the point where damage to property occurs.

LOCAL ECONOMY

When the local economy is on a downswing, the hunting pressure on wildlife can increase. This places additional pressure on the wildlife resource. In extreme cases, the illegal kill during such periods can exceed the legal harvest. Wildlife can benefit the local economy by bringing in tourist dollars.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON WILDLIFE

The effects of each alternative on wildlife are discussed in relation to how indicator species are affected. A summary for each species is presented in Table IV-15.

Table IV-15. Habitat Capability Indices for Indicator Species at End of First, Second, and Fifth Decade

	Alternatives						
	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Northern Spotted Owl	Number of pairs						
Decade 1		66	78	70	83	86	91
Decade 2		49	66	57	76	82	91
Decade 5		42	56	52	63	75	91
Pileated Woodpecker	Number of pairs						
Decade 1		660	763	676	814	839	887
Decade 2		492	661	550	741	803	887
Decade 5		423	576	502	614	733	887

	Unit of Measure	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Pine Marten	Number						
Decade 1		1,237	1,431	1,268	1,525	1,573	1,663
Decade 2		923	1,240	1,031	1,389	1,506	1,663
Decade 5		793	1,081	942	1,151	1,374	1,663
Primary Cavity Excavators	Percent of Potential						
Decade 1		53	68	65	70	71	72
Decade 2		40	65	62	67	69	72
Decade 5		34	62	60	64	67	72
Columbian Black-tailed Deer	Number						
Decade 1		6,462	6,433	6,463	6,423	6,523	6,481
Decade 2		6,147	6,038	6,147	6,125	6,264	6,213
Decade 5		6,008	5,140	6,008	5,179	5,016	4,826
Roosevelt Elk	Number						
Decade 1		3,032	3,030	3,032	3,031	3,081	3,065
Decade 2		2,844	2,834	2,844	2,829	2,895	2,886
Decade 5		2,525	2,536	2,525	2,619	2,650	2,723
Bald Eagle	Nesting Sites						
Decade 1		662	744	723	756	762	774
Decade 2		580	689	640	720	741	774
Decade 5		546	625	586	643	697	774

NORTHERN SPOTTED OWL

The number of spotted owl habitat areas (SOHAs) currently believed necessary to maintain population viability on the Forest is 30. This number is based on the Standards and Guidelines contained in the Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide, 1988. The SOHAs average 3,000 acres in size. Refer to the map overlay accompanying the alternative maps for the locations of the SOHAs. These SOHAs are applicable to all alternatives except NC.

The Spotted Owl Habitat Network contains a total of 144,310 acres of suitable habitat on the Olympic National Forest. This network is composed of all the SOHAs plus all suitable spotted owl habitat within Reserved areas on the Forest. In addition, it is estimated that approximately 589,300 acres of suitable spotted owl habitat are in lands withdrawn from timber harvest owned by the State or Federal Government on the Olympic Peninsula. The Forest has verified 70 pairs of spotted owls living on the ONF between the years of 1985-1989.

A primary indicator of the effects of the alternatives on spotted owls is the amount of forest retained in a suitable habitat condition over time. As a result of management activities in the alternatives, the amount of habitat remaining at end of the fifty year planning period varies widely. Table IV-16 displays the amount of suitable owl habitat remaining under each alternative. Also refer to the old-growth discussion within the

"Vegetation" section of this chapter for additional information on this important component of spotted owl habitat.

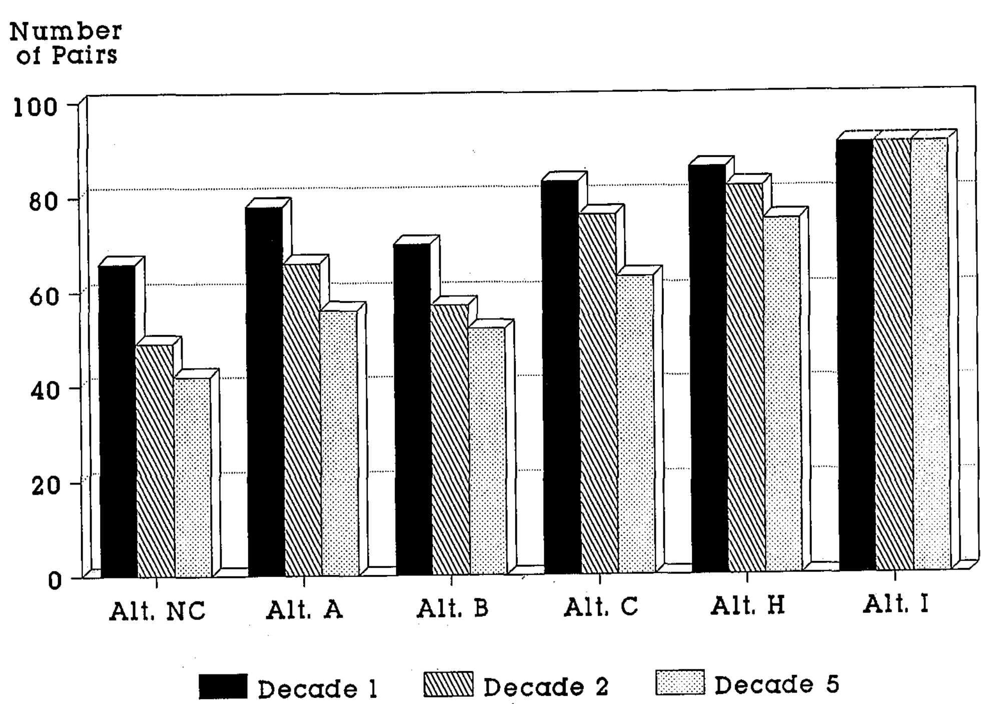
Table IV-16. Suitable Spotted Owl Habitat Remaining at End of Decade One, Two and Five 1/

	Alternatives (thousands of acres)					
	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Decade 1 Percent of Existing	193.0 71	235.0 86	208.9 77	250.0 92	257.7 95	272.0 100
Decade 2 Percent of Existing	156.3 57	204.3 75	171.0 63	228.2 84	245.2 90	272.0 100
Decade 5 Percent of Existing	136.9 50	178.9 66	156.7 58	190.2 70	224.1 82	272.0 100

1/ The definition for suitable habitat can be found in Chapter III.

Based on this information, habitat capability indices for spotted owls associated with each alternative are displayed in Figure IV-5.

Figure IV-5. Spotted Owl Habitat Capability Indices

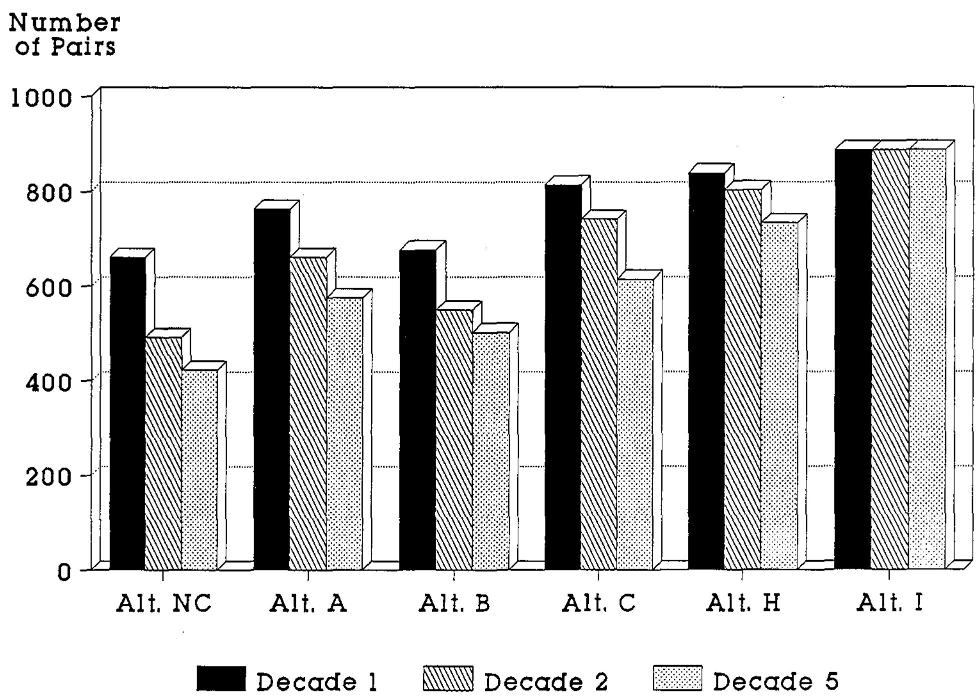


PILEATED WOODPECKER

The pileated woodpecker represents species that inhabit mature conifer habitat. Calculations indicate that current Forest conditions can provide habitat for 887 pairs. The minimum number of areas currently thought to be necessary for distribution requirements is 56. Each area is 600 acres in size, 300 acres of which is maintained in a mature forest condition. These areas are applicable to all alternatives except NC. Under each alternative, there are additional areas of suitable habitat for the pileated woodpecker. These come from two sources, land managed for other resources in a mannner which is compatible with pileated woodpecker needs, and the maturing of younger forest stands into older suitable habitat. The habitat capability index for pileated woodpeckers is based on all available habitat, not simply that within designated pileated woodpecker management areas.

Alternatives H (Modified) and I have ample habitat available now and managment direction for those alternatives will maintain this habitat through time. Although less than H (Modified) and I, the habitat provided by Alternative C-Preferred (Modified) is substantial. Alternatives A-Current Direction, B-Departure (Modified), and especially NC have relatively low habitat availability in decades three and four due to the high proportion of the Forest in younger stands. The habitat capability indices for the alternatives are presented graphically in Figure IV-6.

Figure IV-6. Pileated Woodpecker Habitat Capability Indices

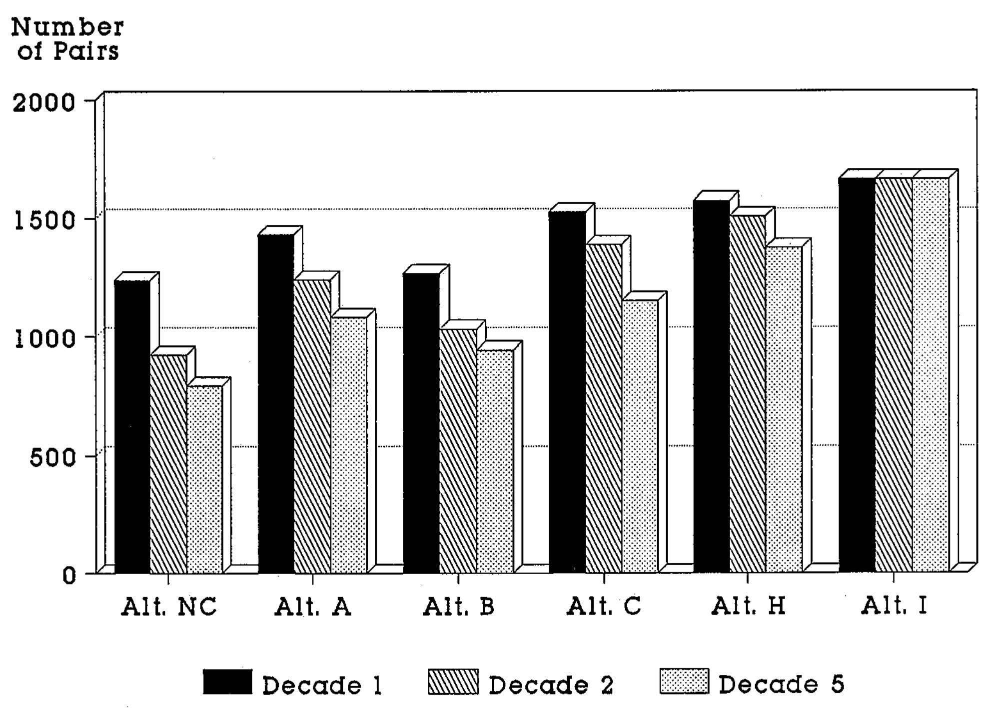


PINE MARTEN

The marten also represents those species that inhabit mature conifer habitat. The minimum number of marten sites currently believed to be necessary for distribution requirements is 155. All sites have a minimum of 160 acres and have been included in all alternatives except NC. Substantial amounts of additional suitable habitat exist in areas allocated to other resources such as recreation, scenery, watershed, riparian, and other wildlife. The distribution of these habitats is dependent on the resource allocations associated with the alternatives. For this reason, the total amount of habitat available also varies with each alternative.

Those alternatives, such as H (Modified) and I, which have relatively low levels of timber management activities will provide the most marten habitat over time. Alternative C-Preferred (Modified) will provide somewhat less habitat, followed by Alternatives A-Current Direction, B-Departure (Modified) and lastly NC, which will provide relatively low levels of marten habitat. The amount of habitat over time is not strictly tied to the land allocations. There is some in-growth of habitat in managed stands, i.e., as younger forest stands become older, more habitat becomes suitable. Based on the management allocation and activities of the alternatives, Figure IV-7 displays the habitat capability indices for the marten.

Figure IV-7. Pine Marten Habitat Capability Indices



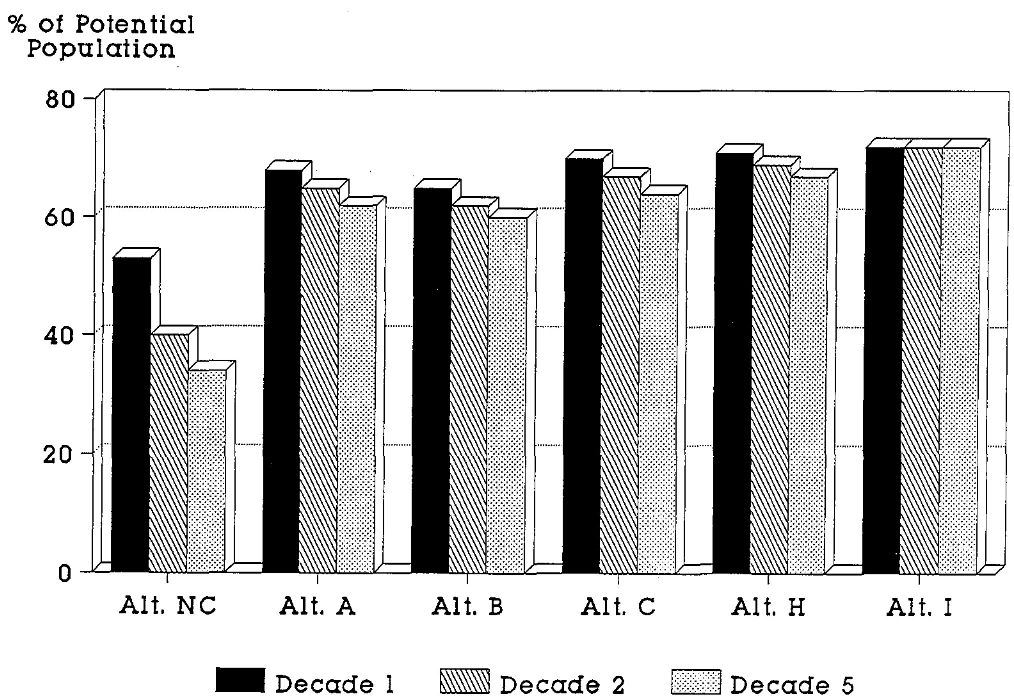
PRIMARY CAVITY EXCAVATORS

Primary cavity excavator habitat is managed to maintain a minimum of 40 percent of its potential population capability in all alternatives except NC. These population levels are to be maintained on all Forest lands, including those suitable for timber management. This analysis concentrates only on those areas allocated to timber production, especially Management Prescriptions E1 and F1 (see Plan Chapter IV "Standards and Guidelines" for definition of Management Prescriptions). Provisions in other prescriptions will result in habitat conditions well above those necessary to meet the required levels. Population levels are directly related to the number of standing dead trees available for feeding and nesting.

Two snag classes (15 to 19 inches, and greater than 19 inches in diameter) were evaluated to determine effects of alternatives. To determine standing snag capability, only those snags greater than 15 inches in diameter were considered. This should assure adequate numbers of snags for the future. The smaller diameter material will contribute to down material needs.

The alternatives have different levels of available standing dead trees, with none below the MR level (20 percent of potential population). Two other levels were calculated to compare snag numbers: current situation and 40 percent of potential population. The current (223 snags/100 acres) is an average of what is available in unmanaged stands, based on timber inventory plots and stand exam records. The 40 percent of potential population level (179 snags/100 acres) is based on Bruce Marcot's snag recruitment simulator for western Oregon and Washington. Although current snag levels are well in excess of the 40 percent of potential population level, density in younger stands is often suboptimum. Standards and guidelines assure a minimum of the 40 percent of potential population level for all alternatives with the exception of the NC alternative. Alternative I will maintain the highest potential population levels for primary cavity excavators, followed in descending order by Alternatives H (Modified),C-Preferred (Modified), A-Current Direction, B-Departure, and finally NC. The habitat capability indices for each alternative are displayed graphically in Figure IV-8.

Figure IV-8. Primary Cavity Excavators Habitat Capability Indices



COLUMBIAN BLACK-TAILED DEER

Because of high public interest and the habitat diversity it requires, the Forest chose to use the Columbian black-tailed deer to analyze the effects of alternatives. Deer numbers are almost totally dependent on the intensity of timber management throughout the forest. Road construction, level of road use, vegetative diversity, and land allocation pattern all play a role in the capability of the forest to provide for the needs of its deer herds.

In order to determine effects of timber management activities on deer, forage is assumed to be the limiting factor. Although thermal cover may be a limiting factor in severe winters, the assumption that forage is generally limiting on deer populations is acknowledged on the Olympic National Forest. The deer populations on the Olympic Peninsula thrive in clearcut areas. Areas where the timber has been cut more than two and less than 15 years provide the maximum forage opportunities.

The alternatives which provide the greatest amount forage will also produce the greatest number of deer. Alternatives NC and B-Departure (Modified), which have the greatest degree of timber harvest, also show the greatest habitat capability for deer during the fifth decade. Alternative I, on the other hand, has the least amount of timber harvest and shows the lowest habitat capability for deer in the fifth decade. As indicated in Table IV-15, and in the bar chart below, the other alternatives range between the two extremes.

A related consideration is the roads associated with timber management activities. These roads improve access for hunters and other recreationists but may result in increased wildlife harassment under the timber intensive alternatives such as NC and B-Departure. Permanent or seasonal road closures may help alleviate some of these concerns, as discussed in the "Mitigation" section below.

As deer populations increase, hunter success usually increases, attracting more hunters to the area. This would generate increased recreational dollars for many of the local communities on the Olympic Peninsula. Alternative B would generate the greatest increase in these dollars and Alternative I would generate the least. These indirect effects are incorporated into the section of this chapter on "Local Economy". Generally, the employment effects associated with wildlife related recreation represent a very minor component of the total Peninsula employment under any alternative.

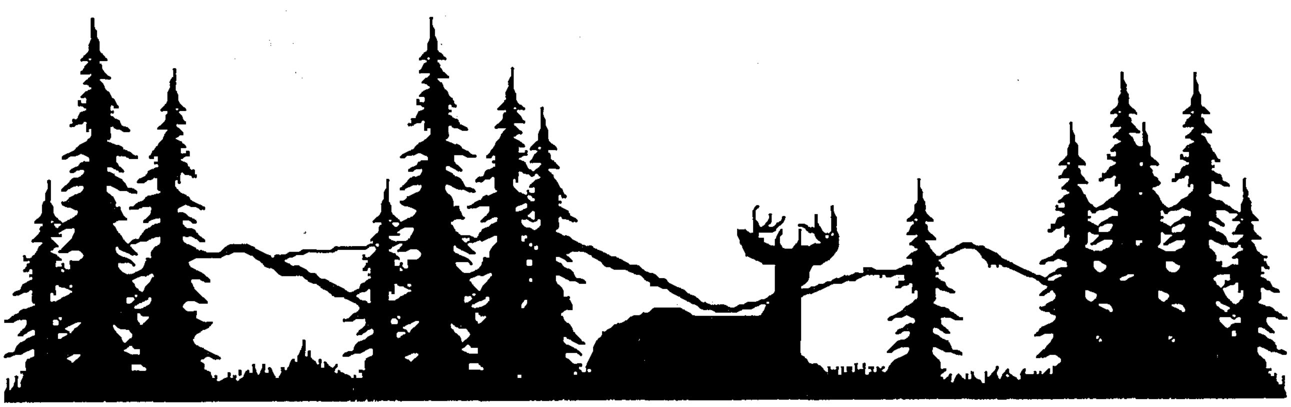
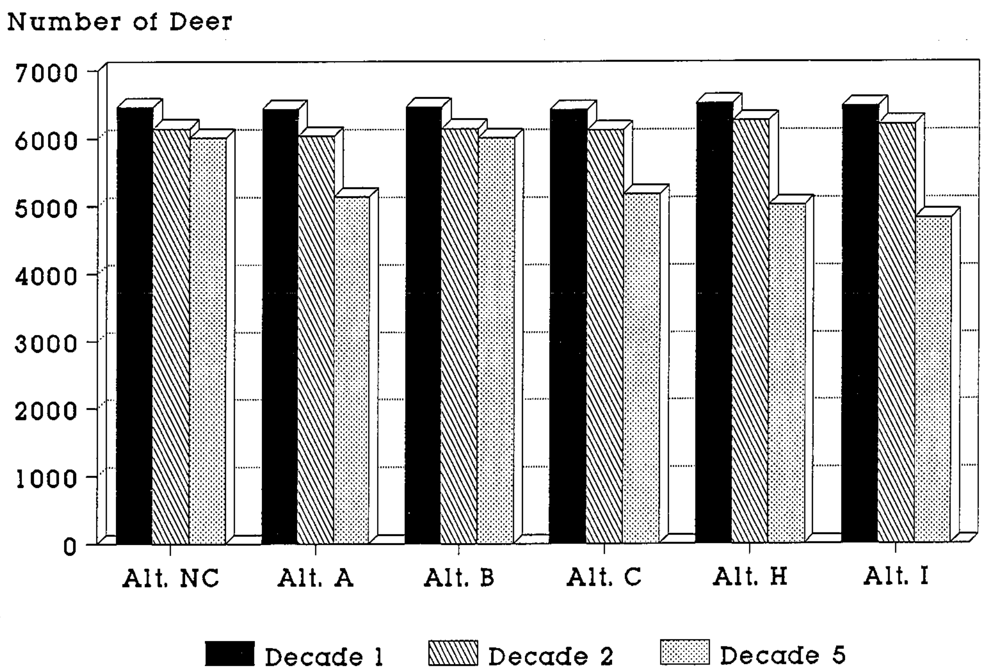


Figure IV-9. Black-Tailed Deer Habitat Capability Indices



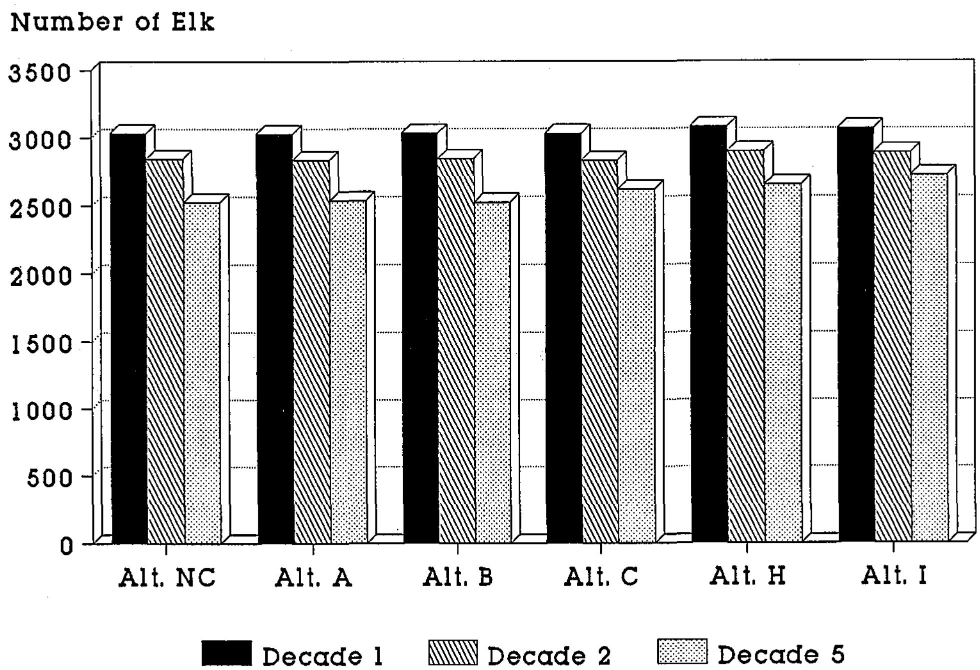
ROOSEVELT ELK

The Roosevelt Elk is also an indicator species and has many of the same needs as the Columbian Black-Tailed Deer. The major differences between the needs of the Roosevelt Elk and Columbian Black-Tailed Deer are the size of each individual's home range and the increased dependence of the elk on winter range for survival. During years with mild winters, elk will do best in areas which are also best for deer. In years with severe winters, elk are much more dependent on areas with optimal cover where adequate forage can be found. Because of the large size of these animals and the fact that they usually congregate in herds, large areas of optimal habitat are needed to carry them through storms that may occur during severe winters.

Because of this, optimal cover habitat is generally acknowledged to be the limiting factor for elk populations on the Olympic Peninsula. As you can see from the habitat capability indices in Table IV-15 and in the bar chart below, Alternative I, which has the greatest amount of optimal habitat at the end of the fifth decade, also has the highest number of elk (2,723 animals). Alternatives NC and B-Departure (Modified), on the other hand, have the least amount of optimal habitat at the end of the fifth decade and also show the lowest habitat capability (2,525 animals). As can be seen in Figure IV-10, the other alternatives span the range between the two extremes.

The economic effect of managing for maximum elk populations seems to be just the opposite of that of managing for maximum deer populations. The alternatives which would produce the greatest economic benefit for local communities from deer hunting, Alternatives NC and B-Departure (Modified), would produce the least economic benefit from elk hunting. The alternative that would produce the least economic benefit for local communities from deer hunting, Alternative I, would provide the greatest economic benefit from elk hunting. It would appear that Alternative C-Preferred (Modified) produces the best compromise between the two ends of the spectrum and would be expected to provide the greatest net economic benefit to local communities from deer and elk recreational hunting. These indirect effects are incorporated into the Local Economy section of this chapter. However, the employment effects associated with wildlife-related recreation represent a very minor component of total Peninsula employment under any alternative.

Figure IV-10. Roosevelt Elk Habitat Capability Indices



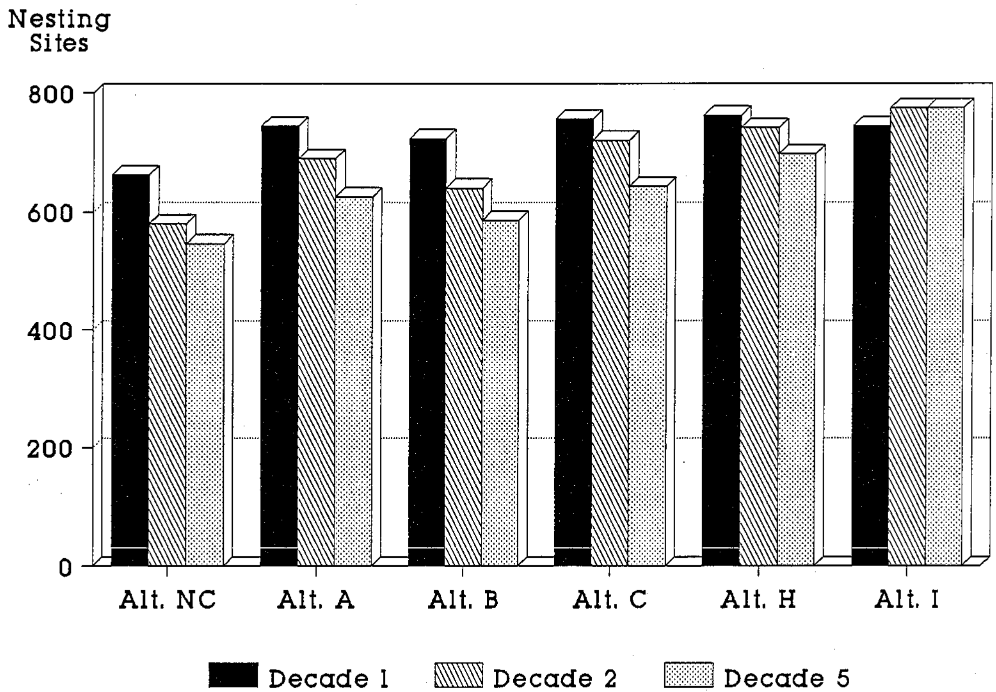
BALD EAGLE

Because the bald eagle is on the Federal list of threatened and endangered species, habitat which is critical to its survival is protected by law. Any action on the Forest which may affect the nesting of any bald eagle on the Forest has been and will continue to be the object of consultation with the US Fish and Wildlife Service. The bald eagle population on the Olympic National Forest is limited by the amount of feeding habitat. Nesting habitat is not currently nor is it expected to be a limiting factor for bald eagle populations on the Olympic National Forest if the standards and guidelines are followed.

Land area for 16 Bald Eagle Management Areas (BEMAs), which will be managed specifically for bald eagles, is provided in each alternative. This accounts for approximately 1,200 acres of actual nesting habitat. Due to the varying land allocations among the alternatives, some alternatives provide more nesting habitat than others, but in no case are there less than 16 nest sites. All active nest sites are protected in all alternatives. Timber harvest, other than that which will be beneficial, is precluded within the BEMAs. Habitat capability for bald eagles is measured by the number of sites available for nesting in riparian habitat along fish bearing streams. Given the relatively low level of timber management activities associated with Alternatives H (Modified) and I, these alternatives will provide the highest level of potential nesting habitat. These same alternatives would also provide for the greatest fish habitat capability and therefore the greatest chance of increasing the limiting factor for the bald eagle population. The bar chart below displays the levels of potential nesting sites associated with each alternative.

Although the capability index measures nest site potential, a primary limiting factor on bald eagle populations for the Forest is availability of food items. Anadromous fish is the primary food item for bald eagles on the Olympic Peninsula. Please refer to the "Fisheries" section of this chapter for information on the effects of the alternatives on the anadromous fish enviromental component.

Figure IV-11. Bald Eagle Habitat Capability Indices



DIVERSITY

Changes in numbers of animal species would not be expected in any alternative, but, changes in the distribution and abundance of animal populations are expected in terms of habitat capability for numbers of animals. The capability of habitat to support numbers of wildlife management indicator species was presented above for each species and is summarized in Table IV-15.

CUMULATIVE EFFECTS OF ALTERNATIVES ON WILDLIFE

NORTHERN SPOTTED OWL

It is important to remember that the Forest is located around the perimeter of Olympic National Park which provides a large amount of undisturbed habitat. Park officials estimate there are 435,500 acres of suitable spotted owl habitat in Olympic National Park. Table IV-17 attempts to show how much of this habitat may be occupied, based on current information being generated by scientific studies in the Northwest.

Table IV-17. Estimation of Occupied Habitat (Olympic National Park)

Total Acres/SOHA Size x Occupancy Factor = Potential Occupied SOHAs

Total Acres	SOHA Size	Occupancy Factor	Potential Occupied SOHAs
435,500	300	.93	1,350
435,500	1,000	.93	405
435,500	2,200	.93	184
435,500	3,000	.93	135
435,500	4,500	.93	90

The occupancy factor is based on the occupancy rate of currently established SOHAs in the ONF.

Availability of this habitat is assured barring natural catastrophe. There has been no thorough population survey to determine how much is actually occupied. As there are no laws requiring maintenance of spotted owl habitat, we can expect very little, if any, to be available on private lands. The State Department of Natural Resources has tentatively set aside 15,000 acres of suitable spotted owl habitat from timber harvest for 15 years of study.

Population viability on the Olympic Peninsula will continue to be dependent on suitable habitat in the National Park and Forest. Viability over time is based on a multitude of factors and is currently being debated in scientific circles. In this analysis, survival of the owls is enhanced by the presence of substantial habitat within the Olympic National Park.

PILEATED WOODPECKER AND PINE MARTEN

The availability of habitat suitable for the pileated woodpecker and pine marten on private lands is largely dependent on the demand for wood products. It is extremely difficult to estimate cumulative effects based on private land holdings on the Peninsula. If the market is weak, we can expect timbered stands to become older, thus providing more suitable habitat. If the demand continues to be high, timbered lands will be harvested as soon as they are merchantable. Based on this, habitat on the Forest, on State land, and in the Olympic National Park will continue to provide the majority of pileated woodpecker and pine marten habitat. The viability of the pileated woodpecker and marten is expected to be maintained, given the projected habitat availability within these two ownerships.

PRIMARY CAVITY EXCAVATORS

Maintenance of adequate habitat for primary cavity excavating wildlife is totally dependent on the ability to provide dead or defective trees (standing and down) at a sufficient level in the future. Dead and defective trees (standing and down) of all size classes will be available in managed stands. Currently, the Forest's ability to provide standing dead and defective trees (snags) in managed stands is hampered, and in some cases eliminated, by compliance with the State of Washington's Division of Labor and Industries regulations covering worker safety. See the discussion in "Relationship to Plans of Others." This will continue to be a major concern in maintaining an effective distribution of habitat. With the exception of Olympic National Park, which provides snags at natural levels, adjacent landowners do not normally maintain adequate habitat for cavity excavators. We expect to see a larger number of dead and defective trees left on non-federal lands with the implementation of the State Timber, Fish, and Wildlife (TFW) agrreement. Alternatives C-Preferred (Modified), H (Modified), and I will have the greatest degree of protection for primary cavity excavator habitat. With the implementation of the TFW agreement, the risk to these species will decline further.

COLUMBIAN BLACK-TAILED DEER AND ROOSEVELT ELK

Assuming that optimal cover is the limiting factor on big game populations during critical years, little to none of this habitat is provided by private landholders adjacent to the Forest. The majority of these private timbered lands range from 0 to 60 years of age and provide very little optimal cover habitat. Future habitat quality and quantity on private and State lands cannot be accurately determined. In our analysis we have assumed that no optimal cover habitat would remain on non-federal lands in the future. The western Forest boundary borders State-controlled lands with an emphasis on timber management. This may be changing with the advent of the new Experimental Forest that the Washington State Department of Natural Resources is proposing for the west side of the Olympic Peninsula. Large amounts of optimal habitat will remain within Olympic National Park. The Forest-wide standards and guidelines provide for adequate optimal cover for current deer and elk populations in all alternatives with the exception of NC.

Based on habitat mixes provided in the alternatives, deer and elk populations on the Forest should remain fairly stable. One factor affecting future big game populations, over which the Forest Service has very little control, is timing and length of hunting seasons. Seasons are established and regulated by the Washington Department of Wildlife.

As the Timber, Fish, and Wildlife (TFW) agreement is implemented on Non-Federal land throughout the State of Washington, many of the negative impacts that timber harvest has had on wildlife populations, will be reduced or eliminated. This will susequently reduce the risk to many populations of wildlife which are now or would have been in the future totally dependant on Federal lands for population viability.

HABITAT ON SIMPSON TIMBER COMPANY LAND WITHIN THE SHELTON CSYU

One area in which this planning process has a direct effect on the quality of wildlife habitat outside the National Forest boundary is Simpson Timber Company land within the Shelton CSYU. The level of timber harvest from this land will depend on the alternative selected for implementation. Therefore, evaluation of the effects of alternatives on wildlife habitat affected by Simpson harvest is included in this analysis. While the effects of Simpson harvest on wildlife habitat could not be estimated as precisely as was done for National Forest harvest, it is possible to reach some reliable conclusions regarding the relative effects of the alternatives on wildlife habitat influenced by Simpson management.

In general, it is anticipated that the range of first-decade harvest levels from Simpson land associated with the alternatives is too small to lead to significant differences in effects on wildlife populations. Simpson land within the Shelton CSYU contains an essentially young forest (100 years of age or less), with little acreage that can be classified as old-growth or mature conifer habitat. For this reason, the effects of the alternatives on species dependent on these habitat types are likely to be minimal.

Variations in Simpson first-decade harvest level will affect the mix of younger age classes available as habitat. This will have the potential to influence elk and deer populations. The magnitude of difference between the alternative with the highest Simpson harvest level (Alternative C-Preferred (Modified)) and the lowest (Alternative NC-No Change) is too small to have a high probability of precipitating major changes in the populations of these species. Analysis of on-Forest effects indicates that deer and elk populations are likely to remain stable, even though there are large differences in on-Forest harvest levels. The same effect is expected on Simpson land. In addition, implementation of the TFW agreement is expected to moderate potential negative effects of harvest on wildlife populations, making significant differences among the alternatives even less likely.

MITIGATION MEASURES AND EFFECTIVENESS

Forest-wide Standards and Guidelines were developed as mitigation measures to proposed activities. When mitigation measures are properly designed and implemented to address site-specific situations they are successful. Where various steps occur during project implementation, such as timber marking, timber sale administration, and post sale activities, the success of the mitigation measures for the entire project is dependent upon successful application of the mitigation measures during each phase of the project. Seasonal road closures are an example of an effective mitigation tool to minimize wildlife harassment.

RELATIONSHIP TO PLANS OF OTHERS

There are very few wildlife management conflicts related to the "Plans of Others" identified in Chapter III.

A conflict (applicable to all alternatives) needing resolution will be the maintenance of standing dead trees (snags) for primary cavity excavators. This conflict between the Forest, which is required to maintain habitat for all species of wildlife, and the Washington Department of Labor and Industries, which enforces regulations governing worker safety, will continue.

In alternative NC most of the old-growth habitat at lower elevations (big game winter range) will be eliminated, potentially reducing population numbers, especially of elk. Implementation of this alternative would be in conflict with the Washington Department of Wildlife's *Strategies for Washington's Wildlife*, which calls for maintaining or increasing big game populations.

There should not be conflicts with other plans.

FISHERIES

OVERVIEW

Although all fish species utilizing Forest habitats are considered important, only the anadromous salmon and trout species group was used as an indicator during the analysis process. This group was selected because they utilize both on and off-Forest habitats during various phases of their life cycles, and because of their values as sport and commercial fish species. Total smolt production, i.e., the numbers of smolt fish produced, was selected as the assessment unit of measure because this estimator is representative of both commercial and sport fish production, as well as the overall productivity of the fishery. Other related output estimates such as sport catch, including wildlife and fish user days (WFUDs), and commercial catch including pounds were also calculated and are included in Chapter II and in the planning process records.

Three primary variables that are known to significantly influence fish production and/or fish habitat capability were evaluated in this analysis. The three variables considered in the evaluation process included: (1) escapement, which is the number of adult anadromous fish that escape the fishery and return to their natal streams to spawn; (2) large, woody debris, both instream and adjacent streamside sources; and (3) sediment yields greater than natural levels.

Escapement was considered one of the major variables because natural fish production is entirely dependent on the numbers of adult fish returning to spawn. This variable, however, could not be used in the assessment process because the majority of the factors that govern escapement are beyond Forest Service control. Escapement goal estimates provided by the State were used to generate the Forest Fish Habitat Capability Indices used in the evaluations. It was assumed that escapement throughout the entire planning period will be adequate to fully seed accessible/suitable habitat.

Large, woody debris, due to its importance as the primary structural component of fisheries habitat, was considered to be another of the significant analysis variables. Unfortunately, this variable could not be utilized in the evaluation process because adequate assessment information pertaining to this habitat component is not presently available.

Sediment yields greater than natural levels were identified as the variable with the greatest influence on the fisheries resources that can be reasonably estimated with current information. This variable was selected and used in the evaluation process because the effects of sediment on fish are relatively well understood, and the amount of sediment likely to be generated by management activities occurring on the Forest can be estimated. A subjective approach, using predicted sediment yield indices as the primary variable, was developed to estimate the effects of the alternatives on fisheries.

This approach, briefly discussed in Chapter III, is based on estimated changes in anadromous fish habitat quality and capability indices resulting from predicted sediment. The approach, as well as the methodologies used to develop the habitat quality and capability indices, are documented in planning process papers. It is emphasized that the following evaluation estimates, made by professional fisheries biologists and hydrologists familiar with the conditions on the Forest, are indicators of the effects of the alternatives on fisheries resources. They are not intended to be interpreted as absolute measurements.

SIGNIFICANT INTERACTIONS

In general, anything that influences water quality or alters the physical attributes of fish habitat can affect associated fisheries resources. Wild stock fish populations have, in most instances, reached equilibrium with available food and quality of living space. Substantial changes in habitat, either natural or as a result of human activities, shift the equilibrium and cause changes in the population structure. Eventually, a new equilibrium is established where total fish production is either increased or decreased, or production of one species is favored over another. The effects of significant environmental components and their respective activities on fisheries resources are described as follows:

GEOLOGY

Geologic processes can have a significant effect on fish populations, by blocking (or opening) migration routes, silting in (or adding coarse bedload to) spawning beds, backfilling ponds and lakes, eroding out the feature that allowed the formation of a pond or lake, or blocking a stream channel and forming a new pond or lake.

The management of geologic resources can significantly affect fish habitat by changing the quality (physical and chemical) and flow patterns of water in a given area.

WATER

The surface waters of the Forest provide the habitat medium for all associated aquatic life. It is evident that fisheries resources are totally dependent on water quality and quantity. All Forest activities which result in changes in water quality or quantity will influence fish populations.

Activities that reduce water quality by increasing sediment yields to levels greater than natural, are considered to be detrimental to fisheries resources. Both suspended and bedload sediment can adversely affect fisheries resources by filling in spawning gravels and smothering eggs and/or embryos, or by temporarily filling in pools that are utilized as rearing habitat. Sediment may interfere with feeding and growth of juvenile salmon and trout for short periods of time while the sediment is being transported downstream. This usually occurs during high rainfall events and generally lasts no more than 3 or 4 days.

Another water quality property that can influence fisheries resources is water temperature. Increases in water temperature resulting from Forest activities, especially during the summer months, can retard growth rates of juvenile game fish species, increase the incidence of disease, and increase competition with nongame species that are more efficient at warmer temperatures. Extreme increases in water temperature can result in direct fish mortality. Conversely, in very cold water systems, temperature increases may enhance onsite fish production. Since the majority of the Forest's streams have water temperatures either near or below optimum levels any increase in water temperature would be expected to enhance onsite fish production. Because of the temperate climate of the Olympic Peninsula it is not anticipated that stream temperatures will ever drop to lethal levels.

VEGETATION

Vegetation management, especially timber management activities, can affect fisheries resources. These activities have three primary effects on fisheries habitat. Logging activities tend to simultaneously increase sediment and temperature in streams while reducing sources of large, woody debris. The effects of sediment and water temperature on fish were discussed in the previous section. The importance of large, woody debris in streams is described below.

Large woody debris is the primary structural component of fish habitat in most small fish-bearing streams. Large trees, with rootwads attached, tend to stabilize stream channels, trap spawning gravels, and create seasonal flow in the flood channels and side channels that are important spawning areas for several species of salmon and trout. Large, woody debris also provides resting pools and instream cover important to adult fish during spawning migrations. Instream debris provides an organic substrate for many fishfood organisms. The importance of streamside trees as sources of future large, woody debris is evident, but the value of the canopy and the cover it provides is sometimes overlooked. Canopy removal can lead to changes in primary stream productivity, increases in summer water temperatures and decreases in winter temperatures. For these reasons, the effects of canopy removal can either be detrimental or beneficial to fisheries resources.

Other less important effects include changes in water chemistry resulting from timber cutting, burning, or use of forest chemicals, and the increased instream biochemical oxygen demand resulting from introduction of fine organic debris. In addition, some relatively minor changes in streamflow may also occur.

WILDLIFE

Numerous amphibians such as newts, salamanders, toads and frogs compete directly with fish for aquatic food chain organisms. Many bird species such as belted kingfishers, great blue herons, osprey, eagles, and numerous diving ducks prey on sport and commercial fish species. Mammals such as mink, river otter and raccoons also prey on fish. These predator/prey relationships are part of the natural environment.

Beaver, on the other hand, are perhaps the only wildlife species on the Forest that are beneficial to fish. Beavers build dams that provide ideal rearing habitat for juvenile salmon and trout species.

FISH

Some short-term adverse sediment-related impacts usually occur as a result of instream projects that are designed and implemented to improve fisheries habitat. This is especially true of rearing and spawning habitat improvement projects that require the construction or placement of instream structures. The long-term beneficial gains from these projects far outweigh the short-term reductions in habitat quality.

Other projects designed to improve habitat for a given species or species group may, in fact, reduce or displace other fish populations utilizing the same habitat. For example, the removal of an anadromous fish barrier to upstream migration may eventually displace an existing resident trout population.

HERBICIDES AND INSECTICIDES

The use of herbicides and insecticides on the Forest could potentially result in the contamination of surface waters and fisheries habitat. However, most use of herbicides has been limited to treatment of undesirable roadside vegetation. Insecticides have only been used at the Dennie Ahl Seed Orchard, and use there has been light. Use of chemicals is generally localized and on a relatively small scale. Past use has not had any measurable effect on the fisheries resources.

FIRE

Fire, whether due to human activity or natural causes, can impact fisheries resources. Wildfire tends to increase erosion-induced stream sedimentation, which adversely affects fisheries habitat. Fires also release soil nutrients into surface waters which, depending on the magnitude, may result in the degradation of water quality and fisheries habitat. Fire can also remove large woody debris sources adjacent to fish-bearing streams or accelerate the input of debris into streams. The loss of large woody debris from riparian zones can result in a future reduction in fisheries habitat. Suppression activities, such as the aerial application of fire retardant, can result in chemical water quality degradation of fisheries habitat if the drop zone includes a fish-bearing stream or lake.

RECREATION

The effects of recreational activities on fisheries resources include facility construction and maintenance adjacent to fish-bearing habitats. These activities can cause subsequent water quality degradation resulting from sediment loading and/or channel stability problems. Impacts of this type are usually short-term and the recovery of the fisheries habitat is usually rapid. Trail access, in some instances, may increase public use within an area, such as a remote lake, and result in an overfishing depletion of the resource. This type of recreational use is managed by seasonal closures and catch limits established by the Washington Department of Wildlife. Overfishing or exploitation of the recreational fishery can also have an adverse effect on the resource. Once again, the effects of overexploitation are controlled by the State Departments of Fisheries and Wildlife.

ROADS AND STRUCTURES

Construction, maintenance, reconstruction, and use of roads on the Forest are the primary sources of sediment that degrades fisheries habitat. This is especially true of roads located within riparian zones and flood plains. Construction within these areas may also reduce sources of large, woody debris and, in some instances, contribute to unstable streambanks and bank erosion problems. Conversely, permanent or seasonal closures of existing roads can decrease sediment loading, partially mitigating the adverse impacts on fisheries resources.

The construction of bridges and their respective approaches can also result in some stream sedimentation. These impacts are usually short-term and generally inconsequential. Culverts in fish-bearing streams can be more of a problem. If they are either improperly installed, improperly sized, or both, they can totally block or hinder fish migrations to otherwise suitable and productive habitats.

Other road-related activities that may affect fisheries resources include various dust abatement practices. Road oiling can adversely affect aquatic habitats if oil enters streams or impoundments. This is unlikely because dust abatement occurs during dry periods when no rainfall is predicted. Paving also reduces dust and, in the long run, is beneficial to fisheries resources because it reduces sediment from road surfaces.

MINERALS

Minerals extraction activities can impact water resources and, consequently, fisheries as well. These activities can change surface runoff, erosion rates, sediment yields, water chemistry and streambank and channel stability, and can alter or remove stream substrate materials. Also, these activities can degrade fisheries water quality, deplete fishfood sources, or remove fish cover from streams. Spawning gravels may be lost through removal or degraded via sedimentation or, in some instances, improved or cleaned through mechanical agitation resulting from hydraulic dredging. Such activities can either reduce or increase fish production. To date, mineral activities and fisheries resource interactions on the Forest have been minimal.

ENERGY

Hydropower development can result in the loss of existing fisheries habitat by blocking anadromous fish access or by dewatering stream reaches that currently provide fish habitat. Conversely, hydropower dams can increase the amount of habitat available for resident fish species.

Firewood removal from riparian areas can result in the loss of large woody debris sources that provide the structural component of fisheries habitat in small streams. Impacts of this type can be avoided or minimized through the use of a managed firewood permit program.

WILD AND SCENIC RIVERS

Protection of rivers under the provisions of the Wild and Scenic Rivers Act will preclude development of hydropower dams and provide further restrictive measures to protect water quality and fisheries habitat.

LOCAL ECONOMY

The most significant effect of the local economy on Forest fisheries resources is the influence of the commercial fishing industry on escapement. Escapement is affected by commercial fishing because the natural or "wild" fish populations are harvested disproportionately along with the hatchery stocks in the ocean. This overharvest of "wild" fish can result in fewer adult fish returning to their natal waters to spawn, on-Forest fish production.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON FISHERIES

Fisheries habitat changes are directly tied to the sediment yield resulting from each alternative. Total sediment yield only tells part of the story however; expected sediment within key productive fisheries drainages will have greater impact on the fisheries resource than sediment within less productive drainages. In general, sediment yields are related to the type, amount and location of activities or disturbances that occur within a given drainage. Certain types of sediments are known to "cement in" the bottom gravels of a stream. None of these types of sediments are known to exist on the Forest. The most significant detrimental effect of sediment in a stream occurs when more sediment is entering a stream than what the stream is able to carry out to the ocean given the current energy of the water in the stream. If this occurs, sediment which exceeds of the hydrological capacity of the stream to carry out is deposited on the bottom of the stream. If this sediment is deposited at the time of year when fish are spawning and if it is deposited on top of fish eggs which are incubating in the gravel, than it is likely that there will be a partial or possibly a total loss of all the eggs which are in the gravel at the time. Any sediment which is caused by forest management activities and is transported to the mouth of the river system from which it was generated, will accelerate the filling in of the lower reaches of the river and the development of a delta at the mouth of that river. The increase in lower river deposition and delta development caused by forest management activities is expected to be very minor in comparison to the natural rate at which rivers are silted in and deltas are formed. At present there are no known negative impacts from this sediment on the fisheries resources. Fisheries habitat capability, in turn, is also influenced by these disturbances.

The major environmental changes likely to influence fish habitat capability will result from timber harvest and road-related activities that increase sediment yields. Based on the varying levels of these and other forest activities noted above in the "Significant Interactions" section, Table IV-18 lists estimated anadromous fish habitat capability for each of the alternatives. On-Forest capability estimates are listed both with and without proposed habitat enhancement activities. The unenhanced estimates are based on the assumption that, as a minimum, current levels of mitigation will be maintained.

The existing potential for influenced off-Forest habitat capability was not estimated due to a lack of relevant data. Habitat capability for existing on-Forest habitat is estimated to be 9,412,000 anadromous smolt fish per year per decade. This estimate, for evaluation purposes, is considered to be the base level for on-Forest anadromous fish production capability. Listed on-Forest unenhanced alternative estimates lower than the indicated base level require additional mitigation measures to maintain existing habitat capability. Conversely, on-Forest estimates for all alternatives, with the proposed enhancement package, will exceed the existing capability.

The estimated fisheries outputs associated with a given alternative may vary considerably from decade to decade. These variations are primarily attributable to timing, location, and magnitude of timber harvest and roading activities within the more productive anadromous drainages.

Alternatives NC-No Change and B-Departure (Modified)

Output estimates were not determined for Alternative NC in the same manner as for the other alternatives, as no FORPLAN analysis was completed for NC. It is expected, however, that fish habitat will be substantially impacted by this alternative and outputs would be similar to those of Alternative B-Departure (Modified) for at least the first two decades (See Table IV-18). Both of these alternatives have high timber harvest and road building activities, particularly in the early decades. The sediment production associated with these activities results in the reduction in fisheries habitat quality and subsequent smolt production. Fisheries outputs derived for Alternative B-Departure (Modified) show that the second decade estimates are considerably below the existing habitat capability level. Without enhancement, substantial mitigation will be required to maintain existing habitat capability. With the enhancement package, capability should increase approximately 15 percent above the current level in the second decade. Even without enhancement, this Alternative is above existing in decade 5 as timber harvest drops substantially in these later decades of this departure alternative.

The commensurate loss of recreational and commercial fishing opportunities in the early decades is presented in Chapter II and within the "Recreation" and "Local Communities" sections of this chapter.

Alternative A-Current Direction

Alternative A-Current Direction output estimates listed in Table IV-18 indicate that habitat capability, in the first, second, and fifth decades, will be slightly above the existing capability. This is due to the reduction in sediment producing activities compared with levels of the previous two decades. Alternative A, with the enhancement package included, should increase habitat capability to approximately 12 percent above the existing level in the first decade and approximately 23 percent in the second. Recreation and commercial fishing will increase proportionately.

Table IV-18. Estimated Anadromous Fish Habitat Capability Index 1/ (Thousands of Smolt Produced Per Year Per Decade)

	Decade 1		Decade 2		Decade 5	
Alternatives	Unenhanced	Enhanced	Unenhanced	Enhanced	Unenhanced	Enhanced
No Change	9,369	10,306	9,485	11,382	9,682	11,567
A-Current Direction						
On-Forest	9,639	10,571	9,682	11,567	9,659	11,573
B-Dep (Modified)						
On-Forest	9,328	10,219	9,030	10,805	9,549	11,473
C-Pref (Modified)						
On-Forest	9,635	10,595	9,581	11,480	9,683	11,605
H (Modified)						
On-Forest	9,700	10,674	9,685	11,620	9,682	11,600
Alternative I						
On-Forest	9,840	10,837	9,800	11,775	9,754	11,684

1/ Existing on-Forest anadromous fish habitat capability is estimated to be approximately 9,412,000 smolt per year per decade.

Alternative C-Preferred (Modified)

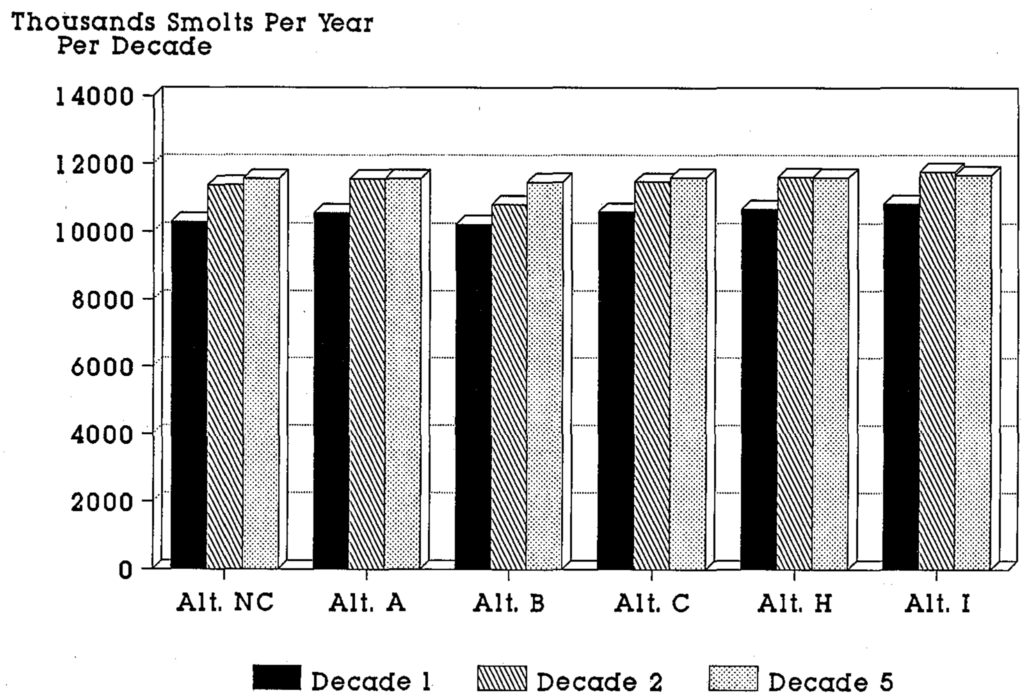
Sediment producing activities in this alternative are significantly below those of the past two decades. Based on the level of management activities (see Chapter II for specifics), the estimated fisheries outputs for Alternative C-Preferred (Modified) indicate an increase in on-Forest habitat capability. Habitat capability, with enhancement, will increase approximately 13 percent over the existing potential in the first decade and 22 percent in the second. Along with these increases in habitat capability will come increased commercial and recreational fish activity with associated effects on the recreational and local communities environmental components. The outputs associated with these effects are detailed in Chapter II and the indirect effects on the other components are discussed within those sections of this chapter.

Alternatives H (Modified) and I

Each of these alternatives has substantially reduced levels of activities which adversely impact fisheries habitat. Refer to the outputs discussions of Chapter II in concert with the "Significant Interactions" section above for an understanding of the low impact nature of these alternatives. The unenhanced habitat capability estimates for Alternatives H (Modified) and I are greater than the existing level. Unenhanced increases over the existing level are about 3 percent for H (Modified) in the first decade and approximately 4.5 percent for Alternative I in the first decade. Enhancement package estimates indicate increases in habitat capability of approximately 13 percent for Alternative H (Modified) and 15 percent for Alternative I in the first decade. These improvements increase capability in the second decade by 23 and 25 percent for Alternatives H (Modified) and I, respectively. Alternative I, followed by Alternative H (Modified), will provide the most substantial increases in fisheries habitat capability.

The high levels of habitat capability associated with these two alternatives will result in commensurate increases in commercial and recreational fish activity as noted in the outputs sections of Chapter II. These indirect effects are also noted within the appropriate environmental components of this chapter.

Figure IV-12. Anadromous Fish Habitat Capability Indices



CUMULATIVE EFFECTS OF ALTERNATIVES ON FISHERIES

The primary concern regarding cumulative effects on fisheries production involves the management of lands outside of the National Forest boundary. The Forest Service has no control over these activities and they are assumed to be constant across all of the alternatives considered in the FEIS. These effects were estimated by drainage during evaluation of the different alternatives in order to provide better data concerning our proposed management activities across the Forest.

The cumulative effects resulting from National Forest management activities are not expected to have a significant impact on the fisheries resources of the Olympic Peninsula. The risk of such effects is certainly greater in those alternatives, such as NC or B-Departure, with relatively high levels of sediment producing activities. (Refer to the "Cumulative Effects" section for the "Water" environmental component). The levels of sediment-producing activities associated with Alternatives C-Preferred (Modified), H (Modified), and especially I are significantly below those of the past two decades. The risk of cumulative effects are commensurately low. During Plan implementation, projects will be analyzed to assess the risk of cumulative effects and appropriate mitigation measures will be taken if necessary.

As the Timber, Fish, and Wildlife (TFW) agreement is implemented on non-Federal land throughout the State of Washington, many of the negative impacts that timber harvest has had on fish populations will be reduced or eliminated. This will subsequently reduce the cumulative effects risk of all Forest management activities on the fisheries resources of the Olympic Peninsula.

One area in which this planning process has a direct effect on the management of land outside the National Forest boundary is Simpson Timber Company land within the Shelton CSYU. The level of timber harvest from this land will depend on the alternative selected for implementation. Therefore, evaluation of the effects of alternatives on fisheries affected by Simpson harvest is included in this analysis.

The effects of Simpson harvest on fisheries could not be estimated as precisely as was done for National Forest harvest, since the data needed to generate such estimates were not available for Simpson land and the drainages it affects. It is possible to reach some reliable conclusions regarding the relative effects of the alternatives on the fisheries draining Simpson land. Since fishery production potential varies inversely with the level of timber harvest activity (and the road construction, reconstruction, and use that this generates), it is likely that alternatives with a high level of harvest from Simpson land will be lower in production potential than alternatives with low harvest levels.

Alternative NC-No Change involves by far the lowest harvest volume from Simpson land in the first decade, as this alternative continues emphasis on harvest from National Forest land within the Shelton CSYU. This alternative is, therefore, expected to provide a relatively high level of fish habitat quality in the first decade. Alternative C-Preferred (Modified) entails the highest level of Simpson harvest, and is likely to entail a relatively low level of first-decade fish habitat quality within Simpson drainages. The remaining alternatives are grouped between Alternatives NC and C-Preferred, all having roughly equal levels of first decade harvest from Simpson land. These alternatives are all expected to lie between Alternatives NC and C-Preferred in first-decade fishery production potential.

Over the last four years (1986-89), harvest from National Forest land within the Shelton CSYU has been greatly de-emphasized, while harvest from Simpson land has increased to an average of 180 million board feet per year. The first-decade annual harvest from Simpson land associated with Alternative C-Preferred is 183.4 million board feet. Therefore, the alternative with the highest Simpson harvest level represents continuation of recent conditions rather than increased effects due to harvest activity. The remaining alternatives all represent reduced levels of fisheries effects. This, in combination with the expected beneficial consequences of implementation of the TFW agreement, makes it likely that none of the alternatives will have an appreciable negative effect on the quality of fish habitat influenced by Simpson harvest.

MITIGATION MEASURES AND EFFECTIVENESS

The primary mitigation measures relevant to fisheries habitat are found in the Standards and Guidelines (Appendix D) and the Best Management Practices (BMPs) in Appendix J. In addition to Forest-wide Standards and Guidelines, mitigation is specifically addressed for the Riparian Areas management prescription (F2), River Corridors management prescription (A4B), and Wild, Scenic and Recreational River management prescription (A4A). When appropriately applied, these Standards and Guidelines and Best Management Practices (BMPs) will be very effective in protecting fish habitat.

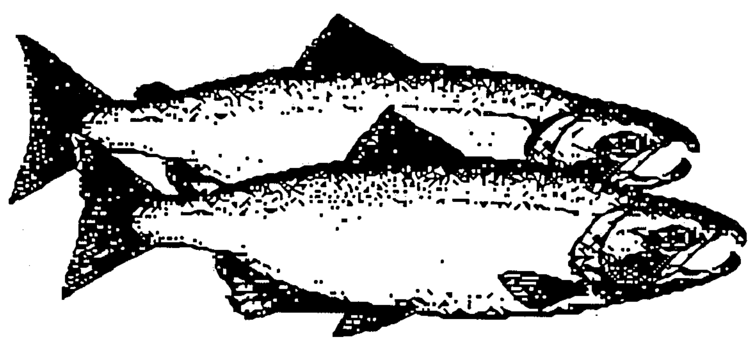
Mitigation and enhancement opportunities on the Olympic National Forest consist primarily of projects that will increase rearing space by improving the quality and quantity of pool habitat. It is estimated that a regular, annual program of pool development, enhancement, and maintenance will, by the end of the first decade, increase on-Forest anadromous fish habitat capability by about 20 percent compared to the associated alternative without the mitigation/enhancement.

During Plan implementation, drainage by drainage analysis of cumulative effects will allow us to plan on-forest management activities in drainages which have been relatively unaffected by previous activities rather than those that have been previously highly impacted. This distribution will mitigate potential cumulative effects in given drainages, as will applications of the Standards and Guidelines and Best Management Practices.

Any Forest Service activity which causes a decline in fish habitat capability will be mitigated by the initiation of a habitat improvement project which will bring the fish habitat up to or above the previous condition. The removal of a human caused barrier from an anadromous fish stream would be an example of such a project.

RELATIONSHIPS TO PLANS OF OTHERS

Fisheries resource conflicts with the plans of others are not anticipated, provided the existing potential habitat capability is either maintained or exceeded by Forest Service habitat mitigation or enhancement measures. This also assumes that an adequate number of returning adult anadromous fish will be allowed to escape the fishery (sport, commercial, and Indian catch) to fully seed available habitat.



FIRE

OVERVIEW

Fire occurrence on the Olympic National Forest, except for an average of 1.8 fires per year due to lightning, results from use of the Forest and its resources by people.

Based on current rates of occurrences, numbers of fires are: one per 122,100 RVDs of recreation and general forest use, one per 6,246 acres of timber harvested and one per 1,143 acres of slash disposed of by burning. These trends are used in projecting likely consequences of the alternatives.

Due to their relatively small size, the major impacts of these fires are in the economic values of resources utilized by people. This is primarily seen in the timber component of the vegetation resource. Timber harvest and its supporting activities, road construction and slash disposal, are the major sources of recent large, damaging fires. However, recreation and general forest use is the source of ignition for about the same number of fires.

SIGNIFICANT INTERACTIONS

VEGETATION

Vegetation provides the fuels that burn. Species of plants, stand age, health of the plants, stage of dormancy and other factors greatly affect the ignition potential, rate of spread, fire intensity and frequency of reburns. These factors also influence the suppression strategies and tactics applicable to fires. Stand species composition and other factors also affect the economic values at risk in a fire occurrence.

Areas where vegetation has been altered by logging or other activities may form areas of increased fire hazard or, where suitably designed and treated, may be used as fuel break components within the overall fire protection system.

Timber harvest and supporting operations result in one fire per 6,246 acres logged (1.3 fires) per year. These fires average 5.3 acres each.

Slash disposal burning activities result in one fire per 1,143 acres treated (5.7 fires) per year averaging about 44.9 acres each. Approximately 26 percent of the area burned in these fires is reburn of the targeted treatment area.

INSECTS AND DISEASE

Insect and disease-killed or damaged trees provide increased potential for ignitions from both natural and human causes. These trees are generally distributed throughout the Forest.

When insects or diseases are at epidemic levels, the volume of potential fuels may be increased substantially. Increased effects on fire spread and intensity result in the area where concentrations of dead/damaged material occur.

FIRE

Fire alters buildups of forest fuels for a period of time following its occurrence. In this way, fire influences the potential of other fires occurring and their intensity. Specific effects vary based on the intensity of the fire that occurs, the amount and arrangement of the fuels on the burned area and the species mix and seral stage of the forest that burned.

RECREATION

Recreation uses are the ignition source for about one fire per 122,100 Recreation Visitor Days (RVDs) per year (10.3 fires). These fires average about 0.6 acres each.

ENERGY

Utilization of biomass materials as an off-site energy source reduces on-site forest fuels. This can reduce on-Forest potential ignition hazards, spread, resistance to control and energy release rate of fires. If sufficient material is removed for use, further fuel treatment may be unnecessary.

ROADS

Roads and trails tend to ease access for Forest users, which affects the pattern of human-caused ignitions. Roads, trails and other system facilities may also be used for suppression access and in suppression action as prebuilt fire lines.

LOCAL ECONOMY

Economic utilization of the timber resource results in 23 percent of the fires that occur on the Forest and 95 percent of the acreage burned. Economic values of the Forest's resources are basic concerns in establishing fire presuppression and suppression investment levels.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON FIRE

The frequency and severity of fires appear to be directly related to weather cycles, fuel loading, and Forest use levels by people. Projected numbers of fire starts and acres burned by Alternative are shown in Table II-14. Severe weather cycles with prolonged fire seasons, incidence of lightning-caused fire starts, and generally resulting larger fires are phenomenon over which we have little direct control. Indirect control can be attained through appropriate fire planning, fire suppression preparedness, and fuels management. Cooperation and coordination with other State, Federal, and local fire protection organizations will also continue to be important elements in the area of fire prevention, fire suppression, and fuel treatment.

Alternatives B-Departure (Modified), NC-No Change, and A-Current Direction

These alternatives, with high timber harvest levels, contribute to a significant increase in fuel loading. Fires can be very severe and cause extensive damage to environmental components under these circumstances. The incidence of fires is also likely to increase under these alternatives since there will be a greater number of industrial operations associated with timber harvesting and road construction. The potential adverse effects and risks are considered to be of short term duration. Timber sale and road construction operations include provisions for the abatement of residue hazards. The short term increase in risk and hazard represents considerable advantages and benefits over time. The planned and scheduled treatment of accumulated fuels will reduce natural residue buildup, and over time, should reduce the occurrence of large damaging wildfires. There are several other fire management advantages inherent in these alternatives. The extended road system will include more miles of road that can serve as fuel breaks or fire control lines. Initial attack and suppression activities with tankers and other vehicles will be easier, more timely, and effective.

Use levels by general forest recreationists will probably increase because the extended road system will make recreation opportunities available to a greater cross-section of the general public. Increasing use levels are expected in all alternatives and any expected associated increases in fire occurrence will likely remain fairly constant across all alternatives.

Alternative C-Preferred (Modified)

The accumulation of residue and fuels resulting from timber harvest operations will be more gradual in this alternative. Treatment and hazard reduction levels will also be lower, with a trend to let natural fuels and residues accumulate over time. The fuel loading of natural residues and a more gradual rearrangement of fuel continuity under this alternative can significantly reduce the severity of wildfires but it will take longer than the earlier referenced alternatives.

Alternatives H-(Modified) and I

Natural fuel levels are likely to accumulate under these alternatives and the potential for large damaging wildfires will increase. Fire suppression activities under these two alternatives will also be less prompt and effective because of the greater allocations to roadless areas.

CUMULATIVE EFFECTS OF ALTERNATIVES ON FIRE

Total fire protection needs for the Forest are also closely related to levels of use, risk, and hazard on adjoining lands protected by other agencies, the currency and level of fuels treatment, and the manning levels of the other protection agencies.

Failure of landowners to treat fuel buildups in a timely manner and to suitable standards can lead to a major fire occurrence with significant impacts on environmental and financial values.

MITIGATION MEASURES AND EFFECTIVENESS

Each project that manipulates vegetation or generates ignition potential affects risk of ignition and fire size and intensity. These projects must be evaluated carefully and thoroughly. A fire prevention plan is designed as a basic part of the project plan and must be carried out effectively.

Fuels resulting from the plan should be evaluated for effective treatment to maintain post project risks and hazards within acceptable levels. A variety of methods and standards of treatment can be considered and applied as needed.

All of the alternatives indicate substantial reductions in acres to be treated with prescribed fire from the current situation. This is due to continued efforts to utilize other methods of site preparation, increase utilization of excess residues and accept increased risk of fires in areas identified as being potentially damaged by prescribed fire use.

RELATIONSHIP TO OTHER PLANS

The major forest protection agencies on the Olympic Peninsula (the Forest Service, National Park Service, and Washington Department of Natural Resources) all have fire protection plans. While these plans are specifically prepared to address responsibilities of the agencies on their specific areas, they include provisions for mutual assistance and free interchange of personnel, equipment and information.

Preseason meetings are held to evaluate staffing and equipment levels and siting of resources in the coming season for maximum joint efficiency. Joint training exercises are held and fire management strategies are discussed.

As the Federal agencies are considered part of the National fire suppression resource and the State has fire protection responsibilities statewide, agreements have been developed that permit use of personnel and equipment nationwide if needed.

Ranking of the alternatives' effects on fire occurrence and the effects of the resultant fires on the environment are listed from high to low and estimated to be: Alternative B-Departure (Modified) - High; Alternatives NC-No Change and A-Current Direction - Medium/High; Alternative C-Preferred (Modified) and Alternative H (Modified) - Medium; and Alternative I - Low.

AIR

OVERVIEW

Except for relatively short-term and localized effects, Forest resource management activities have only minor effects on air quality.

The Forest's major activity affecting air quality that is controllable in management activities, is the quantity of total suspended particulates (TSP) resulting from use of prescribed fire. Currently, most treatment of forest fuels are treated by broadcast burning and estimated quantities of this activity are shown by alternative in Table II-14.

SIGNIFICANT INTERACTIONS

VEGETATION

Vegetation and air continually interact during plant metabolic processes. Vegetation absorbs carbon dioxide from the air and "exhales" oxygen with vapor and other materials from metabolic reactions.

A current world-wide environmental concern is the "Greenhouse Effect." The Greenhouse Effect theory is that massive use of fossil fuels and worldwide deforestation are injecting large quantities of carbon dioxide (CO_2) into the atmosphere. This "traps" heat in the atmosphere and is predicted to lead to warming of the Earth, melting the ice caps and substantially altering climatic patterns. Atmospheric CO_2 is estimated to have increased by approximately 25 percent since 1850.

A major source of CO_2 is deforestation from both burning and decomposition of plant material. It is estimated that currently two-thirds of CO_2 is from fossil-fuel burning and one-third is from deforestation.

Trees, along with other plants, have the capability of extracting CO_2 from the atmosphere and "fixing" it in woody tissue, liberating oxygen as a by-product of the photosynthetic process. Because this bound carbon is temporarily unavailable for conversion back into CO_2, it is effectively removed from its role in the "Greenhouse Effect." Also, as CO_2 concentration increases in the atmosphere, plants absorb it faster, and their growth is enhanced.

For practical purposes, this removal of carbon from the cycle is relatively short-lived and eventually reaches a state of equilibrium. This is often an overlooked value of the growing forest. The oceans are estimated to have the potential to fix almost four times as much carbon as the forests. The contributing effect of the Olympic National Forest and its management activities on the global "greenhouse effect" is considered to be insignificant under any scenario evaluated in the FEIS.

FIRE

Fire affects air by injecting smoke particulate matter and gasses. These particles result in odors, changes in air coloration, reduced visibility and airborne materials that have adverse effects on the health of susceptible people. They also provide condensation nuclei, affecting potential precipitation in downwind areas and possibly its chemical makeup. Carbon dioxide released by fires contributes to the "Greenhouse Effect," a possible long-term environmental concern (Deeming 1982, Sandberg and Ward 1982).

ROADS

Construction and use of roads result in localized dust and exhaust gasses in the air.

MINERALS

Activities to extract or utilize minerals have the potential to produce dust, smoke and odors from processing machinery. This is generally localized and occurs only for the duration of the activity.

RECREATION

Auto exhaust, campfire smoke, and inadvertent ignitions resulting in wildfires are the major effects of recreation use on air quality.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON AIR

Direct air quality effects in each alternative effects are proportionate to the level of activities that generate dust, exhaust gasses from machinery, and smoke. The major activity that affects air quality is the production of TSP where prescribed fire is used for logging slash disposal or other management purposes. TSP productions by alternative are shown in Table IV-19.

Dust and its effects are generally localized near the site of origin. Engine exhaust gases and smoke from all activities enter the atmosphere and contribute to smog and the greenhouse effect.

Smoke from prescribed fire can travel great distances, affecting visual quality of the air. Occasionally, concentrations are high enough in inhabited areas to cause odors and discomfort for residents.

Table IV-19. Total Suspended Particulates (Tons)

	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Decade 1	5,798	2,804	4,498	1,654	1,081	139
Decade 2	Unestimated	2,380	4,647	2,086	1,344	528
Decade 5	Unestimated	1,788	1,578	1,613	1,707	1,450

Alternatives B-Departure (Modified) and NC-No Change

The adverse effects on air quality will be greatest under the management strategies associated with these alternatives. Higher timber harvest levels will result in fuel treatment and hazard reduction over correspondingly greater areas and fuel quantities. Escaped fires and higher fire occurrence are expected to further compound the detrimental effects on air quality.

Alternatives A-Current Direction and C-Preferred (Modified)

These alternatives will also periodically affect air quality but not as severly as Alternatives B-Departure (Modified) and NC-No Change. Timber harvest levels, and subsequent prescribed fire for hazard reduction and site preparation will affect scenic views, clean air, and natural settings that are valued for quality recreation experiences. While these impacts are temporary for the most part, they usually occur at a time when recreation demand is high.

Alternatives H-(Modified) and I

Detrimental effects on air quality would be lowest with the selection of these two management strategies. Larger areas would remain roadless with commensurate localized reductions in vehicle emmissions. Fuel treatments would also be reduced because of lower timber harvest levels. Some prescribed fires would still be used but the duration and intensities would be far less than under other alternatives. A trend in natural fuel accumulation would likely occur. Periodically, air quality would be more adversely affected through wildfires than might be under other management strategies.

CUMULATIVE EFFECTS OF ALTERNATIVES ON AIR

As similar land management activities on other ownerships are often being conducted simultaneously with those on the National Forest, there are times when the combined effects, particularly smoke from slash burning, can very heavily impact air quality on downwind areas.

MITIGATION MEASURES AND EFFECTIVENESS

Where activities that adversely affect air quality are to be conducted, over-all impacts can be mitigated through coordinated scheduling with similar activities of others and analysis of weather patterns that might affect project timing and conduct. This is applicable to all alternatives.

Effectiveness of this strategy can be evaluated by observing the effects of long term monitoring of sensitive receptor areas and direct observation of air quality degradation in target areas due to Forest program activities.

Another mitigating opportunity is the utilization of excess logging residues making it unnecessary to treat the material on-site.

The level of past logging residue treatment or removal has been, at times, excessive. Retention of larger volumes of this material on the site for nutrient recycling and wildlife habitat would significantly reduce the need for burning and minimize the effects on air quality.

A major opportunity is the removal of excess biomass waste material for use as fuel in cogeneration facilities. While this use requires burning of the material in boilers, it can be done under carefully controlled conditions designed to minimize undesirable atmospheric effects. The heat and power produced can be substituted for energy currently provided by fossil fuels, resulting in savings of this critical resource.

Burning of logging residue can be restricted during summer weekends to minimize the impacts to Puget Sound area recreationists. This has proven to be an effective means of mitigating the visual effects of smoke on the public.

RELATIONSHIP TO PLANS OF OTHERS

Regulations of the Washington State Department of Ecology (DOE), under the Federal Clean Air Act and its amendments, call for reduction of overall air pollution and proposed limitations on TSP production.

Achievement of air quality goals requires not only reductions of pollutants put into the air but control of timing to avoid intrusion of smoke into sensitive areas. The Washington DNR has been assigned the task of coordinating the use of prescribed fire in forestry related activities to meet these DOE goals. All proposed forestry related burning State-wide is coordinated on a daily basis by DNR's smoke management office in Olympia.

The State's proposed Visibility Protection Revision to the Washington State Implementation Plan was prepared in response to the Federal Clean Air Act. It establishes an objective of a 35 percent reduction in prescribed fire TSP emissions from slash burning by 1990 from a baseline of the 1976-1979 average level for Western Washington. The Olympic National Forest's proportionate share of this reduction would establish an emissions ceiling of 3,837 tons per year of TSP. Several emission-reduction techniques are outlined in the State's program, including utilization measures.

CULTURAL RESOURCES

OVERVIEW

Our mission at the Forest level is to identify, locate, manage, and protect all cultural resources. Evaluation, data recovery, surveys, research, and other studies are especially, although not exclusively, keyed to cultural resources that may be affected by resource management activities. While it is important to survey and evaluate all areas and resources to develop appropriate evaluative contexts, it is imperative that cultural resources are located and protected in advance of potential adverse impacts that may result from forest management activities. The importance is recognized to the extent that advanced surveys are required by law for all project activities that may affect cultural resources.

Generally, effects on cultural resources will vary in accordance with the degree of other resource program activities, particularly those that result in ground disturbance. As discussed in Chapter II, the probability of adverse impacts or loss of cultural resources increases as lands are allocated to uses involving land-modifying activities. By comparison, the effects from other elements that interact with cultural resources can generally be expected to remain constant, and perhaps neutral, for these same allocation decisions. Climate is a good example.

Impacts or potential impacts to cultural resources as an environmental consequence of land management allocations are directly related to the amount of ground disturbance inherent in a prescribed or selected management alternative. It is important to also recognize that there may be associated benefits from location, identification, protection and interpretation of cultural resources that might remain undetected if not for these activities.

The degree or difference in effects on cultural resources between some allocation alternatives or management strategies is difficult to measure or quantify. For this reason, the alternatives have been grouped with respect to similarities in ground-disturbing intensity and subsequent potential effects on cultural resources.

SIGNIFICANT INTERACTIONS

VEGETATION

The dense vegetation and ground cover typical of Olympic National Forest makes reconnaissance and discovery of cultural artifacts extremely difficult. Timber harvesting can present a significant threat because of the ground disturbance caused by roads, skid trails, landing construction, yarding of logs, slash piling, and tree planting. At the same time, timber harvesting provides opportunities for identification of previously unknown cultural properties by removing vegetation and exposing the underlying materials.

RECREATION

Recreation use may result in impacts on cultural resources, both through the development of campgrounds and trails and through increased potential for vandalism as a result of improved access. Occasionally, public use may result in the deliberate destruction of cultural properties through vandalism, relic collecting, theft and carelessness.

MINERALS

The potential interaction between mineral resource management and cultural resources occurs during the mineral exploration, development and extraction phases, when surface-disturbing activities take place.

The development and use of common variety minerals in road construction can significantly impact cultural resources. This is particularly true when mineral sources are located in alluvial deposits and where stream courses have changed location over the years.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON CULTURAL RESOURCES

ALTERNATIVES H (MODIFIED) AND I

These two alternatives involve low alteration of the landscape, and represent a reduced level of vegetative change and ground disturbance from the current situation. Corresponding impact to cultural resources is also expected to be low to moderately low. Discovery and protection opportunities may be less due to a reduced number of surveys, as compared to other alternatives.

ALTERNATIVE C-PREFERRED (MODIFIED)

This alternative represents a moderate program activity level with corresponding impact potential from associated ground disturbance. Timber harvest, road construction, and other commodity-oriented activities will be lower in intensity than those experienced in recent decades. To the extent that we can determine through post sale and road construction surveys, impacts to cultural resources are not occurring at unacceptable or injurious levels. The comparatively reduced level of activity represented by Alternative C-Preferred (Modified), therefore, does not pose an undue threat of damage potential to cultural resource values. Approximately 12,000 to 15,000 acres of Forest lands will be surveyed each year under the management strategies of this alternative. Selection of this management strategy will offer good opportunities and probability that cultural resources will be located and protected.

ALTERNATIVES A-CURRENT DIRECTION, B-DEPARTURE (MODIFIED), AND NC-NO CHANGE

After the first decade, these alternatives have considerable potential for increased impacts on cultural resources because of the increased timber harvest level associated with these alternatives for management. The number of projects and ground-disturbing activities will increase substantially. Conflicts between cultural resource values and other resource management activities are possible, with a corresponding need to mitigate adverse effects rather than selecting options that assure avoidance of them.

All alternatives include basic consultation requirements with the State Historic Preservation Officer as described in the Standards and Guidelines. (See Forest-wide Standards and Guidelines in Chapter IV of the Forest Plan.) Although the State of Washington has not finished a comprehensive State Historic Preservation Plan, consultation with the State Historic Preservation Officer are a routine requirement of the environmental analysis process prior to implementing any management activity.

CUMULATIVE EFFECTS OF ALTERNATIVES ON CULTURAL RESOURCES

The cumulative effects of any adopted management strategy or alternative will result in decreasing opportunities to retain sites in an undisturbed state.

Alternative I offers the best opportunity to maintain sites in an undisturbed setting because it will have the least cumulative ground disturbance over time, followed by Alternative H (Modified), C-Preferred (Modified), Alternative A-Current Direction, Alternative NC-No change, and Alternative B-Departure (Modified).

While resource management activities may help us discover sites, we will need to be certain that potential damages are either avoided, minimized, or mitigated.

MITIGATION MEASURES AND EFFECTIVENESS

The most desirable mitigation measures are those that provide the least disturbance or impact to cultural resources and their environmental setting. Quality survey work, in advance of project implementation, offers the most effective means to discover sites and avoid damage. The most desirable measures of mitigation are those that protect the cultural resources in place. Many times when sites are discovered in advance of project implementation, the project can be altered or modified to avoid damage altogether. Other measures that can be utilized to mitigate impacts are: full suspension yarding systems; use of existing or previously disturbed roads and skid roads; requiring over-snow yarding; project monitoring during actual ground-disturbing activities; use of protective "capping" techniques through design or covering with fill material; moving or relocating a resource such as a historic structure, and complete recovery through professional, archaeological excavation. There are many means and measures available in our management portfolio to reduce disturbance, minimize impacts and mitigate damage.

Specific mitigation measures for resources eligible for inclusion on the National Register of Historic Places will be implemented on a site-by-site basis in consultation with SHPO and the National Advisory Council.

RELATIONSHIPS TO PLANS OF OTHERS

The Washington State Office of Archaeology and Historic Preservation (SHPO) is in the Resource Protection Planning Process (RP3) for preparing a State-wide Preservation Plan. At this time, the focus of planning has been centered on areas other than general rural lands like the Olympic National Forest. Consequently there are no known conflicts with the RP3 Planning Process. As the SHPO planning process extends to National Forest areas, coordination of effort and activities will be desirable and needed. For further reference to this topic, see also the Forest Plan Chapter IV Goals for Resource Programs (Cultural Resources).

Various Indian Tribes, in the zone of influence for the Olympic National Forest have completed or are in the process of completing resource management plans, some of which specifically address cultural, ceremonial, traditional, and religious concerns. It is imperative that the Forest is informed, involved, and knowledgeable about these planning efforts, especially as it relates to affected National Forest lands.

AMERICAN INDIANS

OVERVIEW

Chapters I and III of this FEIS provide additional information about the concerns, rights, and values held by Peninsula and Puget Sound American Indian Tribes. Central to these issues are Treaty Rights, cultural, ceremonial, religious and traditional values, fish and wildlife habitat, and availability of cedar. These considerations form the core of American Indian concerns regarding management of the Olympic National Forest. Please refer to the Position Statement by Olympic Peninsula Indian Tribes in Appendix K which also addresses these issues.

As individuals, and as a group, the American Indian community has a strong interest in the commodity-oriented use of forest resources, including those of the Olympic National Forest. A broad segment of this community group is directly or indirectly dependent on commodity-oriented utilization of National Forest resources. On the other hand, this group is no less interested in amenity-oriented values and environmentally sensitive approaches to forest management that preserve and enhance these values. Polarized opinions may exist within this group, but there is unanimity that the integrity/quality of fishery habitats and validation of all treaty rights be diligently preserved.

To that end, tribal entities have expressed a strong preference for forest management practices and Forest Plan alternatives that favor fisheries values, especially protection and enhancement of fish habitat. Similar preference has been expressed for management strategies that provide environments conducive to cultural, ceremonial, religious, and traditional uses of the Olympic National Forest. Availability of western redcedar for its many uses and purposes, a scenic and pristine setting, and other opportunities for traditional uses and experiences are values and benefits that the American Indian community desires to maintain and retain (see also the sections of this chapter which address Cultural Resources and Local Communities). Perhaps more than any other group, the American Indian community reflects a need for a balanced approach to forest management strategies, a balance of commodity-oriented goods and services combined with an equally strong emphasis on the protection and enhancement of amenity values.

SIGNIFICANT INTERACTIONS

Significant interactions stem from fundamental resource values that are emphasized or expressed through basic land and resource allocation decisions and alternatives. Significant elements of forest land management that interact with and affect the concerns, rights, and values held by American Indians include, but are not limited to: timber harvest levels and associated road construction, levels of old-growth allocations, protection of fish and wildlife habitats, and selection/designation of special management areas or units such as Wild and Scenic Rivers, River Corridors, and Botanical Areas.

TIMBER HARVEST AND ROAD CONSTRUCTION

Timber harvest levels and associated road construction can have profound and significant effects on fish habitat and amenity values. Amenity values such as natural landscapes, pristine settings, and unaltered availability of plants and vegetation are important elements of cultural, ceremonial, and religious values held by American Indians. The interaction and effects of timber harvest levels and road construction on these values can be significant. Erosion and sedimentation resulting from road construction can be destructive to fish habitats. Viable and productive fishing habitats are essential to perpetuate productive fishing resources that are central to the existence, tradition, and cultural way of life, for Puget Sound tribes. Roads can also adversely affect amenity values that are needed to maintain pristine, natural landscapes.

OLD-GROWTH MANAGEMENT STRATEGIES

Management strategies for old-growth, and the associated flora and fauna of the ecosystem, can have substantial effects and interaction with the rights, concerns, interests, and values held by American Indians. Old-growth western redcedar is a very central and special element that holds a deep and abiding spiritual value and special meaning for all Puget Sound tribes. Associated wildlife species, natural old-growth settings and landscapes fundamental to religious and ceremonial beliefs, also have a direct cause and effect relationship. Selected strategies for old-growth management can easily foster or diminish the availability of these values.

SPECIAL MANAGEMENT UNITS OR AREAS

Allocations, management standards, and strategies for riparian areas, scenic areas, Wilderness, and Wild and Scenic Rivers can significantly affect and interact with fishery resources, and the favored pristine natural landscapes related to religious and ceremonial environments. Management alternatives that favor or emphasize allocations which limit commodity production will provide greater protection and enhancement to fishery resources.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON AMERICAN INDIANS

Detrimental effects and adverse consequences to the foregoing values are possible with the implementation of any management strategy. An emphasis on adequate surveys and coordination with local Indian tribes is essential, because little is known about specific sites that may hold ceremonial, religious, or traditional significance. There is understandably some reluctance by Indian tribes to disclose the location of these sites, as their value could easily be diminished or jeopardized with widespread public knowledge and intrusion. For these same reasons, any cultural resource site information or data is exempt from disclosure under the Freedom of Information Act (FOIA), and any public use or disclosure is restricted. Until specific locations can be identified, the consequences of implementing management alternatives can only be measured in broad terms, i.e., the more intensive the vegetation and land modification, the more likely the alternative could adversely affect American Indian interests.

However, it must be remembered that the interests and concerns of this community group are diverse and varied. Unlike the other groups, American Indians live throughout the Peninsula, both on tribal reservations and within the general population. The American Indian community represents a cross section of the wide range of interests typical of the entire spectrum of community groups. While many individuals within this group have their own specific opinions, interests, and concerns, there is often a very cohesive and uniform response that reflects the common goals, objectives, and cultural heritage of all American Indian people.

Alternatives NC-No Change and B-Departure (Modified)

The American Indian community would probably least favor Alternatives NC-No Change and B-Departure (Modified). While these alternatives offer greater opportunity for harvest-based employment and other associated benefits, the attendant reduction in the quality of amenity values and fishery habitat would not be a welcome tradeoff.

Alternatives NC-No Change and B-Departure (Modified) are more likely than all the other alternatives to have potential detrimental effects. It is difficult to assess any impact potential except in the most general terms. Emphasis is needed to foster a sensitive and effective dialogue with interested tribes about specific sites and amenities that have a profound meaning and place in American Indian religious, ceremonial, and traditional values.

Alternative A-Current Direction (No Action)

Alternative A-Current Direction (No Action), with its slight decline in harvest level and the concurrent improvement in fish habitat quality, would be more likely to be consistent with the overall goals of the American Indian community than are Alternatives NC and B-Departure. The slight reduction in harvest-based employment of this alternative is not likely to be viewed negatively within this community group.

Alternative C-Preferred (Modified)

Alternative C-Preferred (Modified) entails a substantial reduction in opportunity for harvest-based employment relative to Alternative A. Concurrently, this alternative results in an increased level of fish habitat quality and amenity output emphasis. It is anticipated that the mix of harvest-based employment and fish habitat quality associated with Alternative C is likely to be compatible with the objectives of this segment of the Peninsula community.

Alternative C-Preferred (Modified) has more disruptive potential than Alternatives H (Modified) and I, because timber harvest levels are higher and acres managed specifically for amenity resource qualities are lower.

Alternatives H (Modified) and I

Alternatives H (Modified) and I entail progressively greater reductions in opportunity for harvest-based employment and increasing levels of fish habitat quality and amenity output emphasis. The reductions in harvest-based employment associated with these alternatives may be severe enough to be potentially disruptive within this community group. This is particularly true in the case of Alternative I.

Alternatives H (Modified) and I will be the least disruptive to amenity values, because timber harvest levels are comparatively lower, and the allocations to amenity resources, including those protecting fisheries values, are at the highest levels.

Local American Indian tribes also retained specific rights in the treaties that were negotiated with the United States. Many of these rights are directly and indirectly related to wildlife and fishing resources and the habitats that support these resources. The selection of any management alternatives must include provisions and standards that will fully protect the opportunity by Indian tribes to enjoy the rights that were retained and vested in treaties and treaty law. For additional discussions of these topics, please refer to Chapter III.

The distribution and abundance of fish and wildlife resources are of great importance to the local American Indian tribes. Please refer to the "Wildlife" and "Fisheries" sections of this chapter for an evaluation of the effects of the alternatives on these resources.

Since the selection of a management strategy has a fundamental bearing on the Peninsula economy, local Indian tribes are generally interested in management alternatives that foster a vigorous timber industry economy. However, there is also strong interest in protecting and preserving productive fishery habitats. Contrary to some segments of the public, Indian tribes favor management alternatives that offer a balanced approach, as long as fishery habitats and fishery resource values are not diminished. For additional information, please refer also to sections in this chapter titled "Local Economy" and "Local Communities."

CUMULATIVE EFFECTS OF ALTERNATIVES ON AMERICAN INDIANS

A substantial number of sites important to American Indians are likely to be located in Wilderness and special management unit allocations. Wilderness and some special management units are a consistent and uniform element common to all Forest Plan Alternatives. Any sites or values, such as remote and pristine settings, medicinal flora, and ceremonial areas, will remain unaltered and available in these resource allocations. The cumulative effects of amenity-oriented alternatives would suggest a reduction in some opportunities or values for the American Indian. These same alternatives offer some cumulative benefits as well, such as employment opportunities and economic stability. While some opportunities or values may be diminished in a relative sense over time, Standards and Guidelines are in place to secure all treaty commitments and to preserve all rights and interests under such laws as the American Indian Religious Freedom Act.

MITIGATION MEASURES AND EFFECTIVENESS

The mitigation of effects on American Indian concerns, rights, beliefs, and values is in many ways similar to those for cultural resources in general. Please refer to the section earlier in this Chapter that addressed mitigation and effectiveness for cultural resources. Additionally, a continuing dialogue and sharing of information about known or suspected sites will aid in preservation and protection of these values and it is likely the most effective means to reduce direct, indirect, and cumulative impacts.

RELATIONSHIPS TO PLANS OF OTHERS

Please refer to the discussion of this topic under the Cultural Resources section found earlier in this Chapter. Some Indian Tribes have initiated cultural enrichment programs and are conducting various studies and planning efforts. One good example is the recently completed Makah Traditional Cultural Property Study. The coordination and sharing of these studies and information is critical if the interests and concerns of the Tribes are going to be best served.

Every Alternative will include provisions for coordination with the American Indian community to ensure protection of ancestral sites and freedom to continue traditional religious uses of Olympic National Forest lands and resources (see Forest-wide Standards and Guidelines, Forest Plan - Chapter IV).

RECREATION

OVERVIEW

The Olympic National Forest provides a wide range of recreation settings. A recreation setting consists of the physical characteristics of an area, such as the distance from roads and evidence of management activities, and the social characteristics of the area. In terms of the Recreation Opportunity Spectrum (ROS), the settings found on the Forest range from Rural to Primitive. In the Rural setting, natural features may be substantially modified, and there is a high probability of encountering large numbers of individuals and groups. In contrast, the Primitive setting involves areas that are essentially unmodified and natural appearing, and interaction among users is minimal. Refer to Table IV-20 for current acreage in each of the Forest's Recreation Opportunity Spectrum classes.

The mix of recreation settings and environments that will be provided in the future varies considerably from alternative to alternative. The Forest has the capacity to meet projected demand for developed and roaded dispersed recreation in all alternatives. The principal variation among alternatives in the case of these forms of recreation is, therefore, the quality of the recreation environment in which they occur. In the case of recreation in the Primitive and Semi-Primitive ROS classes, however, demand levels are high and expected to grow, while the supply of opportunities is limited. The level of opportunity available in these ROS classes is a key consideration in the comparison of alternatives.

The number of existing and proposed developed recreation sites, and the mileage of recreation trails to be constructed and maintained, will remain the same from one alternative to the next. However, the environment in which they are located or that one must travel through to get to them will vary greatly from alternative to alternative. Access corridors, the areas surrounding developed sites, and the areas through which trails pass will vary from predominantly unmodified natural environments to environments that would be substantially modified, with management activities readily evident.

The Lake Quinault Lodge and the 68 recreation residences on the south shore of Quinault Lake will continue to be managed under special use permits in all alternatives.

The opportunity for roaded dispersed recreation will vary among the alternatives. However, because of the high degree of development of the Forest's existing road system, it is expected that the demand for roaded dispersed recreation will be met in all alternatives.

SIGNIFICANT INTERACTIONS

WATER

Management activities implemented for the protection or improvement of water quality, such as channel stabilization and dust abatement, have positive effects on recreation. Channel stabilization, such as riprapping of a riverbank, serves to protect recreation sites and facilities in addition to protecting water quality. Dust abatement activities, such as oiling or paving, eliminate dust and make travel safer for recreation traffic. Paving a road generally increases recreation use. Activities implemented to protect water quality will also protect or enhance fish habitat, which in turn has a positive effect on recreation.

VEGETATION

Vegetation can be a recreation attraction and benefit or, in some situations, a deterrent. The lush vegetation of the Olympic's temperate rain forest attracts visitors from throughout the United States. Towering old-growth conifers with their understory of moss, lichens and ferns are becoming an uncommon vegetative phenomenon. Vegetation is also an important component of landscapes, such as a rain-covered stand of conifers blanketing a distant ridge or a mountain meadow covered with delicate flowers. At developed sites, vegetation benefits recreation by screening camp units, framing views, helping to block out noise and other distractions, controlling pedestrian traffic, and preventing erosion. Vegetation is also an important part of wildlife habitat and, therefore, enhances the opportunity for seeing wildlife. In some cases, vegetation deters recreational activities such as hunting, fishing and mountain climbing.

There are several vegetative management activities which affect recreation in one way or another. Management that eliminates noxious weeds or enhances threatened, endangered or sensitive plant species generally has positive values. Timber harvest activities often have negative impacts on recreation. Harvesting impacts views, creates slash and can require closure of roads to recreation traffic for extended periods of time. In some situations, timber management activities may enhance recreation opportunities. Careful planning of timber harvesting can be used to create vegetative diversity along a road corridor, open vistas for scenic viewpoints, and improve road access to recreation facilities and attractions.

RIPARIAN AREAS, WETLANDS, AND FLOODPLAINS

Developed recreation sites within flood plains are subject to flooding and erosion. Facilities within these sites are often damaged and, under extremely heavy flood conditions, may be destroyed. Steelhead Campground was washed out when the Dosewallips River changed its course and eroded most of the site, washing out the access road and several units and destroying the well. Currently, Hamma Hamma, Lena Creek, Elkhorn, Collins, and Brown Creek Campgrounds are located within the flood plains of rivers and are subject to flooding and erosion.

Riparian areas, wetlands, and tidal flats are unique recreational settings. Due to the scenery of these water-related settings, and the fish and wildlife associated with these areas, recreational use is often high.

FISH AND WILDLIFE

Fishing and hunting are popular recreational activities. The quality of habitat for fish and wildlife species will have a direct effect on species populations and a subsequent effect on the recreation experience of the Forest users.

Fish and wildife management activities are directed toward planning and developing overall Forest programs to restore, maintain or enhance fish and wildlife habitat. Generally, recreation settings and activities benefit from management activities that improve fish and wildlife habitat and are negatively impacted by activities which damage habitat.

INSECTS AND DISEASE

The major direct effects that insects and diseases have on recreation are related to the vegetation in developed recreation sites such as campgrounds and picnic areas. Insects and diseases can weaken and kill vegetation. Large trees in or near developed sites that have been weakened or killed by insects or diseases are a hazard to visitors and their vehicles. They are also a hazard to onsite facilities, such as comfort stations, tables, roads, waterlines and bulletin boards. Where epidemics occur, large numbers of areas of vegetation might be affected, to the detriment of scenic values.

FIRE

Smoke affects visibility during the period of wild and prescribed fires. Sometimes a substantial area is affected, thereby reducing the recreational value of the area.

AIR QUALITY

Most people who come to the Forest expect to find clean, pure air. This is particularly true of people seeking a Semi-Primitive or Primitive recreational experience. Generally, they are tolerant of their own campfire smoke. In fact, the odors may be part of the memories recalled in later reminiscences. However, the combined smoke from multiple campfires, or particularly from the burning of timber harvest residue, may be considered offensive.

RECREATION

Allocating areas to a particular Recreation Opportunity Spectrum class affects recreation by providing for certain types of recreational activities and opportunities, while at the same time eliminating other types. For example, providing Primitive and Semi-Primitive Non-Motorized opportunities precludes recreation activities involving the use of motor vehicles, such as motor bikes and all-terrain vehicles.

The relationship of some recreational activities to others is important. Noise produced by trail bikes affects the solitude and serenity that hikers and backpackers are seeking. Waterskiing and other motorboating activities may adversely affect fishing success on lakes and reservoirs. On the other hand, many recreation activities rely on other activities to provide the total experience desired. Camping and viewing scenery, hiking and hunting, auto touring and viewing of roadside exhibits, and boating and fishing are examples of activities that can have positive interrelationships.

Recreation settings have a strong effect on recreation experiences. For example, visitors will have a very high probability of experiencing solitude and isolation from the sights and sounds of people in a Primitive setting. One would expect to experience more contacts and affiliation with other individuals and groups, however, in a Rural or Roaded Natural setting.

Trails are an important recreation facility affecting recreation. The 227 miles of existing trails on the Forest provide the principal form of access to unroaded areas and Wildernesses. They also provide opportunities for access to rivers and lakes for fishing and to popular areas for hunting, hiking, mountain climbing and camping. The level of management activities in the vicinity of trails affects the quality of the experience of the person using the trails.

WILDERNESS

Areas classified and managed as Wilderness will provide only a limited portion of the total range of opportunities for outdoor recreation. Wilderness classification excludes certain kinds of recreational activities. For example, trail bikes, hang gliders, mountain bikes, all-terrain vehicles and snowmobiles are prohibited in Wildernesses. Likewise, certain management activities are restricted by the Wilderness classification. For example, use of mechanical equipment for routine activities is generally prohibited, affecting such management activities as trail maintenance, construction and reconstruction. Restricting motorized equipment, which is usually the most economical means of maintaining or constructing trails, increases recreation management costs.

The Wilderness resource plays a key role in providing recreation opportunities and settings that are at the Primitive end of the Recreation Opportunity Spectrum. Visitors seeking opportunities that offer solitude, high risk, adventure, and challenges often visit Wildernesses because of their remote and pristine settings.

WILD AND SCENIC RIVERS

Developed recreation sites, such as campgrounds, picnic areas and boat ramps, are prohibited along Wild rivers. These rivers will provide recreational opportunities available at the Primitive and Semi-Primitive Non-Motorized end of the spectrum.

Wild and Scenic River classification will protect both water quality and fish habitat and should, therefore, have positive effects on recreational activities such as fishing and boating.

UNROADED AREAS

Unroaded areas provide for the recreational opportunities and activities associated with the Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized parts of the Recreation Opportunity Spectrum. Unroaded areas and Wildernesses are the only areas on the Forest that, in the long run, will be able to provide Primitive and Semi-Primitive Non-Motorized dispersed recreation opportunities. Unroaded areas are also the only areas that can provide for Semi-Primitive Motorized use involving motor bikes. Unroaded area retention precludes roaded recreational activities.

ROADS

Most of the recreation use on the Forest depends on road access. The road system, which has been built and maintained primarily to support management of timber resources, provides vehicle access to developed sites, lowland lakes and rivers, and trailheads to Wildernesses and unroaded areas.

In some situations, roads constructed for the purpose of accessing timber will destroy trails. However, such trails can be relocated and reconstructed. Roads constructed into unroaded areas reduce the total available acreage of Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized areas. Road closures have a dual effect on recreation use, as they eliminate certain recreational uses behind the closure while at the same time increasing the area's value for other recreational experiences, such as hunting.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON RECREATION

The effects of the alternatives on recreation opportunities and uses fall into three general categories: effects on developed recreation, effects on roaded dispersed recreation, and effects on unroaded recreation outside Wilderness (effects on Wilderness recreation are covered in the "Wilderness" section of this chapter). In the case of unroaded recreation (the Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized ROS classes), the most important variable affecting future use is the acreage available to provide this opportunity. The alternatives presented in this FEIS vary considerably in the acreages of unroaded recreation opportunity they provide.

The effects of alternatives on developed and roaded dispersed recreation are a little more complex, and depend on the interaction of two variables with opposing effects. The development and maintenance of road access, which is largely dependent on the level of timber harvest activity, serves to encourage both forms of recreation. This is especially true in the case of roaded dispersed recreation, since level of access availability is a primary factor in establishing the degree to which opportunities for such recreation are available. In the case of the Olympic National Forest, the road system has already been developed to the extent that expected demand for roaded dispersed recreation can readily be accommodated. Therefore, development of additional access is not expected to generate significant additional use.

The level of timber harvest activity is a factor which also *discourages* developed and roaded dispersed recreation, due to its effects on the overall recreation setting. High volumes of timber haul traffic, extensively altered landscapes, the noise and activity associated with harvest, and numerous other conditions all serve to discourage recreation use. Therefore, it is expected that alternatives with high levels of timber harvest will have the effect of reducing the quality and desirability of developed and roaded dispersed recreation opportunities, and that this will result in the level of actual use being lower than would be the case in a more natural setting.

In developing projections of the levels of developed and roaded dispersed recreation use associated with the alternatives (see Chapter II, Table II-14), the Forest based its estimates on the expectation that the overall effect of activities associated with timber harvest on the general recreation setting would overshadow the effect of road access development and maintenance on the availability of recreation opportunity. Therefore, it is projected that alternatives with high levels of harvest-related activity in a given decade will have less developed and roaded dispersed recreation use in that decade than those with low harvest levels.

Although it is low in level of use when compared to developed and roaded dispersed recreation (see Table II-14, Chapter II), dispersed unroaded recreation is perhaps the most critical component of the recreation spectrum when considering variations among alternatives. This is because the availability of opportunities for this form of recreation is limited and varies widely from alternative to alternative, and because demand for dispersed unroaded recreation opportunity exceeds the available supply (refer to the "Recreation" section of Chapter III for detail). Therefore, much of the following discussion of the effects of the alternatives focuses on dispersed unroaded recreation.

The Primitive and Semi-Primitive Non-Motorized ROS classes outside Wilderness provide dispersed unroaded opportunities in areas characterized by a predominantly natural or natural-appearing environment. Interactions between users are low, and no motorized use takes place. The chance of experiencing solitude is extremely high in the Primitive zone, and fairly high in the Semi-Primitive Non-Motorized class. The Semi-Primitive Motorized ROS class provides motorized dispersed unroaded opportunities in areas characterized by a predominantly natural or natural-appearing environment. Interactions between users are moderate, and motorized use (such as trail bikes) is usually allowed. The chance of experiencing solitude is moderate. The availability of opportunities for these forms of recreation will depend on the amount of timber harvesting and road construction that takes place within unroaded areas currently providing Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized recreation opportunities.

Unroaded areas play an important role in providing opportunities for dispersed unroaded recreation. When a road is constructed into such an area, dispersed unroaded recreation opportunities are no longer provided. Generally speaking, any portion of an unroaded area within one-half mile of a new road no longer provides dispersed unroaded recreation opportunities. Primitive and Semi-Primitive Non-Motorized opportunities are lost once a road is built. Whether or not Semi-Primitive Motorized opportunities are lost depends largely on the degree to which the natural-appearing environment is altered. Normal clearcutting practices will generally change Semi-Primitive Motorized areas to a Roaded Natural or Roaded Modified classification. The following table displays the acres in each ROS class by alternative. Refer to Table IV-25 in the "Unroaded Areas" section of this chapter for information regarding the acreage to be eliminated from unroaded areas by alternative by the end of the fifth decade.

Table IV-20. Acres of ROS Class by Alternative (thousands of Acres at end of 5th decade) 1/

ROS Class	Existing Acres	NC-No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Primitive	4.9	1.4	2.9	1.7	3.4	4.5	4.9
Semi-Primitive, Non-Motorized	49.1	14.2	29.0	16.7	33.9	44.7	49.1
Semi-Primitive, Motorized	6.6	1.9	3.9	2.2	4.6	6.0	6.6
Roaded Natural & Modified	478.4	521.4	503.1	518.3	497.0	483.7	478.3
Rural	5.1	5.1	5.1	5.1	5.1	5.1	5.1

1/ Does not include acres inside of Wilderness.

It is projected that demand for dispersed unroaded recreation will continue to increase, while the supply of opportunities for this form of recreation will decrease as roads are constructed and timber is harvested within Primitive, Semi-Primitive Non-Motorized, and Semi-Primitive Motorized areas. Based on projected demand, and the available acreage of Primitive and Semi-Primitive areas in the various alternatives, the Forest will have difficulty keeping user density within acceptable limits in these areas. It is expected that the quality of recreation experiences may diminish in the Primitive and Semi-Primitive areas, especially outside Wildernesses, due to the high density of visitors on the limited number of acres. It may become necessary for management to apply restrictions limiting numbers of visitors in order to continue to provide Primitive and Semi-Primitive experiences in these areas.

Alternatives NC-No Change and B-Departure (Modified)

Alternatives NC-No Change and B-Departure (Modified) would result in the greatest reduction of Primitive and Semi-Primitive recreation opportunity outside Wilderness. The No Change alternative would reduce the existing Primitive and Semi-Primitive ROS classes to approximately 17,500 acres, and Alternative B-Departure would retain approximately 20,600 acres in these classes. Because of these reductions in dispersed unroaded recreation opportunity, these two alternatives would provide the lowest levels of this type of recreation use.

These alternatives would also have the greatest effect in reducing unroaded area acreage. Unroaded areas would be reduced by 55,100 acres in Alternative B-Departure and 60,400 acres in Alternative NC. The areas removed from unroaded classification would also be eliminated from future consideration for Wilderness.

Outside of unroaded areas and Wildernesses, these two alternatives would create recreation settings or environments that would be substantially modified. Management activities such as timber harvesting and road construction would be readily evident over much of the Forest. Most developed sites would be surrounded by modified landscapes, and many of the trails would pass through areas that have been logged. Some trails would be crossed by new roads.

These two alternatives would have the greatest increase in access for roaded dispersed recreation. Alternative B-Departure (Modified) would construct an annual average of 28.3 miles of new roads in the first decade, while in Alternative NC-No Change there would be an annual average of 18.3 miles constructed.

Recreation use levels associated with fish and wildlife (such as fishing, hunting, and wildlife observation) are expected to be lower with these two alternatives than with the others (see Table II-14, Chapter II). This is primarily due to the high harvest levels of these alternatives and the resultant effects on fish habitat quality.

The scenic views along road and trail routes and around developed sites would be affected the most under Alternative B-Departure, in which three viewsheds would be moderately altered and 17 heavily altered in appearance. Alternative NC is expected to be similar to Alternative A-Current Direction in this regard, with the Forest's sensitive viewsheds ranging from natural appearing to heavily altered in appearance.

Water quality pertaining to recreation (such as water clarity, fishing, swimming, and scenery) would be the lowest in Alternatives NC-No Change and B-Departure (Modified). These two alternatives would produce the greatest levels of sediment from management activities (essentially timber harvesting and road construction, reconstruction, and use). Alternative B-Departure (Modified) would have the highest first-decade sediment output of all the alternatives.

The combined effects of all of the above factors lead to the projection that developed and roaded dispersed recreation use would be relatively low in the case of Alternative B-Departure and moderate in the case of Alternative NC. With Alternative B-Departure, use is expected to be below that of all the other alternatives (although use will still increase as demand for recreation grows) because of the high levels of harvest activity and landscape alteration. Alternative NC-No Change is expected to generate use levels similar to Alternative A-Current Direction (No Action) in the case of developed and roaded dispersed recreation. This is based on the similarities in land allocation (outside of unroaded areas) between these two alternatives, and may be a slight overestimate of future use (since the level of timber harvest activity in Alternative NC is considerably higher than in Alternative A).

Alternatives H (Modified) and I

Opportunities for Primitive and Semi-Primitive recreation outside Wilderness would remain at roughly the existing level in Alternatives H (Modified) and I. Alternative I would retain all of the existing Primitive and Semi-Primitive ROS classes (60,600 acres), while Alternative H (Modified) would retain approximately 55,200 acres in these classes. These two alternatives would provide the highest levels of this type of recreation use.

These alternatives would also provide the greatest acreage of unroaded area retention. Alternative I would retain all of the currently unroaded areas (85,800 acres) in an undeveloped condition, and Alternative H (Modified) would retain 80,000 acres of unroaded area. These remaining unroaded areas would also be eligible for future consideration as Wilderness.

Outside of unroaded areas and Wildernesses, both Alternatives H (Modified) and I would create recreation settings that would appear predominantly natural or unmodified. The level of activities such as timber harvest and timber haul would be low, and evidence of these activities would be slight. Developed site access corridors and surroundings would range in appearance from modified to natural appearing. Most trails would pass through natural, unmodified settings, and would generally not be impacted by new road construction.

These two alternatives would have the smallest increase in access for roaded dispersed recreation. Alternative H (Modified) would have an annual average of 9.2 miles of new road construction in the first decade, while in Alternative I there would be an annual average of 2.0 miles constructed.

Recreation use levels associated with fish and wildlife (such as fishing, hunting, and wildlife observation) are expected to be higher with these two alternatives than with the others. This is primarily due to the low harvest levels of these alternatives and the resultant effects on fish habitat quality.

The scenery along travel routes and surrounding developed sites would be affected the least under these two alternatives. Both of these alternatives would result in seven viewsheds having a natural appearance and the remaining 13 being slightly altered in appearance.

Water quality pertaining to recreation (such as water clarity, fishing, swimming, and scenery) would be the highest in Alternatives H (Modified) and I. These two alternatives would produce the lowest levels of sediment from management activities. Alternative I would have the lowest first-decade sediment output of all the alternatives.

The combined effects of all of the above factors lead to the projection that developed and roaded dispersed recreation use would be relatively high with either of these alternatives. Expected use levels for Alternatives H (Modified) and I are higher than for all the other alternatives, with Alternative I having slightly higher projected outputs of developed and roaded dispersed recreation than Alternative H.

Alternatives A-Current Direction (No Action) and C-Preferred (Modified)

Opportunities for Primitive and Semi-Primitive recreation outside Wilderness would be moderately reduced in Alternatives A-Current Direction (No Action) and C-Preferred (Modified), and would fall between the above two groupings of alternatives. Alternative A-Current Direction would reduce the existing Primitive and Semi-Primitive ROS classes to approximately 35,800 acres, and Alternative C-Preferred would retain approximately 41,900 acres in these classes. These two alternatives would provide mid-range levels of this type of recreation use.

These alternatives would also provide a mid-range acreage of unroaded area retention. Alternative A-Current Direction would retain 50,500 acres of the currently unroaded areas in an undeveloped condition, and Alternative C-Preferred would retain 57,500 acres of unroaded area. These retained unroaded areas would also be eligible for future consideration as Wilderness.

In these two alternatives, all or some of 10 of the 13 existing unroaded areas would be specifically allocated to providing either Undeveloped Motorized or Undeveloped Non-Motorized recreation opportunities. Significant portions of the other three areas would be managed as Spotted Owl Habitat Areas, thereby retaining the Primitive or Semi-Primitive ROS classification over much of each area. The remaining portions of the existing unroaded areas would be programmed for timber harvesting, which would result in substantially modified settings.

Outside of unroaded areas and Wildernesses, both Alternatives A-Current Direction and C-Preferred would create a wide range of recreation settings, varying from areas that appear predominantly natural or unmodified to those in which high levels of management activity would be apparent. The Forest-wide level of activities such as timber harvest and timber haul would be moderate, with evidence of these activities more prevalent in Alternative A-Current Direction than in Alternative C-Preferred. Developed site access corridors and surroundings would range in appearance from heavily modified to natural appearing. Most trails would pass through natural, unmodified settings, but some would be subject to the impacts of new road construction.

These two alternatives would have moderate increases in access for roaded dispersed recreation. Alternative A-Current Direction would have an annual average of 17.6 miles of new road construction in the first decade, while in Alternative C-Preferred there would be an annual average of 14.1 miles constructed.

Recreation use levels associated with fish and wildlife (such as fishing, hunting, and wildlife observation) in these alternatives are expected to fall between the other two groupings of alternatives. This is primarily due to the mid-range harvest levels of these alternatives and the resultant effects on fish habitat quality. Alternative C-Preferred is expected to have slightly higher levels of fish and wildlife-related recreation use than Alternative A-Current Direction.

The scenery along travel routes and surrounding developed sites would consist of essentially natural appearing or slightly altered viewsheds under Alternative C-Preferred, with a somewhat more modified appearance associated with Alternative A-Current Direction. Both alternatives would fall between the other two groups in overall scenic quality. Management of sensitive viewsheds in Alternative C-Preferred would be essentially the same as in Alternatives H (Modified) and I, in that the objectives of all three alternatives include meeting all Retention and Partial Retention VQOs (refer to the "Scenery" section of this chapter for detail).

Water quality pertaining to recreation (such as water clarity, fishing, swimming, and scenery) would fall between the other two groupings, with Alternative C-Preferred having higher overall water quality than Alternative A-Current Direction.

The combined effects of all of the above factors lead to the projection that developed and roaded dispersed recreation use would be at moderate levels with either of these alternatives. Alternative A-Current Direction is expected to generate use levels similar to Alternative NC-No Change in the case of developed and roaded dispersed recreation. This is due to the similarities in land allocation between these two alternatives. The future use level of Alternative C-Preferred is expected to approach that of Alternative H (Modified), as many of the components of the recreation environment will be similar in these two alternatives.

CUMULATIVE EFFECTS OF ALTERNATIVES ON RECREATION

To the extent that existing unroaded areas outside of Wilderness are developed for purposes other than Primitive and Semi-Primitive recreation, visitors seeking these types of recreation settings will find fewer and smaller areas offering the desired opportunities. As a result, nearby Wildernesses and the remaining unroaded areas which offer Primitive and Semi-Primitive opportunities may receive increases in use, which could result in overcrowding. This could produce unacceptable conditions and undesirable use levels in the Wildernesses, including the Olympic National Park Wilderness, and in the remaining unroaded areas. Forest and Park trails could also become overused. Encounters with other users could become too frequent to provide the Primitive and Semi-Primitive experiences that are being sought. This could ultimately result in an increase in unplanned and unwanted dispersed recreation sites (impromptu camping areas, for example) and "way" trails as visitors seek uncrowded areas.

Alternatives NC-No Change and B-Departure (Modified) would entail the greatest probability of the effects discussed above. These alternatives would provide the lowest levels of Primitive and Semi-Primitive opportunity and eliminate the greatest unroaded area acreage. Alternatives H (Modified) and I would have the lowest likelihood of such effects, with Alternatives A-Current Direction (No Action) and C-Preferred (Modified) involving moderate probabilities of these effects.

The needs and activities of different recreation user types may also affect the level of user satisfaction, and affect recreation resource use patterns. Some types of recreation, such as off-road vehicle use, may cause non-ORV users to seek their Primitive and Semi-Primitive experiences on other areas of the Forest, on other Forests, or in the Park. This type of effect will not vary much from one alternative to the next.

MITIGATION MEASURES AND EFFECTIVENESS

The Forest will continue to implement the National Recreation Strategy as a means of providing and maintaining quality recreation opportunities. The Strategy will explore opportunities to mitigate conflicts and the impacts of other resource activities on recreation activities, as well as mitigating the impacts of recreation on other resources.

Some of the major mitigation measures are:

Unroaded areas allocated to Dispersed Non-Motorized and Motorized recreation will be managed to provide Primitive and Semi-Primitive opportunities. Restrictions may be necessary to prevent overuse.

Trails that may be affected or impacted by timber sales will be managed to maintain and protect the facility during the duration of the sale. Trails may be reconstructed or relocated if necessary.

The road system will be planned, designed, and maintained to provide for and accommodate different types and levels of recreation traffic (in a manner consistent with road management objectives).

Road closures and restrictions may be used to control conflicts between different recreation uses and/or other resource uses.

RELATIONSHIPS TO OTHER PLANS

There is little potential for conflict between Olympic National Forest recreation management and the recreation-related plans of the Washington State Department of Natural Resources, Olympic National Park, or the Federal Highway Administration. There is likewise little potential for conflict with the State Comprehensive Outdoor Recreation Plan (SCORP). Perhaps the most important way in which the Forest's recreation management could affect the plans of other agencies is in the area of Primitive and Semi-Primitive recreation opportunity.

In Alternatives NC-No Change and B-Departure (Modified), most of the Primitive and Semi-Primitive Non-Motorized acreage outside of the five Wildernesses on the Forest would be eliminated by the end of the fifth decade. This could create an even greater demand for Primitive and Semi-Primitive Non-Motorized use within the Olympic National Park. Conversely, Alternatives H (Modified) and I provide the greatest acreage of Primitive and Semi-Primitive Non-Motorized opportunity on the Forest. Therefore, these alternatives provide the greatest potential for minimizing overuse in the Park.

SCENERY

OVERVIEW

The Olympic National Forest is a "showcase" of visible landscapes that are seen from many travel routes, including Wilderness trails, and from use areas such as developed sites, lakes and rivers, and mountaintops and ridges in both the Forest and Olympic National Park. Every acre on the Forest has an assigned Visual Quality Objective (VQO). Areas that have a high degree of landscape variety and are viewed by many visitors are considered to be the most sensitive to changes, and are used in the evaluation of the anticipated effects of the alternatives. Areas that have little or no landscape variety and are not viewed by many visitors are considered less important for their scenic qualities.

Approximately 14 percent (89,700 acres) of the Forest is classified under the Visual Quality Objective of Preservation (in which generally only ecological changes alter the landscape), 4 percent (22,600 acres) is classified with the Retention VQO (management activities are not evident), 11 percent (67,500) has the Partial Retention VQO (management activities may be evident, but do not dominate the natural landscape), and the remaining 71 percent (452,500 acres) is classified as either Modification or Maximum Modification (management activities may dominate the natural landscape, but should repeat natural occurrences). The Forest has identified 20 viewsheds that involve sensitive landscapes, as viewed from high use areas or travel routes. Of these 20 viewsheds, 9 are currently in a Natural Appearing condition, 6 are in a Slightly Altered condition, 3 are in a Moderately Altered condition, and the remaining 2 viewsheds are in a Heavily Altered condition. Refer to Tables IV-21 and IV-22 for the future conditions of these viewsheds by alternative.

SIGNIFICANT INTERACTIONS

VEGETATION

Vegetation is one of the four major characteristics of an area that establishes its scenic character. The Olympic rain forests, giant old-growth, dense conifer forests, and alpine wildflowers are important vegetative attractions on the Forest.

Vegetative management can have significant effects on the scenic resource. Timber harvesting can produce major visual impacts upon an area. Timber management activities that introduce form, line, color and texture that are not found in the natural landscape will generally create visual disturbances. On the other hand, timber management activities can be designed to rehabilitate or enhance an area's scenic quality. This is done by borrowing from the natural line, form, color and/or texture of the characteristic landscape in laying out the management activity.

FIRE

The effects of fire on scenery can be significant, but are generally short-term. Negative visual impacts, such as the black color of charred soil, logs, and stumps, and the searing of vegetation which causes foliage to die and turn brown, are reduced as new vegetation comes back.

RECREATION

One of the key elements in establishing Visual Quality Objectives is the sensitivity level of an area. Sensitivity levels reflect people's concern regarding the scenic quality of an area. The higher the volume of use, the greater the sensitivity level. Landscapes viewed from popular campgrounds, resorts, picnic areas and observation sites, as well as from roads and trails leading directly to major recreation areas such as Wildernesses, National Parks, and popular recreation sites, are extremely sensitive.

WILD AND SCENIC RIVERS

The corridors along rivers that are designated as Wild and Scenic Rivers will be managed to protect the attributes leading to this designation. Management within these river corridors is generally designed to meet Preservation (Wild Rivers), Retention (Scenic Rivers), or Partial Retention (Recreational Rivers) Visual Quality Objectives. Therefore, the scenic quality along these rivers will be protected.

ROADS AND STRUCTURES

Roads, borrow sites, and transmission line corridors and towers can have significant effects on the scenic resource. Ground-disturbing activities such as roads and borrow sites create long-term visual impacts because they result in strong color contrasts which persist for long periods.

OWNERSHIP

Management activities, such as timber harvesting and road building, which are implemented by other landowners may cause visual impacts on lands adjacent to visually sensitive viewsheds on the Forest. In some cases, National Forest lands are being managed to retain the existing scenic character, but adjacent landowners are implementing activities that result in landscapes with heavily altered appearances. In these situations, it is difficult to retain the overall desired scenic quality of the area.

There are also a few situations where adjoining lands managed by other agencies have vegetative screens that block views of National Forest lands from sensitive travel routes and use sites. When these vegetative screens are managed to protect or maintain their natural condition (such as in the Olympic National Park), then Visual Quality Objectives assigned to National Forest land are generally easily met.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON SCENERY

The effects that each alternative has on scenery are measured by the extent to which inventoried Preservation, Retention, and Partial Retention VQOs are met, and by identifying the visual condition of each sensitive viewshed (see Tables IV-21 and IV-22). The visual condition is the visual appearance of a given viewshed, and is described in terms of the degree of alteration of the natural appearing landscape. The four degrees of visual alteration are described in the "Scenery" section of Chapter III.

There are two levels of sensitivity for viewsheds on the Forest. Sensitivity Level 1 Viewsheds involve landscapes that are viewed from Level 1 sensitivity travel routes and use areas, such as U.S. Highway 101 and the Quinault Lake recreation area. Sensitivity Level 2 Viewsheds are variety Class A landscapes (unique in landscape variety) viewed from Level 2 sensitivity travel routes and use areas, such as Wynoochee Lake and the South Fork Skokomish River.

Alternative B-Departure (Modified)

Alternative B-Departure (Modified) would have the greatest effect upon scenery. This alternative would provide the lowest acreage upon which inventoried VQOs of Preservation, Retention, and Partial Retention are met. Alternative B-Departure would meet the VQO of Preservation within the five Wildernesses and the Quinault Research Natural Area, or 14 percent of the Forest. Under this alternative, the remaining 86 percent of the Forest would be managed in such a way that the Modification or Maximum Modification VQOs would be met. This alternative would create viewsheds which appear as Moderately Altered to Heavily Altered landscapes, with management activities such as timber harvesting and roads dominating the natural landscape.

Alternative B-Departure (Modified) would have the greatest impact upon scenery due to road construction, with an average of 28.3 miles constructed annually in the first decade.

Other factors, such as water quality and slash treatment as they relate to scenery, would be affected most under this alternative. Sediment yields, which affect the scenic qualities of water, as well as smoke and blackened areas resulting from slash fires, would be the highest under Alternative B-Departure (Modified).

This alternative would have the fewest acres that would remain natural appearing as a result of allocations involving management prescriptions in which timber is not available for programmed harvest. Examples of such allocations include Management Areas A1A-Undeveloped Recreation (Non-Motorized), A1B-Undeveloped Recreation (Motorized), B1-Wilderness, C1-Spotted Owl Habitat Area, and J2-Research Natural Areas.

Alternatives C-Preferred (Modified), H (Modified), and I

Alternatives C-Preferred (Modified), H (Modified, and I would provide the highest level of protection for scenery. Scenic quality would be retained in the five Wildernesses and the Quinault Research Natural Area, and in all of the unroaded areas in Alternative I, in most under Alternative H (Modified), and in roughly two-thirds in Alternative C-Preferred. In all three of these alternatives, the visual condition of the 20 viewsheds would range from Slightly Altered to Natural Appearing.

VQOs on the 22,600 acres classified as Retention and the 67,500 classified as Partial Retention would be met in these alternatives. However, subtle differences may be evident in Alternative C-Preferred. Roughly 30,000 acres with Retention/Partial Retention VQOs are allocated to Management Area E1-Timber Management in this alternative, as opposed to Management Area A2-Scenic as in Alternatives H (Modified) and I. Attainment of these VQOs is covered by Standards and Guidelines rather than Management Area allocation in Alternative C-Preferred.

Alternative I would have the lowest impact upon scenery due to road construction, with an annual average of only 2 miles of construction in the first decade. Alternative H (Modified) would have the next lowest effect, with an average of 9.2 miles of road construction annually, followed by Alternative C-Preferred (14.1 miles per year in the first decade).

Alternatives H (Modified) and I would have the lowest effects upon water quality and from slash treatment as they relate to scenery. The effects of Alternative C-Preferred (Modified) in these areas would be moderate.

Alternative I would retain the greatest acreage, and Alternative H (Modified) the next greatest, in a natural appearing condition outside of inventoried viewsheds. These two alternatives allocate the most acres to management prescriptions in which timber would not be available for programmed harvest. Alternative C-Preferred also includes a substantial acreage in such allocations.

Alternatives NC-No Change and A-Current Direction (No Action)

Alternatives A-Current Direction and NC-No Change would provide a moderate level of scenic protection that would range between the other two groupings of alternatives. Under both of these alternatives, two viewsheds would have a Natural Appearance, five would appear Slightly Altered, six would appear Moderately Altered, and seven would appear Heavily Altered. VQOs would be met in the five Wildernesses, the Quinault Research Natural Area, and the unroaded areas retained in each alternative (50,500 acres in Alternative A, and 25,400 acres in Alternative NC). In addition, approximately 27 percent of the areas with Retention/Partial Retention VQOs will be allocated to prescriptions calling for VQO attainment in both alternatives.

Both of these alternatives would have moderate effects upon scenery due to new road construction. Alternative A-Current Direction includes construction of an annual average of 17.6 miles of road in the first decade, and Alternative NC involves an annual average of 18.3 miles.

Sediment yields, which affect the scenic quality of water, as well as smoke and blackened areas resulting from slash treatment, would be at levels fairly close to Alternative B-Departure (Modified). Alternative NC-No Change would be slightly above Alternative B-Departure in these effects, with Alternative A-Current Direction slightly below.

These two alternatives would provide a somewhat greater acreage to be retained in a natural appearing condition outside the inventoried viewsheds than would Alternative B-Departure, but would be well below Alternative C-Preferred in this regard.

Table IV-21. Future Condition of Sensitivity Level 1 Viewsheds
Visual Condition at the end of 5th Decade 1/

Viewshed	Existing Visual Condition	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
Hoodsport Hwy 101	NA	MA	MA	HA	SA	SA	SA
Dosewallips Road	MA	MA	MA	HA	SA	SA	SA
Jupiter Ridge Trail	HA	HA	HA	HA	NA	NA	NA
Duckabush Road	NA	SA	SA	HA	NA	NA	NA
Hamma Hamma Road	NA	HA	HA	HA	NA	NA	NA
Lena Lake Trail	NA	NA	NA	HA	NA	NA	NA
Big Creek Road	MA	MA	MA	HA	SA	SA	SA
Lake Cushman Road	SA	MA	MA	HA	NA	NA	NA
Quilcene Hwy 101	SA	HA	HA	HA	SA	SA	SA
Mt. Walker	HA	MA	MA	HA	NA	NA	NA
Quinault Hwy 101	NA	HA	HA	HA	SA	SA	SA
North Shore Road	SA	SA	SA	MA	SA	SA	SA
South Shore Road	NA	NA	NA	HA	NA	NA	NA
Moclips Hwy	NA	HA	HA	HA	SA	SA	SA
Soleduck Hwy 101	SA	HA	HA	HA	SA	SA	SA
Soleduck Park Road	SA	MA	MA	MA	SA	SA	SA
Elwha Park Road	NA	SA	SA	MA	SA	SA	SA
Hoh Road	NA	HA	HA	HA	SA	SA	SA

1/ NA = Natural Appearance, SA = Slightly Altered, MA = Moderately Altered, and HA = Heavily Altered.

Table IV-22. Future Condition of Sensitivity Level 2 Viewsheds
Visual Condition at end of 5th decade 1/

Viewshed	Existing Visual Condition	No Change	A-Current Direction	B-Dep (Modified)	C-pref (Modified)	H (Modified)	I
Wynoochee	MA	SA	SA	HA	SA	SA	SA
S. Fork Skokomish Road	SA	SA	SA	HA	SA	SA	SA

1/ NA = Natural Appearance, SA = Slightly Altered, MA = Moderately Altered, and HA = Heavily Altered.

CUMULATIVE EFFECTS OF ALTERNATIVES ON SCENERY

The effects of ecological changes and resource management activities on Forest landscapes constantly change their scenic qualities. As management activities become more evident, the naturalness of a particular area will be diminished and recreational settings and environments may become less desirable to some recreation users and other Forest visitors.

A given viewshed, as viewed by visitors, does not have administrative boundaries. Parts of a given viewshed may often involve lands that are administered by another agency, such as the Washington State Department of Natural Resources, or they may be privately owned. Timber management activities and road construction on other lands often do not follow any visual resource management system similar to that which is used in National Forest management.

Nine of the Forest's twenty sensitive viewsheds are subject to conflicting visual resource management philosophies, since they entail the potential for timber harvest conducted by other landowners. The Hoodsport Highway 101, Dosewallips Road, Duckabush Road, Hamma Hamma Road, Quilcene Highway 101, Mt. Walter, Quinault Highway 101, Moclips Highway, and Soleduck Highway 101 viewsheds could all have a more altered appearance than would result from National Forest management alone due to the intermingling of ownerships. The portions of these viewsheds that are not National Forest land could be heavily altered in appearance.

The presence of other landowners within a sensitive viewshed increases the probability that there will be undesirable constrasts within the seen landscape due to differing philosophies regarding management for scenic quality. Nonetheless, the probability that such constrasts will occur depends, in part at least, on the objectives of National Forest management. It is less likely that undesirable contrasts will occur when scenic quality is emphasized in National Forest management than when it is not. Therefore, Alternative B-Departure (Modified) would have the greatest likelihood of undesirable contrasts within sensitive viewsheds involving other ownerships, while Alternatives C-Preferred (Modified), H (Modified), and I would have the lowest likelihood of such effects. Alternatives A-Current Direction and NC-No Change would involve a middle range of probabilities that such effects would occur.

MITIGATION MEASURES AND EFFECTIVENESS

Managed landscapes can continue to appear natural by designing management activities to blend them into the landscape. When management activities repeat the appearances of natural occurrences, they will generally remain subordinate to the characteristic landscape. Clearcuts and roads, for example, can be designed to limit their visual effects, and can even blend with the landscape in certain situations. Partial cuts and shelterwoods can also be used to meet visual quality objectives. Harvesting activities can often be scheduled during periods of low public use, and potential impacts can often be avoided by careful selection of yarding equipment and the time of year it is used. Skidding logs over snow to reduce ground disturbance is a good example of this strategy.

Silvicultural and visual prescriptions can be coordinated within viewsheds, and can be aimed at meeting visual quality objectives in order to protect, enhance, and/or perpetuate the scenic values of the area.

Sensitive viewsheds that have been impacted by previous management activities may warrant rehabilitation efforts to return the appearance of the landscape to an acceptable visual condition. Practices such as feathering edges and eliminating straight line edges are examples of possible rehabilitation efforts.

RELATIONSHIPS TO PLANS OF OTHERS

The Olympic National Forest and the Washington State DNR share common boundaries in a few visually sensitive areas on the Peninsula (Mt. Walker, east face of Green Mountain, and the Highway 101 corridor on the Soleduck District). In portions of these visually sensitive areas, scenic management objectives and management activities are not always compatible between the two land management agencies. The Forest Service will manage the scenic resource in these areas in accordance with the objectives of the selected alternative, even when adjacent management practices do not meet scenic resource management objectives.

Landscapes on the Olympic National Forest viewed from Olympic National Park travel routes and use areas are considered to be sensitive areas. Therefore, protecting scenic values will be given consideration when planning resource management activities within these areas.

WILDERNESS

OVERVIEW

Allocation to Wilderness is constant across all alternatives, and consists of the 88,265 acres within the five existing Wildernesses established by the Washington State Wilderness Act of 1984. The range of effects on Wilderness by alternative is somewhat limited, as all five Wildernesses share a common boundary with the Olympic National Park Wilderness which varies from 20 to 40 percent of the total boundary of each Wilderness. Wilderness management by the Park is compatible with that of the Forest, and the two should not affect one another. The Wildernesses also have many natural land barriers that mitigate or shield evidence of activities outside the Wildernesses.

SIGNIFICANT INTERACTIONS

The effects of the alternatives which result from activities within the Wildernesses will largely result from trail construction and reconstruction (which will be the same in all alternatives), impacts to Wilderness resources due to recreation use, and impacts upon the Wilderness visitor resulting from overcrowding. The greatest variations in effects on Wilderness will be the result of management activities on National Forest lands outside of the wilderness boundary, especially those that are adjacent to or close to the Wildernesses.

The following activities which take place outside of Wilderness will have varying effects from one alternative to the next: prescribed fire, construction of additional road access, timber harvesting, and development of unroaded areas. These activities have the potential to affect the wilderness resource and its use, as well as the wilderness experience of the visitor.

Recreation use in Wilderness could vary by alternative in response to development of unroaded areas. As unroaded areas become developed and are no longer available to provide Semi-Primitive and Primitive recreation opportunities, people seeking such opportunities may be displaced into the Wildernesses (thereby increasing use levels). However, the sights and sounds of forest operations (timber harvesting and road construction) and resource management activities (smoke from prescribed fires) in areas adjacent to or close to a Wilderness may detract from the user's wilderness experience and discourage wilderness use. The same is true of high levels of timber management activity throughout the Forest, as this affects the quality and attractiveness of the general recreation setting.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON WILDERNESS

Management activities proposed within the Wildernesses under any alternative will be implemented using the Standards and Guidelines for Wilderness. Activities that would affect the Wilderness are primarily those associated with trail construction, fire, and rehabilitation projects aimed at maintaining consistency with limits of acceptable change guidelines. The effects of trail construction and reconstruction do not vary among the alternatives. Approximately 28 miles of potential trail have been identified within the Wildernesses, and 43 miles of existing trail will require reconstruction to reach an appropriate standard. The effects of new trail construction or trail reconstruction will involve minor amounts of ground disturbance which will be localized to the trail tread area. It can also be expected that some visitors' wilderness experiences will be affected during the actual construction stage. This effect would be short term.

The effects of trail use may vary from one alternative to the next. The effects associated with noise, user density, and reductions in solitude will be the greatest with the alternatives which have the highest level of recreation use within Wildernesses. Level of use within the Wildernesses is expected to depend most heavily on the levels of management activity conducted outside of Wilderness.

The mix of management activities which take place outside of Wilderness varies greatly from alternative to alternative, and many of these activities have the potential to affect the need for Wilderness recreation opportunities and/or the quality of the Wilderness experience. Since both of these can affect Wilderness use, the activities outside of Wilderness which will occur under each of the alternatives must be considered in projecting the effects of the alternatives on Wilderness and its use.

The relationship between activities outside Wilderness and their ultimate effect on Wilderness use is complex, with some activities tending to increase the need for Wilderness opportunities and others tending to discourage use. The principal activity which is likely to increase use within Wilderness is reduction of Primitive and Semi-Primitive recreation opportunities outside Wilderness through road construction and timber harvest within unroaded areas. As opportunities for these recreation types decrease outside Wilderness, it is likely that at least some use will be diverted into Wilderness. Therefore, alternatives which retain relatively small acreages in unroaded areas are most likely to generate additional need for Wilderness recreation opportunity.

The principal activity which has the potential to discourage Wilderness use is timber harvest, along with the timber haul and slash treatment it generates. When timber harvest activity is relatively high, the overall environment for recreation is generally less attractive and inviting (see also the "Recreation" section of this chapter). This tends to discourage recreation use of any kind, and is expected to lead to reductions in the level of Wilderness use. This is particularly likely to occur when the harvest activity is in the general vicinity of a Wilderness, since the sounds of harvest, the modified appearance of the landscape, and the smoke from slash treatment may all be apparent to the Wilderness user.

In developing projections of the level of Wilderness use associated with the alternatives (see Chapter II, Table II-14), the Forest based its estimates on the expectation that the overall effect of activities associated with timber harvest on the recreation environment would overshadow the effect of unroaded area development on the need for Wilderness recreation opportunity. Therefore, it is projected that alternatives with high levels of harvest-related activity in a given decade will have less Wilderness recreation use than those with low harvest levels, even though these alternatives also involve the greatest reductions in unroaded area availability.

It should be noted that these use projections are quite uncertain, due to the complexity of the interactions which influence level of Wilderness use. Reductions in unroaded area acreage could indeed be the most important factor influencing future use of the Forest's Wildernesses, although this is not currently expected to be the case (particularly in the first decade, when unroaded area acreage reductions are not yet close to their long-term totals). It should also be noted that Wilderness use projections are made in the context of growing demand for Wilderness recreation, and that actual use is expected to increase in all alternatives. Therefore, the factors which are described as "decreasing" or "discouraging" use in this discussion are, in reality, factors which tend to slow the rate of use increase.

The Forest's projections anticipate a relatively low degree of variation in Wilderness use from alternative to alternative, especially in the later decades of the planning horizon. Given the complexity of the interactions which determine Wilderness use level, and the fact that the Wildernesses themselves will receive the same management in all alternatives, this low degree of variation is reasonable to expect.

The five Wildernesses will not be affected equally, due to the differing extent of change adjacent to their boundaries, the natural features at their boundaries and management emphasis within each Wilderness.

The following factors were evaluated for their potential effects on Wilderness from one alternative to the next:

Alternatives NC-No Change and B-Departure (Modified)

Alternatives NC-No Change and B-Departure (Modified) are expected to have the greatest effects upon Wildernesses and Wilderness use resulting from activities occurring outside of Wilderness. These two alternatives would result in the highest level of activity taking place adjacent to or near the Wildernesses. In Alternative NC, approximately 70 percent of the existing unroaded areas would be developed, while approximately 64 percent would be developed in Alternative B-Departure. These alternatives would produce the most noticeable effects on the quality of the Wilderness visitor's experience, as smoke from prescribed burning and the sights and sounds of nearby management activities would have a high potential to distract from solitude.

In addition to activity within unroaded areas, the high level of timber harvest and associated activities throughout the Forest in these alternatives would lead to a relatively low level of attractiveness of the overall recreation environment. Harvest and road construction would be readily evident over much of the Forest, scenic views along travel routes to Wildernesses would appear moderately to heavily altered, and the recreation setting would, in general, seem heavily modified. The combined effects of the overall quality of the recreation setting and the high activity level near Wildernesses are expected to discourage Wilderness use to a higher degree in Alternatives NC and B-Departure than would occur with any of the other alternatives.

The level of activity outside Wilderness is expected to discourage Wilderness use to the greatest extent in these alternatives. At the same time, the increased access created by road construction in unroaded areas and the loss of Primitive and Semi-Primitive recreation opportunity as unroaded areas are developed are expected to be factors which would generate increased use. The net effect of these factors is expected to be a relatively low level of Wilderness use (below that of all the other alternatives) in the case of Alternative B-Departure (although use will still increase as demand for Wilderness recreation grows). Use is expected to be moderate in the case of Alternative NC-No Change, and at essentially the same level as in Alternative A-Current Direction (No Action). This estimate is based on the similarities in land allocation (outside of unroaded areas) in these two alternatives, and may be a slight overestimate of future Wilderness use in Alternative NC (since the level of harvest activity, both within and outside of unroaded areas, is considerably higher in this alternative).

If the above projections are correct, and Wilderness use is affected more strongly by level of harvest activity than loss of Primitive and Semi-Primitive recreation opportunity in unroaded areas, then these two alternatives would have relatively slow rates of use increase within the Wildernesses. As a result, Alternatives NC-No Change and B-Departure (Modified) would be least subject to use-related effects within Wilderness. These effects include increased levels of soil compaction and trail erosion, higher risk of water pollution from human waste, greater vegetation loss due to trampling, and higher noise levels.

Alternatives H (Modified) and I

Alternatives H (Modified) and I are expected to have the lowest level of effect upon Wildernesses and Wilderness use resulting from activities occurring outside of Wilderness. These two alternatives would result in the lowest level of activity taking place adjacent to or near the Wildernesses. In Alternative H (Modified), approximately 93 percent of the existing unroaded areas would remain undeveloped, while all existing unroaded areas would remain undeveloped in Alternative I. These alternatives would produce the least noticeable effects on the quality of the Wilderness visitor's experience, as smoke from prescribed burning and the sights and sounds of nearby management activities would be minimal and have low potential to distract from solitude.

In addition to lack of activity within unroaded areas, the low level of timber harvest and associated activities throughout the Forest in these alternatives would lead to a relatively high level of attractiveness of the overall recreation environment. Evidence of harvest and road construction would be minimal, scenic views along travel routes to Wildernesses would appear natural to slightly altered, and the recreation setting would, in general, seem largely unmodified. The combined effects of the overall quality of the recreation setting and the low activity level near Wildernesses are expected to encourage Wilderness use to a greater degree in Alternatives H (Modified) and I than would occur with any of the other alternatives.

The low level of activity outside Wildernesses is expected to encourage Wilderness use in these alternatives. At the same time, the maintenance of virtually all of the existing Primitive and Semi-Primitive recreation opportunity within unroaded areas will result in little diversion of use from these areas into Wilderness. The net effect of these factors is expected to be relatively high levels of Wilderness use (above those of the other alternatives) in Alternatives H (Modified) and I.

If the above projections are correct, and Wilderness use is affected more strongly by the overall quality of the Wilderness environment and the Forest-wide recreation setting than by the availability of high levels of Primitive and Semi-Primitive recreation opportunity in unroaded areas, then these two alternatives would have relatively high rates of use increase within the Wildernesses. As a result, Alternatives H (Modified) and I would be most subject to use-related effects within Wilderness. These effects include increased levels of soil compaction and trail erosion, higher risk of water pollution from human waste, greater vegetation loss due to trampling, and higher noise levels.

Alternatives A-Current Direction (No Action) and C-Preferred (Modified)

Alternatives A-Current Direction (No Action) and C-Preferred (Modified) are expected to have effects on Wildernesses and Wilderness use resulting from activities occurring outside of Wilderness that fall between those of the other two groupings of alternatives. These two alternatives would result in a moderate level of activity taking place adjacent to or near the Wildernesses. In Alternative A-Current Direction, approximately 41 percent of the existing unroaded areas would be developed, while approximately 33 percent would be developed in Alternative C-Preferred. These alternatives would produce moderately noticeable effects on the quality of the Wilderness visitor's experience, as smoke from prescribed burning and the sights and sounds of nearby management activities would have some potential to distract from solitude.

In addition to moderate activity within unroaded areas, the level of timber harvest and associated activities throughout the Forest in these alternatives would lead to a level of attractiveness of the overall recreation environment that falls between those of the other two groupings of alternatives. Evidence of harvest and road construction would be moderate, scenic views along travel routes to Wildernesses would range from natural to varying degrees of alteration, and the recreation setting would appear unmodified in some areas and heavily managed in others. Evidence of management activity would be more prevalent in Alternative A-Current Direction than in Alternative C-Preferred. The combined effects of the overall quality of the recreation setting and the moderate activity level near Wildernesses are expected to affect Wilderness use to a degree falling between the effects of the other alternative groupings.

The moderate level of activity outside Wildernesses is expected to discourage Wilderness use to some extent in these alternatives. At the same time, the access created by road construction in unroaded areas and the loss of some Primitive and Semi-Primitive recreation opportunity as unroaded areas are developed are expected to be factors which would generate moderate use increases. The net effect of these factors is expected to be mid-range levels of Wilderness use (between those of the other alternative groupings) in Alternatives A-Current Direction (No Action) and C-Preferred (Modified), with a slightly higher level of use associated with the latter.

If the above projections are correct, these two alternatives would have moderate rates of use increase within the Wildernesses. As a result, Alternatives A-Current Direction and C-Preferred would fall between the other two groupings of alternatives in susceptibility to use-related effects within Wilderness. These effects include increased levels of soil compaction and trail erosion, higher risk of water pollution from human waste, greater vegetation loss due to trampling, and higher noise levels.

CUMULATIVE EFFECTS OF ALTERNATIVES ON WILDERNESS

Some nonconforming features, improvements, and conditions currently exist within the Wildernesses. Additional nonconforming conditions may occur during any future development of Tubal Cain mine, an existing valid mining claim. Any new nonconforming developments create additional unnatural conditions that affect the quality of the Wilderness resource.

Increases in wilderness use, which are expected in all alternatives, could add to the problem of overcrowding and increase the potential for impacts involving soil compaction, trail erosion, water pollution, and vegetation trampling. New management activities adjacent to Wildernesses could result in additional impacts on visual quality and the quality of the wilderness experience.

As the Forest and Park implement the Limits of Acceptable Change program, which may limit the number of visitors to a given area within the Wilderness, visitors may seek their experiences elsewhere. This could increase use in other areas, including nonwilderness undeveloped areas outside of the Wildernesses.

MITIGATION MEASURES AND EFFECTIVENESS

Wilderness management is guided by the Wilderness Act of 1964 which focuses on preserving and protecting in perpetuity the primeval character of the wilderness. Opportunities for recreational, scenic, scientific, educational, conservation and historical uses are consistent with wilderness values. The Act also allows for some activities that occurred prior to Wilderness classification to continue. Such operations will be permitted with provisions to protect wilderness values as much as practical. The use of motorized and/or mechanized vehicles for these excepted activities will be scheduled to minimize conflicts with wilderness values and wilderness users as much as possible. Ground disturbing activities, such as trail construction, will require careful planning and implementation to protect wilderness values. Existing nonconforming features will be removed when feasible. The Limits of Acceptable Change (LAC) process will be implemented in each of the five Wildernesses in order that acceptable limits can be established and monitored. LAC will be an effective way to monitor the effects of use in the Wilderness and to change recreation use patterns when limits are exceeded.

RELATIONSHIPS TO PLANS OF OTHERS

Both the Olympic National Forest and the Olympic National Park will be implementing the Limits of Acceptable Change process to help meet management direction called for in the Wilderness Act. The two agencies will coordinate as limiting factors and Wilderness Resource Spectrum classes (see *Glossary) are identified during the process.

The Olympic National Forest will continue to coordinate with the Washington State Department of Wildlife concerning the fish stocking program developed between the two agencies and documented in the High Lake and Stream Survey Report, Parts One and Two (Johnston 1972, 1973), in accordance with Wilderness Standards and Guidelines.

The Forest will continue to coordinate with the various County Sheriffs and Olympic National Park officials concerning Search and Rescue operations within the Wildernesses.

WILD AND SCENIC RIVERS

OVERVIEW

For analysis purposes, a corridor extending one-quarter mile on each side of a river was used to determine the effects of alternatives on the potential wild, scenic or recreational designation of each eligible river. It should be noted that the corridors of all eligible rivers to be studied by a lead agency other than the USDA Forest Service will be managed, under all alternatives, to maintain their characteristics that qualify them for consideration. See Appendix F for details. Such management will continue until a final classification decision is reached. Therefore, the analysis of effects on Wild and Scenic Rivers is focused on the ten rivers for which the Olympic National Forest is the lead agency.

SIGNIFICANT INTERACTIONS

TIMBER HARVESTING

Timber harvesting and the associated activity of road construction can have a major effect on the potential for a river to meet eligibility requirements and, if eligible, which classification it meets.

Extensive, highly visible and ongoing timber harvesting within a river corridor could result in the river being ineligible. At most, such a river could qualify for classification as a Recreational River.

Timber harvest scheduled over a full or extended rotation, with an emphasis on maintaining the natural appearance of the forest (as seen from the riverbank) and meeting the Visual Quality Objective of Retention, is consistent with Scenic River classification. Silvicultural prescriptions may include clearcutting, thinning, shelterwood and removal of dead and down timber (salvage). Harvest, meeting the Visual Quality Objective of Partial Retention, would be acceptable within such a river corridor outside of the area seen from the river.

New or ongoing timber harvest within a river corridor precludes its classification as a Wild River.

HYDROPOWER DEVELOPMENT

Any impoundment of a river for hydropower or other development precludes classification of that stretch of the river as a Wild or Scenic River. A low dam or diversion that does not create an impoundment is compatible with a Recreational River classification. A high dam with a large impoundment would cause a river or river segment to be ineligible for any classification.

Other developments associated with hydropower, such as pipelines, penstocks, powerhouses, and power transmission lines, can also affect river classification. While it is acceptable for these structures and other evidence of man's activity to be visible, the level of visibility is the key. If the activities are visually subordinate to or borrow from the naturally established form, line, color or texture of the landscape, they can be acceptable within a Recreational River corridor. If they dominate the shoreline and characteristic landscape, the affected river or river segment may be ineligible for Wild and Scenic Rivers Act classification.

ROADS

Any road construction within a river corridor eliminates that river from Wild River classification, but it may still qualify as Scenic or Recreational.

Construction of roads and bridges which occasionally reach, parallel or cross a river may be consistent with a Scenic classification. The key is that the roads generally be inconspicuous and infrequently seen.

Construction of a road system that makes a river readily accessible (often on both sides), with bridge crossings throughout the system, limit a river to the Recreational River classification.

MINING, MINERAL EXTRACTION AND OIL AND GAS LEASING

Mining, mineral extraction or energy development that shows evidence of human activity results in a river not meeting criteria for the Wild River classification. Mining and other mineral activities, if limited in size and without substantial evidence of human activity, are acceptable within a Scenic or Recreational River classification. Such activities must meet the Visual Quality Objectives of Retention in the river foreground and Partial Retention in the remainder of the river corridor to be consistent with a Scenic classification.

Mining development and the associated structures and improvements which show substantial evidence of human activity are acceptable only in a Recreational River classification. If the level of development dominates the river corridor, it could result in part or all of the river being ineligible for classification.

RECREATION DEVELOPMENT

Development of trails and small hike-in campgrounds with minimum site modification are acceptable within a Wild classification. Development of an occasional campground or picnic area that involves low to moderate site modification and road access is consistent with the Scenic and Recreational classifications. Developed viewpoints and occasional boat launches also fit within a Scenic or Recreational classification. Trail development does not influence classification unless the trails are open to vehicular travel. Having trails open to vehicular traffic is inconsistent with the criteria for Wild classification.

Extensively developed recreation facilities designed to accommodate use of the river and its environs, such as campgrounds, picnic areas, viewpoints and boat launches generally limit a river to the Recreational classification.

WILDLIFE AND FISHERY IMPROVEMENT

Construction of off-channel rearing ponds, channel improvement structures, potholes, or other wildlife and fishery improvements does not affect river classification unless it results in changes of the shoreline or area seen from the river to the extent that there is evidence of human activity. In this case, the river or segment no longer meets Wild criteria, but remains eligible for Scenic or Recreational classification. The protection afforded by designation as a Wild and Scenic River will provide quality habitat for fish and wildlife species.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON WILD AND SCENIC RIVERS

A primary effect of Wild and Scenic River designation is the prohibition on damming or otherwise substantially altering a stream's flow characteristics. This protects its natural flow and fish habitat.

Designation prohibits the affected stream or segment from being developed for hydropower, domestic, or irrigation consumptive uses of its waters.

Power and water the designated stream might have provided will have to be obtained from other sources or the need left unsatisfied. Fisheries production of the stream will continue to be available in the future and would be expected to improve given the protection afforded by designation.

Given the restrictions associated with designation, Alternatives H (Modified) and I, which have the most rivers recommended, would have the greatest effect on limiting hydropower and other flow altering projects. These same alternatives would result in the highest level of riparian and river protection and subsequent higher levels of fish habitat and scenic quality. See Appendix F for specifics for each river.

Conversely, Alternative B-Departure (Modified), with no rivers recommended, will offer the highest level of energy development and timber production potential but with the negative consequences of altered stream flow, increased sedimentation, activities within riparian areas, and reduced fisheries habitat and scenic quality.

Alternatives A-Current Direction (No Action) and NC-No Change recommend only one river for designation and no rivers under the River Corridor allocation. Other than Alternative B-Departure (Modified), these two alternatives afford the lowest level of protection of Wild and Scenic river values.

Alternative C-Preferred (Modified) recommends three rivers for designation and also assigns all other eligible rivers to the River Corridor management prescription. It is expected that this balance will provide opportunities for development in some areas while affording substantial protection for the unique river characteristics and associated resources such as riparian vegetation, fish and wildlife habitat, and scenic quality.

An indirect effect of stream designation is the effect it may have on the property rights of adjacent landowners. Under the Wild and Scenic Rivers Act, where 51 percent or more of the designated stream corridor is owned by Federal or other governmental entity, the right of eminent domain cannot be used to acquire additional rights along the river. In Alternatives H (Modified) and I, the law would authorize condemnation of private property in the Main Stem and West Fork Humptulips, East Fork Humptulips and Wynoochee corridors outside of the Olympic National Forest boundary if the river segments outside of the National Forest are designated.

If only the Olympic National Park and Olympic National Forest segments of the rivers are designated, as proposed, there will be no direct effect on privately owned lands within the river corridors. There will be some indirect effects, however, due to increased use of the streams by users who become aware of them through their Wild and Scenic designation.

Increased use of the rivers will also result in increased costs for search and rescue, provisions of garbage and sanitation services and policing and administration of the areas.

There will be some effect on local communities ranging from increased traffic on the roads accessing these areas to opportunities to provide goods and services for these recreational users.

EFFECTS OF ALTERNATIVES ON SPECIFIC POTENTIAL WILD AND SCENIC RIVERS

The effects of proposed management on each eligible river that includes a significant amount of National Forest land is presented below. The key question is whether the management proposed for a given corridor in a particular alternative will or will not maintain existing attributes making the river eligible for consideration at this time. The discussion is limited to the effects of alternatives on National Forest portions of the corridors only. Olympic National Park portions are not likely to be changed and the Forest Service does not have control over the activities of other land managers or owners.

Dungeness and Gray Wolf Rivers

All or part of this river system is included as a Wild and Scenic River in Alternatives C-Preferred (Modified), H (Modified) and I. Because the river system includes two rivers, the effects of the alternatives will be presented in two parts.

Since the Olympic National Forest's Gray Wolf segment is almost entirely within the Buckhorn Wilderness, National Forest management activities are not likely to alter the existing character of the river in any alternative. However, development of hydropower facilities, allowed within Wildernesses, is not compatible with Wild and Scenic River designation. Development of the hydropower resource is precluded in those Alternatives (C-Preferred (Modified), H (Modified) and I) that recommend designation of the Forest's Gray Wolf segment a Wild and Scenic River.

In the Dungeness River, Alternative A-Current Direction includes a management area in its middle section that temporarily precludes timber harvest and road construction until past management problems have been corrected. If this direction was continued, this section would become more natural appearing. The entire river is recommended for Wild and Scenic designation in Alternatives C-Preferred (Modified), H (Modified) and I. In Alternative B-Departure (Modified), activities will result in changes in the character of the river corridor to the point where it would no longer meet scenic standards. This rate of change will be at an increasing rate of change in that alternative. Alternatives NC-No Change and B-Departure (Modified) are the only ones likely to result in changes in the first decade.

Dosewallips River

Alternatives H (Modified) and I recommend Wild and Scenic River designation for this river. Alternative C-Preferred (Modified) includes River Corridor management prescriptions which will maintain existing attributes of the corridor. Alternatives NC, A-Current Direction and B-Departure (Modified) will result in changes to existing attributes. Changes will occur quickly in Alternative B-Departure (Modified), but more slowly in Alternative A-Current Direction. It should be noted that about one-half the National Forest portion flows between two Wildernesses. Alternative A-Current Direction management will be compatible with a recreation designation in this section.

Duckabush River

Alternative B-Departure (Modified) will result in conditions within the river corridor that are not consistent with wild and scenic attributes. Approximately two-thirds of the corridor is within The Brothers Wilderness and will not be affected in any alternative. All other alternatives include a recommendation for Wild and Scenic River designation of this river.

Hamma Hamma River

Wild and Scenic designation is included for this river in Alternatives H (Modified) and I. Though not recommended as a Wild and Scenic River, river corridor management direction in Alternative C-Preferred (Modified) is compatible with a scenic designation and would retain current eligibility. However, hydropower development could be pursued. Management direction in Alternatives NC, A-Current Direction and B-Departure (Modified) are not compatible with designation as a Wild and Scenic River. Rate of change would be greatest in Alternative B-Departure (Modified), followed by NC and then A-Current Direction.

Main Stem and West Fork Humptulips

The main stem of the Humptulips does not reach the National Forest boundary. Therefore, the following discussion is limited to the West Fork. Alternatives NC, A-Current Direction and B-Departure (Modified) do not provide for management activities compatible with potential designation. Rate of change will be greatest in Alternative B-Departure (Modified) followed by NC and A-Current Direction. Practices implemented under River Corridor designation would be compatible with a "recreational" designation in those sections currently eligible for "scenic" designation. All other alternatives provide for management consistent with existing eligibility designations. Wild and Scenic River designation is recommended in Alternatives H (Modified) and I. River Corridor management direction for Alternative C-Preferred (Modified) will result in current attributes being maintained, but formal Wild and Scenic River designation is not recommended.

Soleduck River

The Soleduck is included as a Scenic River in Alternatives H (Modified) and I. Although not included in Alternative C-Preferred (Modified), the River Corridor allocation along Highway 101 is compatible with Scenic River criteria and, therefore, would retain the existing character along the river. Alternatives NC, A-Current Direction and B-Departure (Modified) are not compatible with Wild and Scenic River designation. Rate of change the river's attributes would be greatest in Alternative B-Departure (Modified), followed by A-Current Direction.

East Fork Humptulips, South Fork Skokomish and Wynoochee Rivers

In response to the DEIS, a number of people asked that the South Fork Skokomish, Wynoochee and East Fork Humptulips be reevaluated for eligibility for inclusion in the Wild and Scenic River system.

All of these rivers, or major segments of them, were found to possess "outstandingly remarkable" values and are eligible for inclusion in the Wild and Scenic River system. They are all recommended for designation as Wild and Scenic Rivers in Alternatives H (Modified) and I and will provide the associated high quality fish and wildlife habitat, and scenic values.

In Alternative C-Preferred (Modified) they will be managed as designated River Corridors. This allocation will result in management activities which protect the "outstandingly remarkable" characteristics, but it will not preclude utilization for water supply or hydropower purposes. These rivers are not recommended for protective allocations in Alternatives NC, A-Current Direction, or B-Departure (Modified). Roading, timber harvesting, and other management activities will be implemented subject to the Standards and Guidelines with the associated effects as displayed in the other environmental component sections of this chapter. Refer to the "Fisheries", "Wildlife", "Water", and "Scenery" sections.

CUMULATIVE EFFECTS OF ALTERNATIVES ON WILD AND SCENIC RIVERS

Designated streams will contribute to meeting the National Wild and Scenic Rivers System objectives.

The designated streams will provide, unimpeded, their "outstandingly remarkable" values for the future. By selecting an appropriate group of streams, a representative sample of the Nation's unfettered waters can be preserved for the use and enjoyment of future generations.

The rivers recommended by alternative are expected to be in addition to recommendations of other government agencies, such as the National Park Service. Any effects noted above will be cumulative with the effects associated with non-Forest Service recommendations.

The number of recommended streams and miles of stream by classification are displayed by Alternative in Table II-14.

Cumulative effects on other enviromental components associated with the rivers can be found within the specific component sections of this chapter.

MITIGATION AND EFFECTIVENESS

Development of skills and attitudes of users of the designated rivers through a program of training and education would reduce behaviors and accidents that lead to the need for Search and Rescue and cleanup activities. Judicious development of public use sites and removal of safety hazards can be identified in the detailed implementation planning phase for each river. Some of these needs can be met through the use of volunteer and partnership agreements with interested groups and individuals.

Education and involvement of local landowners in the Wild and Scenic River designation process will be useful for resolving many concerns regarding effects of Wild and Scenic River designation on private property and rights of property owners.

RELATIONSHIP TO PLANS OF OTHERS

The National Park Service and Senator Brock Adams are evaluating Olympic Peninsula rivers for designation as additions to the National Wild and Scenic Rivers System. The State of Washington Scenic Rivers Program is also evaluating Peninsula rivers as contributors to the State Scenic Rivers System.

UNROADED AREAS

OVERVIEW

An unroaded area usually consists of an area, generally 2,500 acres or more in size unless adjacent to the Olympic National Park, that does not contain any roads. The Roadless Area Reviews and Evaluations I and II identified a total of 15 unroaded areas on the Forest. The Washington State Wilderness Act of 1984 considered these areas for designation as Wilderness, designating most of five unroaded areas as Wilderness and releasing the remainder of these, as well as the other ten unroaded areas, for other forms of management. The ultimate use of the released unroaded areas is to be determined through the forest planning process. The purpose of the Washington State Wilderness Act of 1984 was to: (1) "designate certain National Forest System lands in the State of Washington as components of the National Wilderness Preservation System," and (2) "insure that certain other National Forest System lands in the State of Washington be available for nonwilderness multiple uses."

Since the Draft EIS, one unroaded area has been eliminated (Pine Mountain, 290 acres), two have been reduced in size (Mt. Baldy from 5,652 to 3,895 acres and Madison Creek from 1,469 to 1,079 acres), and one area has been enlarged (Rugged Ridge from 4,009 to 4,564 acres). These changes were the result of the National Forest/National Park boundary change of 1986. There are currently 13 unroaded areas having a total of approximately 85,800 acres. This represents approximately 14 percent of the total Forest acreage.

SIGNIFICANT INTERACTIONS

The primary factor affecting the nature of unroaded areas is road construction. When a road is constructed into an unroaded area, opportunities to provide Wilderness or unroaded recreation are no longer available. Those alternatives that involve road construction within unroaded areas eliminate the option of these areas being designated as Wilderness in the future. Road construction also eliminates Primitive and Semi-Primitive recreation opportunities within the area affected by the road. Those alternatives that retain unroaded areas in an unroaded condition provide options for evaluating Wilderness values in future planning efforts. Such alternatives will also provide the highest levels of unroaded dispersed recreation opportunity.

Some of the existing unroaded areas will remain unroaded due to the difficulty of road construction. Escarpments, steep and rocky slopes, unstable slopes and the high probability of mass movements are important reasons why roads have not been constructed into some of these areas. One small unroaded area (McDonald) is entirely within a Spotted Owl Habitat Area, and will remain unroaded in all alternatives except Alternative NC-No Change.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON UNROADED AREAS

The future condition of the inventoried unroaded areas on the Olympic National Forest varies considerably from alternative to alternative. Tables IV-23 through IV-25 identify the acreage in each unroaded area that is expected to have been developed by the end of the first, second, and fifth decades in each alternative. Further development after the fifth decade is not anticipated. Therefore, the acreage remaining in each unroaded area at the end of the fifth decade is expected to be retained in an unroaded condition in perpetuity.

Table IV-23. Acres Eliminated from Unroaded Area by End of First Decade

		Alternatives (M Acres)					
Unroaded Area	Existing Acres	NC-No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
McDonald	0.5	0.3	0.0	0.0	0.0	0.0	0.0
Quilcene	19.0	7.6	2.4	2.9	2.4	2.4	0.0
Mt. Zion	5.4	2.7	1.8	1.8	0.9	0.0	0.0
Green Mtn.	4.5	2.3	1.9	1.9	1.9	0.0	0.0
Jupiter Ridge	8.3	3.4	2.8	3.6	1.9	0.5	0.0
Jefferson Ridge	9.4	2.8	2.6	4.5	2.6	0.0	0.0
Lightning Peak	7.2	1.8	0.9	2.7	0.9	0.0	0.0
Upper Skokomish	6.2	1.0	0.6	2.2	0.6	0.0	0.0
Moonlight Dome	5.9	0.3	0.3	3.0	0.0	0.0	0.0
S. Quinault Ridge	9.8	3.4	2.7	3.4	1.2	0.0	0.0
Rugged Ridge	4.6	2.3	1.1	1.1	1.1	0.0	0.0
Mt. Baldy	3.9	2.0	0.7	0.7	0.7	0.0	0.0
Madison Creek	1.1	0.6	0.1	0.1	0.1	0.0	0.0
TOTAL ACRES	85.8	30.5	17.9	27.9	14.3	2.9	0.0

Table IV-24. Acres Eliminated from Unroaded Area by End of Second Decade

		Alternatives (M Acres)					
Unroaded Area	Existing Acres	NC-No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
McDonald	0.5	0.4	0.0	0.0	0.0	0.0	0.0
Quilcene	19.0	11.4	3.6	4.3	3.6	3.6	0.0
Mt. Zion	5.4	4.1	2.7	2.7	1.4	0.0	0.0
Green Mtn.	4.5	3.8	2.9	2.9	2.9	0.0	0.0
Jupiter Ridge	8.3	5.0	4.1	5.3	2.9	0.8	0.0
Jefferson Ridge	9.4	4.2	3.8	6.7	3.8	0.0	0.0
Lightning Peak	7.2	2.7	1.4	4.1	1.4	0.0	0.0
Upper Skokomish	6.2	1.4	0.9	3.2	0.9	0.0	0.0
Moonlight Dome	5.9	0.5	0.5	4.4	0.0	0.0	0.0
S. Quinault Ridge	9.8	5.1	4.0	5.1	1.8	0.0	0.0
Rugged Ridge	4.6	3.5	1.6	1.6	1.6	0.0	0.0
Mt. Baldy	3.9	2.9	1.1	1.1	1.1	0.0	0.0
Madison Creek	1.1	0.8	0.1	0.1	0.1	0.0	0.0
TOTAL ACRES	85.8	45.8	26.7	41.5	21.5	4.4	0.0

Table IV-25. Acres Eliminated from Unroaded Area by End of Fifth Decade

		Alternatives (M Acres)					
Unroaded Area	Existing Acres	NC-No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
McDonald	0.5	0.5	0.0	0.0	0.0	0.0	0.0
Quilcene	19.0	15.2	4.8	5.7	4.8	4.8	0.0
Mt. Zion	5.4	5.4	3.6	3.6	1.8	0.0	0.0
Green Mtn.	4.5	4.5	3.8	3.8	3.8	0.0	0.0
Jupiter Ridge	8.3	6.7	5.5	7.1	3.8	1.0	0.0
Jefferson Ridge	9.4	5.6	5.1	8.9	5.1	0.0	0.0
Lightning Peak	7.2	3.6	1.8	5.4	1.8	0.0	0.0
Upper Skokomish	6.2	1.9	1.2	4.3	1.2	0.0	0.0
Moonlight Dome	5.9	0.6	0.6	5.9	0.0	0.0	0.0
S. Quinault Ridge	9.8	6.8	5.3	6.8	2.4	0.0	0.0
Rugged Ridge	4.6	4.6	2.1	2.1	2.1	0.0	0.0
Mt. Baldy	3.9	3.9	1.4	1.4	1.4	0.0	0.0
Madison Creek	1.1	1.1	0.1	0.1	0.1	0.0	0.0
TOTAL ACRES	85.8	60.4	35.3	55.1	28.3	5.8	0.0

Alternatives NC-No Change and B-Departure (Modified)

Alternatives NC-No Change and B-Departure (Modified) would have the greatest effect on the condition of unroaded areas. Alternative NC would reduce the existing unroaded area acreage from 85,800 to approximately 25,400 acres (30 percent of the current total). Under this alternative, six of the unroaded areas would be eliminated and the remaining seven would be reduced in size. This alternative would involve roughly 40 miles of road construction within unroaded areas in the first decade. Including Wildernesses, approximately 18 percent of the Forest would be in an unroaded condition in perpetuity with this alternative.

Alternative B-Departure (Modified) would reduce the unroaded area acreage to approximately 30,700 acres (36 percent of the current total). One area would be eliminated under this alternative and eleven of the remaining twelve unroaded areas would be reduced in size. Only one small unroaded area (McDonald, which lies within a SOHA) would be retained in its entirety. Alternative B-Departure would involve construction of roughly 57 miles of road within unroaded areas in the first decade. Including Wildernesses, approximately 19 percent of the Forest would be in an unroaded condition in perpetuity with Alternative B-Departure.

Alternatives H (Modified) and I

Alternatives H (Modified) and I would provide the greatest level of unroaded area retention. The full 85,800 acres of existing unroaded areas would be retained in perpetuity in Alternative I. Including Wildernesses, approximately 28 percent of the Forest would be in an unroaded condition in perpetuity with this alternative. There would be no roads constructed in any of the unroaded areas under Alternative I.

Alternative H (Modified) would reduce the unroaded area acreage to approximately 80,000 acres (93 percent of the current total). Only two unroaded areas would be reduced in size, while all of the remaining eleven would be retained in their existing unroaded condition with Alternative H. This alternative would involve approximately 10 miles of road construction within unroaded areas in the first decade. Including Wildernesses, approximately 27 percent of the Forest would be in an unroaded condition in perpetuity with this alternative.

Alternatives A-Current Direction (No Action) and C-Preferred (Modified)

Alternatives A-Current Direction (No Action) and C-Preferred (Modified) would provide a middle range of effects on unroaded areas. Alternative C-Preferred would reduce the unroaded area acreage to approximately 57,500 acres (67 percent of the current total). Two unroaded areas (McDonald and Moonlight Dome) would be retained in their entirety in this alternative, and portions of the remaining eleven areas would also be retained. This alternative would involve approximately 21 miles of road construction within unroaded areas in the first decade. Including Wildernesses, approximately 23 percent of the Forest would be in an unroaded condition in perpetuity with this alternative.

Alternative A-Current Direction would reduce the unroaded area acreage to approximately 50,500 acres (59 percent of the current total). Only one small unroaded area (McDonald) would be retained in its entirety, while portions of the remaining twelve areas would be removed from unroaded status with this alternative. Alternative A-Current Direction would involve approximately 25 miles of road construction within unroaded areas in the first decade. Including Wildernesses, approximately 22 percent of the Forest would be in an unroaded condition in perpetuity with this alternative.

Refer to Appendix C for individual descriptions of each unroaded area, and for a discussion of the environmental consequences of unroaded area management by alternative.

CUMULATIVE EFFECTS OF ALTERNATIVES ON UNROADED AREAS

Once an unroaded area has been developed with roads, there is an overall reduction in total unroaded area acreage. This reduces the availability of Semi-Primitive and Primitive recreation settings. This affects not only the specific unroaded area that has been developed in terms of the availability of Semi-Primitive and Primitive settings, but also the use of Wildernesses and other unroaded areas throughout the Forest, the Olympic Peninsula, and Washington State. The loss of Primitive and Semi-Primitive recreation opportunity in a given area can often result in shifts of either current or future demand for unroaded recreation to other areas, which could result in overcrowding and additional impacts to the areas to which demand has shifted. Also, once an area is roaded, it is generally excluded from being considered for Wilderness in future planning efforts, thus reducing the total acreage available for addition to the Wilderness Preservation System.

Activities adjacent to unroaded areas can have an effect on the character of the unroaded area itself. Road construction and timber harvesting in areas adjacent to unroaded areas can have detrimental effects on the Primitive and Semi-Primitive recreation settings within unroaded areas. The sights and sounds of activities from areas adjacent to unroaded areas could move the ROS class within an unroaded area closer to the Rural end of the Recreation Opportunity Spectrum. Effects associated with activities outside of unroaded areas would be greatest in Alternatives NC-No Change and B-Departure (Modified). Alternatives H (Modified) and I would have the lowest level of effects of this kind, while Alternatives A-Current Direction and C-Preferred (Modified) would involve a middle range of such effects.

MITIGATION MEASURES AND EFFECTIVENESS

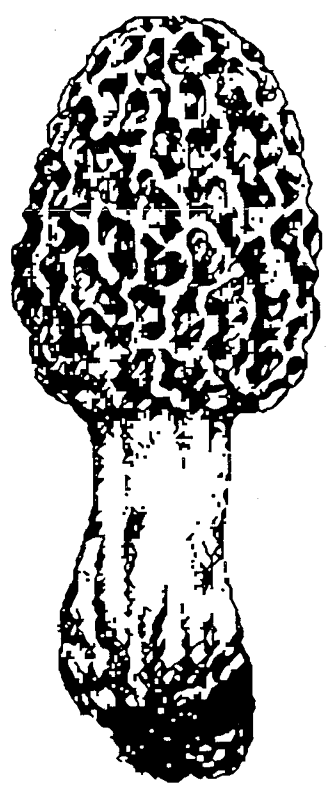
Unroaded areas allocated to Undeveloped Non-Motorized and Undeveloped Motorized recreation (Management Areas A1A and A1B) will be managed to provide Primitive and Semi-Primitive recreation settings and opportunities. Restrictions may be necessary to prevent overuse from occurring.

New trails constructed in unroaded areas can increase the total capacity by redistributing visitor use and by providing access to areas that would otherwise be inaccessible. This would require careful planning in order to meet the criteria for providing Primitive and Semi-Primitive recreation opportunities.

In the case of unroaded areas that are not allocated to unroaded recreation management, no mitigation is planned to maintain the undeveloped character of the area through time. This character would gradually be lost as roads are constructed.

RELATIONSHIPS TO PLANS OF OTHERS

None are known to exist.



ROAD ACCESS

OVERVIEW

Throughout this chapter, we are generally concerned about the effects of roads on other components of the environment. However, the activities associated with the alternatives can also affect the roads themselves and the access provided by these roads. In assessing the effects of the alternatives on road access, two concerns are primary. The first is the nature of the road system itself, i.e., the extent of the system (which affects the amount of access it provides) and the way in which it is managed (which determines how the available access is to be used). The second is the volume and type of traffic associated with various land use and output patterns, as this can have substantial effects on both user safety and the ease and convenience of travel.

While the focus of the following discussion is the effects of the alternatives on road access, it is important to note that roads can affect many of the other environmental components included in this chapter. The construction, reconstruction, management, and use of the Forest's roads can have significant effects on fish habitat quality, wildlife, recreation use patterns, unroaded area characteristics, and many other aspects of the forest environment. Please refer to the sections covering the individual environmental components for discussion of the way each is affected by the road system and road use.

SIGNIFICANT INTERACTIONS

VEGETATION MANAGEMENT - TIMBER HARVEST

The activity expected to have the greatest effect on the road system in the future is timber harvest. The extent and location of timber harvest will be important in determining the levels of both road system expansion and road management. With few exceptions, future road construction will be for the purpose of serving timber harvest. Therefore, road mileage to be constructed will vary directly with the size of the harvest program. Similarly, the location of new roads will depend on which areas are to be harvested. Finally, road construction timing will depend primarily on harvest timing.

The extent, location, and timing of the harvest program will affect road management as well as road construction. The higher the timber volume over a given road system, the greater the need for road reconstruction, road maintenance, and traffic management. The likelihood of conflict between recreation travel and timber haul increases in proportion to the harvest level. This possibility is most pronounced on the Forest's road system, but extends to county systems as well. Conversely, opportunities to expand road closures, reduce maintenance and reconstruction costs, and ease road use conflicts increase as harvest level decreases.

RECREATION USE

Increased recreation travel will not affect road construction, but will have essentially the same effect on road management and reconstruction as increased timber harvest. Road use conflicts and management costs will rise as recreation travel expands. Increased travel to Forest destinations will add to total traffic on county and State systems.

MINERALS

Both the availability and quality of rock and aggregate resources have a major role in road use and road economics. The availability (or unavailability) of a suitable source profoundly affects road costs. Rock haul cost can, by itself, make a project uneconomical in certain instances. Use of unsuitable rock or aggregate (due to either lack of availability or lack of sufficient funds) can severely limit the suitability of a road for certain uses. For example, use of a weak surfacing course can result in the need for mechanical assists for log haul trucks to facilitate negotiating steep grades. In general, the probability of limited future availability of suitable rock sources increases as harvest level increases, since existing rock supplies must be used to construct and maintain roads for timber haul. Conversely, development of new access roads to serve timber harvest can also provide access to new rock sources.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON ROAD ACCESS

ACCESS DEVELOPMENT

The extent and location of new road construction associated with each alternative is an important factor in determining the overall accessibility of the Forest for various uses. Three categories of use are of primary concern: resource extraction (essentially timber haul), recreation travel, and administrative use (such as land management and fire suppression). The greater the expansion of the Forest's road system, the higher the level of accessibility for all uses. Since 88 percent of the Forest outside Wilderness is currently considered roaded, it should be noted that additions to the road network at this point represent incremental additions to an already well-developed access system rather than major access development undertakings.

The road construction program associated with each of the alternatives is displayed in Table IV-26. Mileage figures are based on the expansion of the existing road system needed to serve the timber harvest program of each alternative. Construction needs are estimated for the first decade and for the 50-year planning horizon, and are shown for both the total Forest and for currently undeveloped areas. Note that for this analysis, "undeveloped" includes all areas that do not have a preliminary access system in place (as opposed to the "unroaded areas" described in Appendix C or areas that fall into unroaded recreation ROS classes). The proportion of total undeveloped acreage (outside Wilderness) to be roaded in each alternative is also displayed.

Table IV-26. Road Construction (Miles) by Alternative

	Forest Total Construction		Undeveloped Area Construction		
Alternative	First Decade	Total	First Decade	Total	Percent Undeveloped to be Accessed
NC-No Change	183	560	49	118	65.0
A-Current Direction	176	460	33	83	32.9
B-Dep (Modified)	283	638	67	167	66.0
C-Pref (Modified)	141	415	28	70	28.2
H (Modified)	92	272	16	39	15.4
I	20	102	5	13	5.2

Alternative B-Departure (Modified)

Alternative B-Departure (Modified) involves the greatest expansion of the Forest's road system. Especially important is the extent of first decade construction within undeveloped areas in this alternative, as this represents a significant increase in access to new areas. This development also entails a substantial effect on the characteristics of these areas in the near future (see "Direct and Indirect Effects of Alternatives on Unroaded Areas" in this chapter). Accessibility of the Forest will be expanded to the greatest extent in this alternative.

Alternative NC-No Change

Alternative NC-No Change also involves substantial expansion of the Forest's road system, with road construction mileage estimated to fall between Alternatives A-Current Direction (No Action) and B-Departure (Modified). The extent of first decade construction within undeveloped areas in this alternative is also substantial, and results in a high level of access development into new areas. Substantial effects on the characteristics of these areas could result. Alternative NC represents a significant expansion of the accessibility of the Forest.

Alternatives A-Current Direction (No Action) and C-Preferred (Modified)

Alternatives A-Current Direction (No Action) and C-Preferred (Modified) entail more moderate levels of road system expansion and include substantially reduced roading of undeveloped areas in the first decade. Much of this reduction in road construction mileage is due to the objective of basing timber harvest allocations on contribution to PNV, as opposed to the timber production objectives of Alternatives NC and B-Departure.

Alternatives H (Modified) and I

Alternatives H (Modified) and I involve the lowest levels of road system expansion among the alternatives, primarily due to the increased emphasis on amenity outputs in these alternatives. The most substantial reductions in construction (relative to Alternatives A and C) occur in undeveloped areas, where roading is minimal. Alternative I includes a very small Forest-wide road construction program in the first decade. These alternatives provide the lowest level of Forest road access expansion.

ACCESS MANAGEMENT: MAINTENANCE LEVELS AND ROAD CLOSURES

A second important factor influencing the accessibility of the Forest is the way in which the road access system is maintained and managed. Options range from high levels of maintenance and management to accommodate all uses to minimal maintenance and management for very limited use. The former strategy provides the highest degree of accessibility, while the latter minimizes road management costs and results in lowered levels of road-related environmental effects. The actual management of the road system associated with each alternative will include a mix of these opposing strategies. This mix will be designed to provide for efficient management of the system while being responsive to the objectives of each alternative.

The effects of alternatives on the mix of traffic types for which the road system is to be managed are displayed in Table IV-27. The extent to which roads are to be maintained for passenger car use is based on both the goal of accommodating recreational travel to established destinations and the overall maintenance level resulting from the size of the timber harvest program. An extensive harvest program will result in a higher proportion of the road system being maintained (for timber haul) at a level which will permit passenger car use. Maintenance for high clearance vehicle (HCV) use also depends on the nature of the timber harvest program. An active harvest program leads to frequent use of local roads for timber haul, and thus results in a fairly high proportion of the road system being kept open to HCV use. A low level of timber harvest, and the resulting infrequent use of roads, makes a more intensive road closure program economically attractive.

The estimates of road use management shown in Table IV-27 are based on the following assumptions:

1. Continued gradual reduction of the average maintenance level of Forest development roads.
2. A lower average maintenance level for new roads (predominantly local) than for the existing system.
3. Increased use of both seasonal and long-term closures.
4. A higher proportion of the road system open to use when timber harvest is high than when harvest is low.
5. Continued availability of passenger car access to established recreation destinations for which such access is currently provided.

Refer to Chapter III, "Roads - Current Situation," for additional information regarding the road management categories displayed below.

Table IV-27. Road Use Management by Alternative

Alternative	Passenger Car - All Season		Passenger Car - Seasonal Closure		High Clearance Vehicle - All Season		High Clearance Vehicle - Seasonal Closure		Gated Closure		Blocked to All Use	
	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent
No Change												
Decade 1	686	25	49	2	1,156	41	164	6	197	7	525	19
Decade 5	682	22	57	2	1,293	41	205	6	261	8	656	21
A-Current Direction												
Decade 1	684	25	49	2	1,152	41	163	6	197	7	525	19
Decade 5	650	21	53	2	1,216	40	191	6	271	9	673	22
B-Dep (Modified)												
Decade 1	707	25	52	2	1,221	42	174	6	197	7	526	18
Decade 5	707	22	60	2	1,354	42	215	6	253	8	643	20

Table IV-27. (Cont'd.)

Alternative	Passenger Car - All Season		Passenger Car - Seasonal Closure		High Clearance Vehicle - All Season		High Clearance Vehicle - Seasonal Closure		Gated Closure		Blocked to All Use	
	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent
C-Pref (Modified)												
Decade 1	670	24	47	2	1,123	41	158	6	202	7	535	20
Decade 5	615	20	50	2	1,157	38	181	6	289	10	717	24
H (Modified)												
Decade 1	651	24	45	2	1,080	40	151	6	208	8	551	20
Decade 5	558	19	44	2	1,030	36	160	5	312	11	762	27
I												
Decade 1	626	24	42	2	1,021	39	141	5	216	8	568	22
Decade 5	484	18	36	1	875	32	133	5	343	13	825	31

Alternatives B-Departure (Modified) and NC-No Change

These two alternatives provide the highest levels of accessibility, due to both relatively extensive access development programs and high levels of maintenance in response to timber harvest programs. These alternatives will provide high levels of access availability for both passenger car use and high clearance vehicle use.

Alternatives A-Current Direction (No Action) and C-Preferred (Modified)

These alternatives involve moderate levels of accessibility, with generally lower maintenance levels than associated with Alternatives B-Departure and NC. Proportion of the road system available for passenger car and high clearance vehicle use will be somewhat reduced, with a concurrent slight increase in use of seasonal and long-term road closures.

Alternatives H (Modified) and I

These alternatives include the lowest degree of accessibility, as expansion of the road system is minimal and road maintenance levels are relatively low in both alternatives. Alternative I in particular involves an extensive road closure program, with an estimated 50 percent of the road system having some form of closure (either seasonal or long-term) by the end of the fifth decade.

USER SAFETY AND EASE OF TRAVEL: TRAFFIC FLOWS

User safety and travel ease are most likely to be affected when demand for use of the road system exceeds the system's capacity to efficiently accommodate traffic. The anticipated on-Forest traffic flows of each alternative were assessed to determine the likelihood that projected road use would exceed existing capacity on the Forest's main road systems during the first 20 years of the planning period. Projected volumes of recreation and timber haul traffic combined were used to make this assessment. Traffic variations among alternatives are expected to be the result of changes in both timber traffic and recreation traffic, with timber traffic volume being the most important factor leading to differences between one alternative and another.

Recreation traffic projections indicate increases in this form of traffic for all alternatives. Alternative B-Departure (Modified) is expected to result in the slowest growth in recreation traffic flows, and Alternative I, with its strong emphasis on amenity outputs, should entail the most rapid increases. Based on expected changes in recreation use, it is likely that recreation traffic increases could range from 10 percent (Alternative B-Departure) to 50 percent (Alternative I) by the end of the second decade.

Timber harvest traffic is expected to exceed current levels thoughout the first two decades in Alternatives NC-No Change and B-Departure (Modified). Timber traffic flows of the remaining alternatives are either comparable to or well below current levels. Alternatives H (Modified) and I involve reductions in haul traffic substantial enough to reduce road reconstruction and traffic management requirements considerably.

The projected increases in recreation traffic in all alternatives, if they occur, are expected to result in increased need for traffic management, road maintenance, and road surface replacement. The majority of recreation travel increases are likely to occur in the Eastside zone, where most of the principal recreation roads have the capacity to handle increased traffic, while timber haul is generally concentrated in the Westside zone. Therefore, conflicts between timber haul and recreation use should not become a major problem as a result of increased recreation travel alone. Exceptions to this general rule are most likely in alternatives with higher volumes of timber traffic. The potential for conflict between timber haul and recreational travel is greatest in such alternatives.

Alternatives B-Departure (Modified) and NC-No Change

These two alternatives, with heavy volumes of timber haul traffic anticipated, are the most likely to result in conflicts regarding user safety and travel ease. Despite the fact that recreation travel is expected to be somewhat lower in these alternatives than in the others, the high total volume of traffic could lead to a higher probability that there will be periods of heavy and conflicting road use. Higher average road maintenance levels and intensified traffic management will serve to moderate these effects.

Alternatives A-Current Direction (No Action) and C-Preferred (Modified)

These alternatives will entail timber haul traffic volumes at or below today's levels, in combination with moderate increases in recreation travel. Conflicts regarding user safety and travel ease are less likely with these alternatives than with Alternatives B-Departure and NC.

Alternatives H (Modified) and I

While these two alternatives entail the lowest average maintenance levels among the alternatives and the greatest anticipated increases in recreation travel, it is likely they also involve the lowest probability of user safety conflicts and travel inconvenience. The low volumes of timber haul traffic associated with these alternatives (Alternative I in particular) will result in minimal likelihood of conflict. Access to popular recreation destinations will be fully maintained in both alternatives.

CUMULATIVE EFFECTS OF ALTERNATIVES ON ACCESS AND SAFETY

The effects of alternatives on overall Olympic Peninsula traffic flows were evaluated. The higher the total traffic flow associated with a given alternative, the greater the influence of that alternative on the total Peninsula road system. This is because virtually all Forest traffic uses State and county road systems to reach the Forest. It is unlikely that any alternative will generate enough traffic to create significant congestion problems or necessitate major reconstruction of public road systems. Nonetheless, those alternatives having relatively high traffic volumes are more likely to precipitate such effects, especially short-term congestion problems during peak use periods. When such congestion problems do occur, both user safety and travel convenience become a concern.

The greatest variations in total traffic flow by alternative are associated with differences in timber harvest level rather than recreation use. Therefore, alternatives with high timber harvest levels, and the associated high traffic volumes, are likely to have the greatest influence on traffic levels on the Peninsula road system as a whole. Alternative NC falls in this category, as does Alternative B-Departure. These alternatives have the greatest potential to affect safety and travel ease on the Peninsula's road systems, although severe problems are unlikely.

Alternatives H (Modified) and I generate the smallest traffic flows and, therefore, entail the smallest probability of increasing congestion on State and county road systems. Because these alternatives have substantially reduced timber haul traffic, they could result in some slackening of the conflicts that sometimes arise between timber haul and recreation travel on major Peninsula travel routes. Alternative I is more likely to have such an effect.

The two remaining alternatives involve total traffic flows which are not markedly different from present levels. It is unlikely that either of these would result in noticeable differences in overall Peninsula traffic flows or congestion levels.

Development and management of the Forest's road access system is not expected to affect the accessibility of off-Forest destinations on the Peninsula. With a few exceptions, the Forest's road system serves Forest destinations only, and changes in the nature of this system should have little impact on off-Forest access. Therefore, cumulative effects due to interactions between the Forest's road access system and that of the Peninsula as a whole are not anticipated.

Interactions between the road access expansion, maintenance, and management programs of the alternatives and the long-term availability of suitable road surface rock resources can have some interesting consequences in terms of accessibility. Alternatives involving extensive expansion of the road system and high levels of road use have the potential to deplete rock resources to an extent that precipitates limitations on further access development or maintenance.

If rock source depletion causes a major shift in the economics of rock use, limitations on further access become a possibility. Such an effect is most likely in Alternatives B-Departure (Modified) and NC-No Change, which involve high levels of road construction and heavy road use. This possibility is mitigated to some extent by the fact that these alternatives also provide the greatest opportunity for locating and accessing new rock sources. It is anticipated that lack of rock availability, if it becomes a problem, will influence road construction standards and maintenance levels rather than basic access development objectives. Refer to "Minerals" in this chapter for detail regarding rock resource availability.

MITIGATION MEASURES AND EFFECTIVENESS

The potential for conflicts in the area of user safety and ease of travel is an important consideration in establishing management and maintenance strategies for the Forest road system. If demand for road use becomes such that safety and convenience problems occur, these are mitigated through use of road management techniques. Current practices include management of Forest roads for traffic levels consistent with the resource objectives served by each road, and management to reduce conflict between recreation traffic and timber harvest traffic. The latter is often accomplished by restricting timber haul to weekdays and/or months of low recreation use in areas where conflict is likely. It is anticipated that effective use of road management will continue to avoid or mitigate safety and congestion problems that develop on the Forest's road system.

The contribution of Forest-generated traffic to the total traffic volume of the Peninsula road system also has the potential to precipitate congestion and result in the need for increased traffic management. At present, this is not expected to be a major concern. If future Forest traffic volumes lead to increased likelihood of congestion effects on the overall Peninsula road system, expanded use of road and traffic management strategies may be necessary to mitigate such effects.

RELATIONSHIPS TO PLANS OF OTHERS

Although the alternatives present a wide range of road development options and levels of traffic flow, it is not anticipated that any of them would lead to significant changes in the road management plans of other agencies. Any of the alternatives could result in some modification of share-cost agreements and/or Forest road designations as timber haul patterns and traffic flows evolve in response to new management direction. It is expected that such changes can be developed smoothly and without undue friction. It is doubtful that any alternative would precipitate changes of greater scope, since the variations among alternatives represent only a very minor component of the total Peninsula transportation system and traffic flow.

STRUCTURES AND UTILITY CORRIDORS

OVERVIEW

At the present time, there are no plans for new construction of administrative sites, utility corridors, or major special use facilities of a similar nature. One exception may be the relocation of the Forest Supervisor's Office in the Olympia area, which will not affect National Forest ownership. As Chapter III has pointed out, some new powerline corridors may be needed in the future as specific projects are proposed and developed. No significant or firm proposals have been received and none are anticipated at this time. A utility corridor may be needed in association with hydro-power development at Wynoochee Dam, but a preferred alternative for a specific route has not been identified.

SIGNIFICANT INTERACTIONS

The number and location of administrative sites is not likely to change significantly.

The primary variable directly affecting utility corridors and special use structures is land allocation. Where land is allocated to uses with which such facilities are not compatible, their development will be discontinued, phased out or precluded. Other allocations may not preclude facility development, but costs may increase if additional provisions are needed to assure compatibility. The existing power lines through Klahowya Campground and along the Quinault South Shore Road are cases in point. These lines are not consistent with Visual Quality Objectives. In order to meet Visual Quality Objectives, the lines may be relocated underground as a scenic resource rehabilitation measure.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON STRUCTURES AND UTILITY CORRIDORS

The number and location of administrative sites will not vary from alternative to alternative. The establishment and operation of special use structures and utility corridors is most likely to be affected by land allocations associated with the alternatives. Where land is allocated to uses with which such facilities are incompatible (e.g., a microwave station in Wilderness), their development will be precluded. Other allocations, such as management for scenic quality, do not preclude such facilities, but may necessitate additional development or operation costs to assure that management objectives are met. The probability of conflict between allocations and special uses increases in direct proportion to the acreage allocated to potentially restrictive uses.

Alternatives B-Departure (Modified, A-Current Direction (No Action and) NC-No Change

Alternative B-Departure (Modified), because it entails very few allocations that would be incompatible with special uses, is the alternative least likely to be limiting in this area. Alternatives A-Current Direction and NC-No Change also contain relatively low levels of allocations that restrict resource development and use of this type.

Alternatives C-Preferred (Modified) and H (Modified)

Alternative C-Preferred (Modified), with some increased emphasis on amenity outputs, is more likely to result in some conflict with, or restrictions in, special use authorizations. The probability of such conflict or restrictions can best be described as moderate. Alternative H (Modified) similarly affects these uses and development opportunities, but the increased emphasis on unroaded area retention makes conflict somewhat more likely in this alternative.

Alternative I

This alternative includes the highest levels of allocation to uses that could restrict or limit special use structures and/or utility corridor development. The more extensive allocations to old-growth habitat of Alternative I are not considered to be incompatible with most potential special uses.

CUMULATIVE EFFECTS OF ALTERNATIVES ON STRUCTURES AND UTILITY CORRIDORS

Alternatives that are oriented to amenity values would have the greatest cumulative effect on development of administrative structures, and utility corridors. Cumulative effects, however, are not considered to be a major concern during this plan period or a 50-year planning horizon. Present demand, commensurate projection, and technical ability to expand capacity of existing corridors, suggests that cumulative effects for any Forest Plan Alternative will not be a critical factor very soon. Exceptions may occur in the event of a national energy crisis, such as experienced in the early 1970's, when the "Northern Pipeline" project was considered along with many hydropower project proposals. Most of these proposals were withdrawn or reconsidered when the energy crisis subsided.

MITIGATION MEASURES AND EFFECTIVENESS

Utility corridors for power, roads, pipelines, and water systems can have significant environmental impacts. Administrative structures, electronic sites, etc., can similarly create impacts because they are usually located in prominent, highly visible locations. These impacts are compounded in areas where the management strategy forms natural landscapes and undisturbed pristine settings. Mitigation of these impacts can be very effective through route-locating and selection processes and the application of landscape management practices and guidelines designed specifically for these facilities. Often the most effective mitigation is obtained by utilizing existing corridors to full capacity before new corridors are considered or when compatible utilities occupy the same corridors. New technology and methods are also increasing the carrying capacity of existing powerlines with few additional impacts to existing corridors.

RELATIONSHIPS TO PLANS OF OTHERS

The greatest impacts from utility corridors are usually associated with major project proposals by Federal, State, municipal or public utility districts. Most of these agencies conduct marketing studies to determine population trends and movement, and associated utility needs. It is imperative that the Forest Service is involved in the planning efforts of these entities well in advance of developmental stages. At this time, specific proposals or projected future needs have not been identified.

MINERALS

OVERVIEW

Demand for access to National Forest System lands for the purpose of mineral exploration and development may increase over time. Operating plans will be submitted for approval and must be processed in a timely manner. This will not change by alternative. Mineral commodities, deposit locations and deposit characteristics will not vary by alternative. Demand for mineral commodities is expected to increase over time regardless of the alternative selected. As described in Chapter III, minerals are classified as locatable, leasable, or salable, and the laws by which each type is managed will not change by alternative. Those lands that are not withdrawn from mineral entry will remain subject to exploration and development under the mining and mineral leasing laws. Under the various alternatives, certain lands are recommended for withdrawal and other lands are recommended for management under a variety of prescriptions.

In most cases, the value of mineral resources is not well quantified. It is, therefore, difficult to quantify effects by management alternative. There are "measured," "indicated" and "inferred" manganese resources (as well as copper, molybdenum, chromium, and iron) occurring on the Olympic National Forest for which there is no present demand. The potential for development of these resources in the near future appears to be relatively low. A large portion of the area is also classified "prospectively valuable" for oil and gas resources, but there are no known deposits on the Forest. Also, there appears to be little interest in exploring the area. Therefore, the consequences are best shown by analyzing the relative degree to which management prescriptions may limit the availability of lands for minerals exploration and development, or constrain proposed mineral activities.

SIGNIFICANT INTERACTIONS

The manner in which the lands are to be managed under each alternative will have an effect on the availability of those lands for mineral entry and on the cost of conducting exploration, development and reclamation activities. Not only will implementation of the plan preclude future exploration and development in areas recommended for withdrawal, but the management prescriptions may adversely influence interest in exploring some areas for their mineral resources.

Reasonable access is essential to mineral exploration and development. The present road system appears to satisfactorily serve the present demand for mineral-related access on this Forest. Should interest in the Olympic's oil, gas, or manganese resources increase for unexpected reasons, the increased activity would put an additional burden on the existing road system. The present interaction between the two, however, appears to be minor and of a positive nature. In most cases, when access is needed for mineral-related activities, it can be managed to be compatible with the Forest Service road system.

On the Forest, the dominant use of road construction materials is in support of the timber management program. Future demand will continue to reflect the level of road building and maintenance needed for timber harvesting activities. It appears that the need for new roads will be influenced insignificantly by mineral-related activities.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON MINERALS

Management prescriptions have been grouped by their relative restrictiveness. These groups are shown in Table IV-28. For example, the prescriptions requiring complete withdrawal of lands from mineral entry (i.e., Wilderness or Wild Rivers) are most restrictive. Such withdrawals will usually preclude mineral entry. The only mineral activities allowed will be those conducted on mining claims, leases or permits having valid existing rights established prior to withdrawal. Prospecting, leases and mineral permits may be allowed in some circumstances. The second group, which is considered to be "highly" restrictive toward minerals, includes those lands managed as Scenic or Recreational Rivers, dispersed recreation areas, developed recreation sites or special interest areas. From a minerals standpoint, the least restrictive management areas are those lands allocated to timber production. In all, except the first group, mineral activity is generally not restricted beyond reasonable precautions for environmental protection.

In areas with highly restrictive prescriptions, except where they are specifically withdrawn from mineral entry, the public has a statutory nondiscretionary right to explore public lands for locatable minerals. Upon confirmation that a discovery of a valuable mineral deposit has been made, claimants have the right to mine. The Forest Service will approve appropriate operating plans to conduct reasonably necessary mineral activities in these areas. The public also has an exclusive right to explore for leasable minerals and to produce both leasable and salable minerals in these areas if they hold a valid lease or permit. Whether leases or permits will be issued depends on whether associated mineral activities could meet management requirements. Specific leasing decisions, however, will be made when lease proposals are received. When claimants have a right to mine or produce minerals, they are also guaranteed reasonable access for mining purposes. Operators will, however, be expected to protect other resources for which these areas are being managed. As a consequence, operating costs will be higher than they might be otherwise. This may negatively influence interest in exploring these areas for their mineral resources, but it would not preclude exploration or development should demand justify the higher cost of operation.

Table IV-28. Restrictions on Mineral Activity
(thousands of acres)

Alternatives	Withdrawn	High	Moderate	Low
NC-No Change	105.5	48.1	24.8	453.9
A-Current Direction	105.5	74.5	36.7	415.6
B-Dep (Modified)	105.5	48.1	24.8	453.9
C-Pref (Modified)	105.5	108.9	36.0	381.9
H (Modified)	105.5	223.8	45.4	257.6
I	105.5	288.8	45.4	192.6

As seen in Table IV-28, Alternative B-Departure (Modified) and NC-No Change has the least adverse effect on the availability of potential mineral discoveries and Alternative I has the most. This is because the total area recommended for withdrawal or management under highly restrictive management strategies is larger in Alternative I.

The effect that each alternative will have on the availability of potential leasable mineral commodities (i.e., for the Olympic this appears to be limited to oil or gas) is of a similar nature.

The area already withdrawn as Wilderness does not vary by alternative, but the areas with restrictions on mineral activities varies considerably.

Not shown here are those withdrawals that result when a new application for a power project is received. Not only is the site automatically withdrawn from mineral entry when the application is received, but it remains withdrawn and there is presently no mechanism for revocation. Since we do not know where, when, or what type of hydroelectric project will be applied for, there is no way to quantify the anticipated impact that future proposals of this nature will have on minerals availability. It appears, however, that the market-oriented alternatives would be more likely to encourage this type of development than would the more amenity-oriented alternatives. This type of withdrawal would add to the cumulatively adverse impact on mineral resource availability.

The adverse effect that highly restrictive management prescriptions will have on mineral resources, again, cannot be accurately quantified.

Since there is presently no leasable or locatable mineral production from the Forest, and little indicated future interest in exploring or developing the mineral resources, the effects that each alternative would have in terms of dollars, tons, or billions of BTU has not been estimated.

The demand for common variety minerals is closely associated with road construction and maintenance activities. As a consequence, the management plan alternatives that limit road building activities will be accompanied by less demand for the mineral resources. However, these consequences will also limit the discovery, availability, and development of rock resources. Commodity-oriented alternatives will be accompanied by increased demand, but more potential sources will also be discovered and available.

Table IV-29 outlines estimated rock and aggregate requirements for each alternative based on the average miles of new road construction and maintenance of existing system roads, especially the relative maintenance impacts implied by open versus closed road management strategies. These volumes reflect system-road base and surfacing applications only. They do not reflect other applications, such as for rip-rap and rock used for construction of unspecified timber sale roads.

Table IV-29. Projected Rock Use by Alternative (thousands of cubic yards per year)

	Construction			Maintenance		
Alternative	Miles of Road 1/	Average Miles per Year	Average Annual Need	Level of Closed Road Status 2/	Average Annual Need	Total Average Annual Need
NC-No Change	560	11.2	35	Low	40	75
A-Current Direction	460	9.2	29	Low	40	69
B-Dep (Modified)	638	12.8	40	Low	40	80
C-Pref (Modified)	415	8.3	26	Moderate	35	51
H (Modified)	272	5.4	17	Higher	10	27
I	102	2.0	6	Higher	10	16

1/ See Table IV-26, FEIS - Miles of new construction in 50-year planning horizon.
2/ See Table II-1, FEIS - Number of existing roads managed in closed status.

Proven and inventoried common variety minerals in 1985 totalled 5,573,200 cubic yards. While inventoried quantities would suggest a plentiful supply of available material, the location and distribution makes the availability question a more complex issue. The southeast, east and northeast areas of the Forest generally have a well distributed quantity of common variety materials. Available sources can fairly easily meet the need commensurate with any selected management alternative. The southwest, west and northwest areas of the Forest contribute most significantly to timber production. The attending need for road construction and maintenance to remove these timber volumes is correspondingly high. Unfortunately the need for construction and maintenance rock is high where distribution and availability is poor and scarce. The critical aspects of this situation fluctuate with the various intensities of timber production inherent in each management alternative. Perhaps with the exception of Alternative H (Modified) and I, the supply of common variety material on the westerly side of the Forest is, and will remain, a critical issue. Conservation, location, and development of any and all sources will be essential. In some locations, use of surface courses that minimize rock replacement needs, such as asphalt, may be the only way of maintaining a usable long-term road system.

CUMULATIVE EFFECTS OF ALTERNATIVES ON MINERALS

The cumulative effects are not going to vary much between alternatives. Of the mineral values that exist, most do not have reasonable expectation for commercial success. The marginal economic potential is due to the quality and quantity of deposits and relatively high exploration and developmental costs. Alternative I is the most restrictive commodity oriented alternative. Access, normally developed by other resource management activities such as timber management, will not be as extensive as for other alternatives. Under Alternative I, and somewhat under Alternative H (Modified), this will make it more difficult for mineral resource values to carry the cost of development. Special Management Unit designations under these two alternatives will also increase costs for more restricted operating and developmental requirements to mitigate adverse effects on other resource values. Economic viability is rather tenuous at best under all alternatives and cumulative effects do not post a significant concern now or in the near future for any alternative management strategy.

MITIGATION MEASURES AND EFFECTIVENESS

Foregoing Chapter III speaks to the interaction between minerals resources and other National Forest resources. Mineral exploration and development can have distinct, negative impacts on other resource values. Most of the time, these impacts can be identified early in the planning process and adequate measures for mitigating adverse effects can be incorporated in operating and rehabilitation plans. Mitigation measures can be preventative through proper planning and design of access, operations and applied standards. For example, appropriate access in some instances may mean helicopter or trail access and not an automatically assumed or accustomed road access.

Other mitigation measures might include restricted periods of operation, top-soil stockpiling and replacement, monitoring of sound, air, or water quality, revegetation and reclamation plans, etc. There is considerable experience in the mitigation of adverse effects associated with mineral and gas and oil operations. Proper timing, scheduling, and operating plan development has been demonstrably effective in mitigating adverse effects on other resource values.

RELATIONSHIPS TO PLANS OF OTHERS

The opportunities for mineral and gas and oil development are somewhat unique in the context of adjacent ownerships such as Olympic National Park, State and private land, and the Quinault Indian Reservation. In most instances, mineral development is compatible with the management objectives of these other landowners. It is important that mineral development activities are coordinated with these landowners and agencies whenever any planned operations are near these ownerships or even if indirect impacts might occur. Examples may be where a mining operation was readily seen from an area of concentrated public use in the National Park. Concerns for special plants and animals might be a consideration where close contact and coordination is maintained with the U.S. Fish and Wildlife Service or the Washington Natural Heritage Program.

ENERGY

OVERVIEW

Development of the Forest's energy potential would have varying effects on the Forest and its resources. These range from permanent changes in streambeds and water flow regimes, and visual effects of establishment of power transmission corridors, to temporary, short-term effects resulting from removal of additional volumes of woody biomass from a timber harvest area utilizing yarding and hauling methods similar to those for normal logging activities. The removal of woody biomass for conversion to heat energy through burning would result in greater amounts of combustion gasses and particulates from stoves and furnaces in urban areas. Otherwise, at least a part of this material would have been disposed of by on-site burning in the Forest.

SIGNIFICANT INTERACTIONS

VEGETATION

Amounts and types of vegetation affect the woody biomass energy production capability of the Forest. The species of trees is generally not as important in this context as the materials location and size, as these affect the costs of its utilization.

WILDLIFE AND FISH

Management for wildlife and fish can affect energy by imposing limitations on its development. Such limitations are necessary, for example, when a proposed development would affect a given species' habitat to the extent that the species viability could become threatened, or when a proposed project would block passage of anadromous or resident fish. In these cases the benefits to be gained from the project must be carefully weighed against potential losses. If the project is to be undertaken, mitigation practices may be necessary to offset losses of fish and/or wildlife habitat.

FIRE

Fire generally has no effect on hydropower projects. Potential biomass materials which might be used for energy production may be consumed by fire.

RECREATION

Hydropower developments have an effect on the sites where they occur and, in the case of impoundments, the areas both upstream and downstream from the dam or diversion. Effects may include: changing the character of upstream waters from moving stream to stillwater, occasional or recurrent exposure of reservoir drawdown areas and dewatering or artificially altering the flow characteristics downstream from the structure. In some cases, penstocks carry the impounded or diverted waters considerable distances before the waters are utilized for power generation and returned to the drainage, or they may be discharged into another drainage.

Concern over the effects of hydropower development are at the heart of much public interest in preventing diversion or damming of streams designated as potential Wild and Scenic Rivers.

Utilization of woody biomass for fuelwood has no significant impact on the recreation setting of the Forest, but provides a recreational activity for many people. This has a deferred, tangible benefit by providing heat for the homes where it is used. Many people look forward to their woodcutting outings in the forest as family recreational events.

ROADS

Roads do not directly affect hydropower development or utilization. They are, however, used or constructed to expedite installation and operation of structures and transmission lines.

Roads are a major component of any currently feasible plan to utilize woody biomass material. Due to relatively large quantities and low unit value, bulk handling of biomass is necessary for efficient utilization. At present, the economical transportation of biomass from the Forest to suitable utilization sites depends on the availability of road transportation.

WILD AND SCENIC RIVER RECOMMENDATION

Recommendation of a river for inclusion in the Wild and Scenic River System would preclude development for hydropower production.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON ENERGY

In the utilization of woody biomass for its energy potential, the amount of energy spent to obtain the energy benefits of the material utilized varies. The amount of energy spent is based on the size of the material to be used, its species and moisture content, the distance from the source to the utilization site, and the amount of processing of the material necessary before utilization can occur.

We currently estimate that the removal and processing of residue biomass material from the woods to the plant site would return about 3.79 times the energy input to remove and process it. This is a large gain overall, where the woody biomass material is utilized in the projected manner.

Most of the energy used for biomass removal is through use of fossil fuels, as is a large part of the basic energy source of electricity and heat that could be replaced by biomass use for cogeneration. Hydropower produced on the Forest could also replace fossil fuel-produced electricity. As these energy sources are developed, the Nation's dependence on fossil fuels (much of it imported from foreign shores) is reduced. It also contributes to beneficial use of currently unused resources.

Hydroelectric power potential is:

- highest in Alternative B-Departure (Modified) - All rivers and sites are available that meet environmental constraints.

- is high in Alternatives NC-No Change and A-Current Direction - All rivers and sites are available that meet environmental constraints except for the Duckabush River, which is to be designated a Wild and Scenic River.

- is medium high in Alternative C-Preferred (Modified) - All rivers and sites are available that meet environmental constraints except for those in the Gray Wolf, Dungeness and Duckabush Rivers, which are recommended as Wild and Scenic Rivers.

- is lowest in Alternatives H (Modified) and I - All eligible rivers in these Alternatives would be recommended for designation as Wild and Scenic Rivers. The only other sites that meet environmental constraints are available for hydropower development.

Biomass Energy Potential - The Alternatives with the highest amount of old-growth timber harvest are those with the greatest potential for excess biomass energy material production. In order, the Alternatives are: B-Departure (Modified), NC and A-Current Direction, C-Preferred (Modified), H (Modified), and I.

Given the above, the net potential energy consumption or generation by alternative is presented in Table IV-30 for decade one. See Table II-14 for information on subsequent decades. It is interesting to note that energy generation through biomass potential and hydropower potential actually exceeds energy consumption for Alternative I, given the limited management activities associated with this alternative.

Table IV-30. Projected Average Annual Net Potential Energy Consumption or Generation by Alternative for Decade One.

Alternative	BTUs (in billions)
NC-No Change	-4,233
A-Current Direction	-2,101
B-Dep (Modified)	-3,417
C-Pref (Modified)	-1,676
H (Modified)	-486
I	+242

CUMULATIVE EFFECTS OF ALTERNATIVES ON ENERGY

Development of nonpolluting (hydropower) and nonfossil-fueled energy sources that reduce balance of payment problems is a national goal of the Federal Government.

Use of excess biomass fuel in urban areas will contribute to air quality degradation in these areas, which requires regulation of use of this material as a fuel.

There should be no significant effect of these uses on historical or cultural values unless potential hydropower installations reduce or eliminate cultural sites or affect culturally significant fish runs.

The development of hydropower potential of the Forest could contribute to long-term energy needs of the region as would the increased utilization of current excess biomass material.

In theory, the energy produced from these Forest sources can be used to meet a portion of the Region's and Nation's energy needs from nonfossil fuel sources, and the hydropower generated electricity can be produced without contributing to air pollution or the "*greenhouse effect.*"

Careful site selection and design of hydropower projects and their operating schedules could minimize their impact on water related values such as fisheries and recreational uses. These methods could be used to reduce, but would not eliminate, their effects.

MITIGATION MEASURES AND EFFECTIVENESS

Concern has been expressed about the negative environmental effects of removal of biomass needed for on-site nutrient cycling and its other values. This can be alleviated by permitting removal of only biomass materials in excess of what is necessary to meet on-site residues needs.

There is also a concern that hydropower development will have negative effects on water quality and especially anadromous fish habitat.

These concerns can be addressed in the design of each proposed hydropower project and where they cannot be satisfactorily resolved through project design, the project can be refused a license or permit.

Mitigation opportunities for use of alternative fuels are currently limited by engine designs of yarders, trucks and autos.

Substitutes for petroleum-based dust-reducing surfacing materials are possible, but currently suitable materials are generally more costly and/or have their own environmental impacts.

Paving of roads reduces the long-term need for replacement of surfacing material and reduces fuel used for travel and materials hauling. This would also reduce dust released into the atmosphere and exhaust gases and emissions. Initial road construction costs would be higher, but offset to some extent by lower road use costs. Maintenance costs appear to be about the same over the service life of the road.

LANDOWNERSHIP

OVERVIEW

Aside from the basic objectives in landownership adjustment discussed in Chapter III, management of scattered, isolated and fractional subdivisions of land is expensive and often ineffective. The Landownership Adjustment Plan (LAP) for the Olympic National Forest recognizes this concern, among others, and the resultant acquisition and divestiture plans are designed to consolidate ownership. For the Olympic National Forest, this is not an especially complex matter and the LAP is essentially the same for all Forest Plan Alternatives.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON LANDOWNERSHIP

There will be no drastic changes or material impacts to the present landownership pattern from any management alternative considered in the Forest planning process. Some minor adjustments or changes in the 1980 Forest Landownership Plan may be warranted to accommodate or implement a specific resource management objective inherent in a selected management strategy (see Chapter III, "Landownership Planning" section). Possible changes under any management strategy considered, however, do not carry the emphasis of a Congressional requirement or mandate. For example, under any contemplated designation of Wild and Scenic Rivers, the acquisition of private land may be desirable but not mandatory. Under such circumstances, the change in the landownership pattern would likely be minor and protracted. Under these and similar circumstances, acquisition through land exchange or purchase would only be on a "willing seller" basis. Landownership adjustment, not predicated by a selected Forest Plan management strategy, would be undertaken utilizing the same policy, objectives, and criteria that are outlined in the Olympic National Forest Landownership Adjustment Plan of 1980. Any decision to acquire or dispose of lands will be formed utilizing established guidelines which will be consistently applied to all management alternatives. The effects, are not likely to vary much, if at all, from alternative to alternative.

CUMULATIVE EFFECTS OF ALTERNATIVES ON LANDOWNERSHIP

The cumulative effects of all alternatives will be similar. Ownership will be more consolidated, administrative and management costs will be more effective and efficient.

MITIGATION MEASURES AND EFFECTIVENESS

Prior to any disposal of ownership, complete reviews will be made through the NEPA process to make certain that needed rights are retained and that reservations are properly included in deeds. Any title defects in acquisition cases will be appropriately cured and/or covered by title insurance to protect the interests of the United States.

RELATIONSHIPS TO PLANS OF OTHERS

Within, and adjacent to, the Olympic National Forest boundary are lands held and managed by State and Federal agencies and several private timber companies. Because these entities own fairly substantive acreages, they offer excellent opportunities for mutual improvement in landownership patterns. The Forest

Service has completed several exchanges, interchanges, and boundary adjustments with the National Park Service and the Washington State Department of Natural Resources. Longstanding mutual endeavors and interests are expected to continue to drive and capture every opportunity for efficient and effective landownership improvement. Efforts to similarly improve landownership patterns have been explored with ITT Rayonier, Inc., Merrill and Ring, Inc., and Simpson Timber Company. Every effort will be made to identify opportunities that satisfy National Forest management objectives and those of adjacent landowners for mutually improved landownership patterns and benefits. The objectives, policies, and criteria outlined in the Olympic National Forest Landownership Plan of 1980 will serve to identify Forest Service priorities and interests. The use of these guidelines will essentially lead to identical results in landownership acquisition and disposal considerations. Effects will vary negligibly from alternative to alternative.

LOCAL ECONOMY

OVERVIEW

The Olympic National Forest and its activities and outputs form an integral part of the economy of the Olympic Peninsula. Almost 6,500 jobs, or about 12.5 percent of the Peninsula labor force, depend upon the current output mix of the Forest. In addition, the governments of Peninsula counties rely on the National Forest to supply a portion (precise percentages unavailable) of their operating budgets. While changes in Forest management are not likely to result in major disruptions of the total Peninsula economy, the Forest can and does have some influence on the overall economic health and well-being of the Peninsula.

The effect the Forest has on the local economy depends most directly on the output mix it provides. Timber harvest level is the most significant output in this regard, accounting for approximately 80 percent of the employment changes projected for each alternative. In addition, timber receipts provide over 95 percent of the base from which payments to county governments are generated. Although small relative to the effects of timber harvest, changes in recreation opportunity and quality of the fishery (especially the anadromous fishery) also have effects on the overall economic base of the Peninsula. The variations in these outputs among alternatives serve as the basis for the analyses which follow.

SIGNIFICANT INTERACTIONS

EMPLOYMENT AND PERSONAL INCOME

A variety of Forest activities and outputs have the potential to generate employment and personal income within the economy of the Olympic Peninsula. Any product or service that the Forest is capable of supplying can add to the Peninsula's economic base, assuming demand for the output exists. Given present conditions, the Forest's timber output makes the greatest contribution to the local economy, followed in importance by recreation outputs. Commercial fisheries outputs and other miscellaneous products are of relatively minor importance in the overall economic picture, but are a significant source of income for some enterprises.

As the mix of outputs varies among alternatives, so do employment and income effects. When timber production is emphasized, employment levels are expected to be higher than when other outputs are stressed. When departure harvest schedules are used, employment increases are more pronounced (in the short term, at least) than when nondeclining flow is applied. Although it seems a contradiction of projections regarding the declining role of timber in the Peninsula economy (see Chapter III, "Local Economy"), the Forest output which bears the strongest correlation to employment levels is timber. This condition is not expected to change significantly in the future, unless the overall demand for Pacific Northwest timber declines dramatically.

It should be noted that the employment and income projections developed for this analysis are projected estimates. Extensive data has been compiled regarding the interactions of the wood products industry with the remainder of the local economy, yet there is still a high potential for actual effects to be far different from predicted effects. Changes in technology and shifts in the proportion of timber exported are examples of important factors which could affect the overall timber employment picture in the future.

Predictions for recreation and fisheries employment are even more likely to differ from actual effects. Both the precision of effects modeling and the reliability of output projections are less solid than for the timber component of Forest outputs. Fishery effects predictions are particularly likely to differ from actual, since the level of actual utilization of fish habitat that will occur under each projected set of conditions is highly speculative. This is especially true in projecting effects on off-Forest habitat, where a variety of factors beyond the control of the Forest Service enter into the determination of habitat utilization.

One aspect of employment and income that is not captured in the data and models used to project effects is the subsistence fishing activity of the Peninsula's American Indian tribes. From a cultural and traditional perspective, as well as providing sustenance, subsistence fishing is an important economic activity to those involved (even though it does not entail any "market" exchange of goods or services). Alternatives with highest gains in recreation and fishery related employment are also most likely to benefit the American Indian subsistence fishing activity.

PAYMENTS TO COUNTIES AND TREASURY RECEIPTS

As with employment and income, timber output is the largest single factor in determining payments to counties and returns to the Federal treasury. Developed recreation and other revenue generating programs make less significant contributions. In addition to total harvest volume, the level of financial return from timber harvest influences the magnitude of returns to governments. The greater the difference between timber value and harvest costs, the larger the contribution to revenues. In the case of harvest where timber management costs exceed returns ("sales below cost"), payments to counties approach zero and the Federal treasury sustains a negative cash flow.

Comparison of projected county payments and returns to the treasury with total first-decade timber harvest reveals some lack of correlation between harvest and returns. This is primarily due to the relationship of harvest from National Forest land within the Shelton CSYU to total unit harvest. Some alternatives include relatively high levels of harvest from National Forest land, while others are substantially lower. Since only harvest from National Forest land contributes to county payments and treasury returns, alternatives with little or no harvest from such land within the Shelton CSYU show low returns relative to total harvest volume.

A second factor influencing the relationship between total harvest and returns is how timber harvest from areas in which timber management costs exceed returns ("sales below cost") and/or use of timber prescriptions for which net returns are relatively low are needed to meet the objectives of a given alternative. Having timber sales below cost (see also Chapter III, "Local Economy") is most likely to occur when the objectives of an alternative emphasize timber production rather than contribution to PNV as the criterion for selecting harvest allocations. While all alternatives are, by definition, cost-efficient in meeting their objectives, the nature of these objectives varies by alternative.

Some alternatives emphasize timber production rather than contribution of harvest to PNV as the means of meeting the overall objectives of the alternative. These entail a relatively high probability of including timber sales with total management costs exceeding returns. These sales often have timber prescriptions with relatively low net returns. Other alternatives select harvest prescriptions based on contribution to PNV. In these alternatives, the likelihood of management costs exceeding returns is relatively low, since harvest is selected only when it contributes to total PNV.

THE SHELTON COOPERATIVE SUSTAINED YIELD UNIT

The shelton CSYU plays a unique and important role in the economy of Mason County. The principal consideration regarding this aspect of the local economy is the question of maintenance or modification of the basic nature of the Unit itself. Disolving the Unit or substantially revising its fundamental function could potentially have effects within the Mason County economy that might not be captured by consideration of changes in harvest level alone. Analysis of the possible effects of any alternative proposing significant changes in the basic structure of the Shelton CSYU is necessary.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON THE LOCAL ECONOMY

EMPLOYMENT AND PERSONAL INCOME

Employment and personal income on the Olympic Peninsula are affected by the differences in output mix among the alternatives. Table IV-31 displays the projected changes from present levels of employment (person-years of employment) and personal income (millions of 1982 dollars) associated with each of the alternatives. The factors that were considered in developing these projections are (in order of magnitude of effect): timber harvest level, commercial fish output, and projected level of recreation use. Please refer to FEIS Appendix B ("Social and Economic Impact Analysis") for detail regarding the techniques used to estimate employment and income effects, including the IMPLAN model response coefficients upon which these estimates are based.

Of the above factors, timber harvest level has the greatest effect on employment and personal income. This output varies widely from alternative to alternative and, has significant employment and income differences associated with it. Commercial fish production shows a low degree of variation among alternatives, resulting in relatively moderate changes in employment and income. Variations in recreation use are also relatively small, and result in fairly small employment and income effects.

In assessing the effects of changes in commercial fishery outputs, the projected effects of Forest activities on off-Forest habitat have been included. Although the products of off-Forest fisheries are not Forest outputs, changes in productivity due to Forest management are effects of the alternatives. It is appropriate to consider such effects in the estimation of employment and income changes. Employment and income estimates were generated on the basis of the following assumptions:

1. All timber offered for sale will be purchased, harvested, and processed. The planned harvest level of each alternative is related to the current level of *actual* harvest (averaging 380 million board feet from 1980 through 1988) to estimate the effects of variations in harvest level by alternative.

2. Recreation opportunities provided will be consumed at the projected rates.

3. Available fish habitat, both on and off-Forest, will be fully utilized and, therefore, provide the outputs associated with the potential productivity estimated for each alternative.

Note that Alternative NC shows substantial increases in employment and income, even though it is based on continuation of current management of the Forest and could logically be expected to result in unchanged employment and income levels. This apparent inconsistency results from the assumptions listed above. The potential yield timber output levels which serve as the basis for Alternative NC are considerably above the average level of actual harvest occurring in the 1980-88 period. As a result, this alternative shows significant employment gains in the future when, in actuality, the 1980-88 harvest level of 380 million board feet would lead to substantially smaller gains. This comparison demonstrates the importance of using estimates in Table IV-31 to compare the alternatives rather than firm projections of the numerical changes that will occur. The actual degree of change associated with a given alternative will largely depend on the proportion of projected timber output that is actually harvested.

In considering the information in Table IV-31, note that all the pluses and minuses relate to the current employment situation. For example, assume that 50,000 people are currently employed on the Peninsula. Alternative A-Current Direction (No Action) is expected to result in the average annual loss of 200 jobs in the first decade. If this alternative were to be implemented, the average employment on the Peninsula during the first decade would be 50,000 - 200 = 49,800.

Table IV-31. Employment and Personal Income Changes by Alternative

Change in Jobs = Person-years of Employment per Year
Change in Income = Million Dollars of Personal Income per Year

	1st Decade Changes in Employment:				1st Decade Changes in Income:			
Alternatives	Timber-Related	Recreation/ Fish Related	Total	Percent Labor Force	Timber-Related	Recreation/ Fish Related	Total	Percent of Total
NC-No Change	+850	-200	+650	1.3	+17	-3	+14	1.4
A-Current Direction	-300	+100	-200	0.4	-6	+1	-5	0.5
B-Dep (Modified)	+1,100	-250	+850	1.6	+22.5	-4.5	+18	1.8
C-Pref (Modified)	-1,150	+350	-800	1.6	-23	+6	-17	1.7
H - (Modified)	-2,250	+400	-1,850	3.5	-45.5	+7.5	-38	3.8
I	-3,000	+600	-2,400	4.6	-60.5	+10.5	-50	5.0

Alternatives NC-No Change and B-Departure (Modified)

Alternatives NC-No Change and B-Departure (Modified) more significantly increase employment and personal income than the other alternatives. Both of these alternatives generate substantial increases in jobs and income in the first decade. Their high timber harvest levels are the principal factor contributing to these projected increases. The timber-related increases are expected to be offset to some extent by reductions in the employment and income generated by recreation and commercial fisheries outputs. These alternatives are also expected to be least beneficial to the American Indian subsistence fishing activity.

Alternative A-Current Direction (No Action)

Alternative A-Current Direction (No Action) is the only alternative that results in projected employment and income levels roughly equivalent to the present situation. This alternative's slight reduction in timber harvest level combined with small increases in fish habitat quality and the attractiveness of the recreation setting results in a projected employment and income mix similar to present levels. The changes associated with this alternative are expected to be well below one percent of current Peninsula-wide employment and income totals.

Alternative C-Preferred (Modified)

The projected effects of Alternative C-Preferred (Modified) include moderate reductions (less than two percent of the Peninsula total) in employment and personal income. The principal factor generating these expected reductions is the lowered timber harvest level of this alternative. This effect is offset to some extent by the employment and income generated by increased recreation and commercial fishery outputs.

Alternatives H (Modified) and I

Alternatives H (Modified) and I result in increasingly significant reductions in total employment and income. Alternative I in particular involves significant employment and income decreases in the first decade, involving close to five percent of the total labor force. The reductions in timber harvest level associated with these alternatives are the principal factor generating these effects. While increased recreation outputs and improved fish habitat conditions lead to employment and income gains in these areas, these gains are insufficient to balance the losses in the timber industry sector. This is especially true in the case of personal income, since employment associated with wood products generates a higher level of income per job than recreation and fisheries. These alternatives are expected to be most beneficial to the American Indian subsistence fishing activity.

General Conclusions

Alternatives H (Modified) and I have first-decade effects on employment and personal income which may be disruptive. Any large shift in employment availability has the potential to disrupt an economy. Even the rather substantial employment increases projected for Alternatives NC-No Change and B-Departure (Modified) could be potentially disruptive (in an essentially positive way). The considerable drops in employment and income associated with Alternatives H and (especially) I may be significant enough to threaten the stability of timber-dependent communities on the Peninsula.

The employment and income effects discussed above were estimated and assessed without regard for trends in the larger Peninsula economy. To put this analysis in the context of the projected future condition of the Peninsula as a whole, refer to the discussion of cumulative effects later in this section ("Cumulative Effects of Alternatives on the Local Economy").

PAYMENTS TO COUNTIES AND TREASURY RECEIPTS

Differences in timber harvest level from alternative to alternative have, by far, the greatest effect on payments to counties and returns to the Federal treasury. While all Forest income is included in the base from which these items are determined, over 95 percent of the total returns of each alternative are accounted for by harvest receipts. Projected county payments and treasury returns are displayed in Table IV-32. Figures are millions of 1982 dollars. Estimated average annual payments for the first decade and the average of the first five decades are shown. Treasury receipts are different from the net receipts displayed in Chapter II, as explained in Chapter III, "Local Economy."

Table IV-32. Payments to Counties and Treasury Receipts (Millions of Dollars)

	Alternatives					
Payments to Counties 1/	No Change	A-Current Direction	B-Dep (Modified)	C-pref (Modified)	H (Modified)	I
1st Decade:						
Clallam	4.5	2.4	3.7	1.5	1.0	.2
Grays Harbor	1.4	.7	1.1	.5	.3	.1
Jefferson	6.1	3.2	5.0	2.0	1.4	.2
Mason	1.4	.8	1.2	.5	.3	.1
TOTAL	13.4	7.1	11.0	4.5	3.0	.6
50-year Ave.:						
Clallam	3.8	2.4	2.3	2.1	1.7	1.0
Grays Harbor	1.2	.7	.7	.7	.5	.3
Jefferson	5.1	3.2	3.1	2.9	2.3	1.4
Mason	1.2	.8	.7	.7	.5	.3
TOTAL	11.3	7.1	6.8	6.4	5.0	3.0
Treasury Receipts:						
1st Decade	24.0	11.8	18.0	7.1	4.3	0.5
50-yr Ave.	20.0	11.9	9.3	11.1	8.8	5.0

1/ Payments to Thurston County are negligible (0.046% of the total), and are not included in table.

Alternatives NC-No Change and B-Departure (Modified)

Alternative NC, with its high first decade harvest level and emphasis on harvest from National Forest land within the Shelton CSYU, has the highest level of both payments to counties and treasury returns in the first decade. Much the same character is associated with Alternative B-Departure (Modified), and also provides relatively high payments and returns. Both of these alternatives emphasize timber production rather than the contribution of harvest to PNV to meet the overall objectives of the alternative. For these reasons it is highly probable that these alternatives will include timber sales where total management costs exceed returns and timber prescriptions with net returns that are relatively low. These factors moderate, to some extent, the positive effect of high harvest levels on total receipts and payments to counties.

Alternative A-Current Direction (No Action)

Alternative A-Current Direction (No Action), with its moderately high timber harvest level and relatively high level of harvest from National Forest land within the Shelton CSYU, provides moderate levels of both payments to counties and treasury returns. This alternative bases selection of harvest prescriptions on their contribution to PNV. As a result, there is relatively low likelihood of harvest from areas in which management costs exceed returns or extensive use of timber prescriptions for which net returns are low.

Alternative C-Preferred (Modified)

This alternative provides payments to counties and treasury returns at a level considerably below that of Alternative A-Current Direction (No Action). Two factors account for this difference: the lower overall timber harvest level of Alternative C, and lower harvest from National Forest land within the Shelton CSYU. Like Alternative A, this alternative has selection of harvest prescriptions on the basis of contribution to PNV as a basic goal, and entails relatively low likelihood of harvest from areas where management costs exceed returns or extensive use of timber prescriptions with low net returns.

Alternatives H (Modified) and I

Alternatives H (Modified) and I provide successively lower levels of both payments to counties and returns to the treasury. Alternative I in particular involves a significant reduction in returns to counties and the treasury, and could substantially impact on county budgets. These alternatives are characterized by low levels of harvest, both in total and from National Forest land within the Shelton CSYU in particular. Both have selection of harvest prescriptions on the basis of contribution to PNV as a basic goal, and entail low likelihood of harvest from areas where management costs exceed returns or extensive use of timber prescriptions for which net returns are low.

THE SHELTON COOPERATIVE SUSTAINED YIELD UNIT

The only alternative presented in the DEIS that would have had a significant effect on the nature and intent of the Shelton CSYU was Alternative F, in which the Unit was dissolved. This alternative has not been carried forward in detail in the FEIS. The remaining alternatives maintain the Shelton CSYU essentially as it is today. Although harvest levels, proportions of harvest from National Forest land versus Simpson land, and management strategies and philosophies vary widely across these alternatives, the basic structure of the Unit is unaffected. Under any of these alternatives, the Unit would continue to function as was originally intended.

CUMULATIVE EFFECTS OF ALTERNATIVES ON THE LOCAL ECONOMY

RELATIONSHIP TO NON-FOREST SERVICE TIMBER SUPPLY

Olympic Peninsula mills are expected to face a substantially reduced timber supply over the next 50 years. Projections indicate that the supply of non-National Forest stumpage will drop rather sharply in the next decade, continue to decline gradually for the following 20 years, then rise to a more stable output level (see also "Vegetation, Future Trends" in Chapter III). If the anticipated conditions do materialize, the result could be a significant decline in the economic health of the Peninsula timber industry during the years of reduced supply. Therefore, alternatives containing National Forest harvest flows that counterbalance changes in non-National Forest supply could have the beneficial effect of stabilizing, at least to some extent, Peninsula economic conditions over the next 50 years.

Table IV-33 displays the total Peninsula harvest volume expected for each decade under each alternative. Volume figures are average annual harvest in millions of board feet. Board foot estimates of National Forest volume in decades two through five are based on the average board foot/cubic foot conversion factor of first decade harvest in each alternative.

Table IV-33. Total Projected Peninsula Harvest by Alternative

	Projected Harvest by Period:					
	80-88	90-99	00-09	10-19	20-29	30-39
Non-National Forest Volume	1,315	1/ 1,180	1,145	1/ 1,110	1,165	1,155
Total Supply by Alternative: 2/						
No Change	1,695	1,620	1,570	1,525	1,575	1,570
A-Current Direction	1,695	1,535	1,500	1,465	1,520	1,510
B-Dep (Modified)	1,695	1,645	1,610	1,515	1,525	1,475
C-Pref (Modified)	1,695	1,475	1,440	1,430	1,490	1,505
H (Modified)	1,695	1,390	1,370	1,350	1,470	1,535
I	1,695	1,335	1,310	1,290	1,420	1,515
Projected Demand 3/	N/A	1,735	1,735	1,735	1,735	1,735

1/ Midpoint of projected range of non-National Forest supply in first and third decades (see Table III-14, Chapter III).
2/ Includes harvest from Simpson Timber Co. land within Shelton CSYU as "National Forest" volume in all alternatives.
3/ Midpoint of projected range of total demand for Peninsula timber (see Table III-15, Chapter III).

In all alternatives, cumulative timber supply falls short of the demand level projected for the next 50 years. In fact, only Alternatives B-Departure (modified) and NC-No Change provide a National Forest harvest level high enough to bring total Peninsula harvest close to the 1980-88 level. With the exception of allocations needed to meet management requirement specifications, Alternative B-departure contains virtually every acre of tentatively suitable timberland in its harvest base, and is based on the objective of maximum timber output over the 50-year planning horizon. Alternative NC is based on existing Timber Management Plans, and includes harvest levels that are likely to be unattainable under today's requirements. With such structures, these alternatives closely approach (or, in the case of Alternative NC, may exceed) the Forest's maximum potential for providing harvest volume over the next five decades. It can be concluded from these results that the Forest does not have the capacity to fully meet anticipated demand for timber over the planning horizon.

If the projected demand is realized, and supply availability becomes the primary factor limiting the vigor of the Peninsula timber industry, the variable having the most importance with respect to this industry's health and stability becomes total volume available for harvest. This is especially important over the next 30 years, as total volumes in the fourth and fifth decades are reasonably similar for all alternatives. Volume available through 2019 is clearly highest in Alternative B-Departure (modified), followed closely by Alternative NC-No Change. These two alternatives provide a harvest level reasonably close to that of the 1980 to 1988 period. The remaining alternatives do not.

Alternatives A-Current Direction (No Action), C-Preferred (Modified), H (Modified), and I result in increasingly large differences between present and projected harvest levels over the next 30 years. Alternative I, with its low National Forest harvest level in the early decades, has the most substantial decline in overall supply availability. The first decade harvest level associated with this alternative (360 million board feet/year below 1980-88 levels) is considerably below those of the other alternatives. After the third decade, the harvest level of Alternative I (as well as those of Alternatives A, C-Preferred, and H) begins to more closely approach those of Alternatives B-departure and NC.

There is a great deal of uncertainty associated with long-term projections of both demand for timber and supply availability. Demand conditions can fluctuate dramatically, although a long-term average projection of essentially stable demand is not unreasonable. In addition, the estimates of future non-National Forest supply are quite uncertain, especially for the private sector. For this reason, the above projections regarding cumulative supply and its relationship to demand are highly speculative, and should be regarded as an index for alternative comparison rather than a concrete prediction of future events.

CUMULATIVE EMPLOYMENT EFFECTS

The effects of Forest-generated employment changes displayed in Table IV-31, combined with anticipated overall changes in Peninsula employment over the next 10 years, are displayed in Table IV-34. Projected changes in employment resulting from Forest output levels have been added to employment changes expected to result from the variations in non-Forest Service harvest discussed above (see also Chapter III, "Vegetation, Future Trends"). The result is an estimate, for each alternative, of the total employment effect of on-Forest and off-Forest factors combined.

Total employment effects (direct, indirect, and induced) for each alternative are displayed in Table IV-34. The figures represent the difference between current employment on the Peninsula and the average annual employment anticipated for each alternative in the first decade. For example, the "-950" entry for Alternative B-Departure (Modified) means that annual employment is expected to be 950 person-years below today's level, or 51,810 - 950 = 50,860. Percentage of the total Peninsula labor force represented by each figure is also shown.

In Table IV-34, employment effects are not estimated past the first decade due to the high degree of uncertainty associated with long-term projections of this nature. Instead, decade-to-decade changes in anticipated total harvest level are shown, along with the proportion of current (1980-88) Peninsula harvest these changes represent. The principal shift in anticipated non-National Forest timber supply occurs in the first decade, when projected volume drops from the current 1,315 million board feet to 1,180 million board feet per year (a drop of 135 million board feet). Peninsula-wide harvest levels tend to stabilize after this initial drop (see also "Relationship to Non-Forest Service Timber Supply"). General fluctuations in total employment for the second decade and beyond can be assessed by considering the direction and magnitude of projected harvest changes. A rough approximation of employment effects can be obtained by estimating that changes will occur at a rate of 13 jobs per million board feet available for harvest.

Table IV-34. Cumulative Employment Effects by Alternative

Changes in Jobs and % of Labor Force, First Decade
Changes in Projected Total Harvest, Decades Two through Five

	Job Changes		Projected Harvest Changes (million board feet):							
	1990 - 1999		2000 - 2009		2010 - 2019		2020 - 2029		2030 - 2039	
Alternatives	Number	Percent	MMBF	Percent	MMBF	Percent	MMBF	Percent	MMBF	Percent
No Change	-1,150	2.2	-50	3.0	-45	2.7	+50	3.0	-5	0.3
A-Current Direction	-2,050	4.0	-35	2.1	-35	2.1	+55	3.2	-10	0.6
B-dep (Modified)	-950	1.8	-35	2.1	-95	5.6	+10	0.6	-50	3.0
C-pref (Modified)	-2,600	5.0	-35	2.1	-10	0.6	+60	3.5	+15	0.9
H - (Modified)	-3,650	7.0	-20	1.2	-20	1.2	+120	7.1	+65	3.8
I	-4,200	8.1	-25	1.5	-20	1.2	+130	7.7	+95	5.6

The previous table displays the implications of the anticipated decline in non-Forest Service timber supply. All alternatives project a steady decline in total employment through the 2010-2019 period, which corresponds to the expected low point in non-Forest Service harvest. From 2020 on, employment projections increase as off-Forest harvest returns to higher levels. In Alternatives H (Modified) and I, this recovery is enhanced by increased National Forest harvest levels in the fourth and fifth decades. The employment change resulting from non-Forest Service supply changes is projected to be a drop of 1,800 jobs (3.5 percent of the current labor force) during the first decade, followed by more moderate changes as non-Forest supply stabilizes.

Given these projections, none of the alternatives can fully mitigate the anticipated changes in overall employment, but there are clear differences among alternatives regarding cumulative employment effects. In considering the stability and health of the Peninsula economy as a whole, two factors are important: the total magnitude of the employment change (by far the most important) and decade-to-decade variability of employment. These are discussed below.

Alternatives NC-No Change and B-Departure (Modified) involve relatively low declines in total employment, and moderate the effects of the anticipated decline in employment associated with non-National Forest harvest. The remaining alternatives are associated with substantial employment drops, ranging from four to eight percent of the total Peninsula labor force. These alternatives (Alternatives H (Modified) and I in particular) add to rather than moderate the job losses expected to result from non-Forest supply changes.

Fluctuations in total employment following the first decade are minor relative to the initial effects. The principal consequence of continued variability in employment is the possibility of long-term instability in the labor force. In this analysis and the projected levels of employment and timber supply availability, the most significant changes are expected in the first decade. Several fluctuations in future harvest level are also described. Alternative B-Departure (Modified) could result in a substantial drop in total harvest in the third decade (when timber output from the Forest drops below the high departure level of the first two decades). Alternatives H (Modified) and I have the potential to increase total harvest substantially in the fourth and fifth decades, when the National Forest harvest levels of these alternatives increase significantly above initial decade outputs.

MITIGATION MEASURES AND EFFECTIVENESS

Substantial declines in employment and personal income on the Olympic Peninsula are possible effects from several alternatives. This would result from the combined effects of non-National Forest timber supply reductions and lower levels of harvest from the Forest. Perhaps the most effective potential forum for mitigating these effects would involve cooperative efforts by multiple government agencies in helping resource-dependent communities prepare for and manage their future. Such a strategy could aid in promoting a smooth transition from the current level of economic activity to that expected in the future. Retraining and relocation of displaced employees, encouragement of new investment, and development of alternative employment opportunities (e.g. in the recreation field) are also possibilities for mitigating anticipated employment fluctuations.

While the cumulative employment losses projected for some of the alternatives appear quite substantial, it should be noted that employment levels on the Peninsula have fluctuated considerably over the past 10 years without causing severe disruption of the overall social and economic fabric. The cumulative job loss projection for Alternative I, for example, is 4,200 person-years of employment per year. Even though this is over eight percent of the current Peninsula labor force, it is approximately the same level of fluctuation that has occurred on the Peninsula over the last 10 years. In 1980, the Peninsula's total labor force was 52,000. In 1984, at the bottom of the slump in demand for wood products, the labor force had dropped to 47,290 (a difference of 4,710). By 1988, as demand returned to earlier levels, the labor force had climbed to 51,810 (up 4,520). Fairly large fluctuations in the Peninsula labor force, while a cause for concern and desirable to avoid, are not extremely unusual.

LOCAL COMMUNITIES

OVERVIEW

The community groups discussed in Chapter III ("Local Communities") and the social effects analysis variables presented below (see "Effects Assessment") form the basis for assessing the effects of alternatives on local communities. This assessment is complicated by the fact that the Olympic National Forest exists within a dynamic social setting. Changes in Forest management alone cannot be considered to be the principal change affecting community groups, as they might be in a more stable situation. Over the past ten years, Peninsula communities have undergone a cycle of significant change as a result of the radical fluctuations within the timber market and the employment effects associated with them. The projection is that such changes will continue, with reduced timber supply from non-Forest sources being a primary influence in the future. Thus, the effects of changes in Forest management on local communities will occur in the context of broader social and economic changes.

Because change within Peninsula communities is likely to continue, assessment of the effects of changes in Forest management can only be approximated. To simplify the process and provide an uncomplicated basis for comparing alternatives, the effects of variations among alternatives are estimated assuming current conditions (employment levels, lifestyles, values) would remain stable if Forest management did not change. This assessment provides the basic tool for comparing alternatives. The possible cumulative effects of the changes resulting from different alternatives combined with the expected ongoing changes in Peninsula communities are covered in the discussion following the basic "steady state" effects analysis.

SIGNIFICANT INTERACTIONS

THE FOREST'S ROLE IN LOCAL COMMUNITIES

The activities and outputs of the Olympic National Forest occur in the context of the values and lifestyles of the surrounding communities. Every Forest action has the potential to be either consistent with or in conflict with the goals, preferences, and desires of community members. Variability in values within the Peninsula society leads to a broad range of reactions about these actions.

Because the Forest is a source of employment, a supplier of recreational and aesthetic opportunities, and a component of the overall pattern of American Indian traditional values, it can affect community members in a variety of ways. The lifestyles, values and traditional beliefs, cohesion, and even stability of local communities can be disrupted or enhanced by the management of the Forest. Because goals and desires differ, and increases in one output or resource quality generally entail changes in another, there is no single factor to gauge the effects of Forest activities on the surrounding communities. It is the *mix* of outputs and resource qualities, considered in the context of community values and desires, that determines the nature of the Forest's effect on its community environment.

The goals, values, and lifestyles of communities affected by Forest activities vary greatly as one travels around the Peninsula and its environs. While individual concerns and desires are, of course, highly varied, it is possible to group those related to Forest management into two distinct lifestyle types and value sets: those most closely tied to forest products and timber harvest, and those oriented toward recreation and/or conservation of natural resources.

Close ties with timber harvest are characteristic of those who perceive their employment and/or income to be dependent upon the timber industry. Harvest is also an important consideration to many long-term Peninsula residents who are not directly involved in the industry, but hold values which have evolved in an environment dominated by the "timber ethic" (a set of beliefs which places high value on the timber-oriented lifestyle). The orientation toward recreation and conservation is generally held by newer residents and non-Peninsula residents who perceive no direct economic dependency on the timber industry (or recognize some dependency but deem it unimportant), and by many whose livelihood is perceived to be tied to the recreation or fishing industry.

Because many of the Forest's effects on local communities are related to the management of its timber, and because timber harvest level and the associated employment level are the primary factors used in estimating timber-related effects, it is necessary to discuss the assumptions used in relating harvest to effects. The difference between current actual harvest (annual average, 1980-1988) from Forest lands (including Simpson Timber Company land within the Shelton CSYU) in each zone and the planned harvest level of each alternative is used to project timber-related effects. This assumes that all volume offered will be sold and harvested, even though at present only 86 percent of planned volume is actually cut. Planned harvest levels by zone are shown in Table IV-35.

Table IV-35. Harvest Volume by Zone
Average Annual Harvest (million board feet), First Decade

		Alternatives					
Zone	1980 - 1988 Harvest	No Change	A-Current Direction	B-Dep (Modified)	C-Pref (Modified)	H (Modified)	I
East	40.0	43.0	30.4	53.2	23.1	18.3	5.2
West	160.0	171.8	121.7	196.8	78.5	46.0	5.2
Shelton	180.0	227.0	206.1	213.7	192.7	147.2	146.1
TOTAL	380.0	441.8	358.2	463.7	294.3	211.5	156.5

EFFECTS ASSESSMENT

Assessment of the effects of Forest management on key social factors is, of necessity, qualitative in nature. Considerable guidance as to what social variables and which communities to consider was obtained from Adelman's "Socio-Economic Overview of the Olympic Peninsula" (described in Chapter III, "Local Communities"). Prediction of the responses of communities to changes in Forest management was also facilitated by this document.

The focus of social effects analysis is the set of variables assessed in combination with the communities analyzed. Five variables were selected as being the most significant indicators of the potential effects of National Forest management: community lifestyles, community values and traditional beliefs, community cohesion, the potential for effects on these to affect overall community stability, and population trends. Definitions of these variables are presented below.

Community Lifestyles: Broadly, this can be defined as "the way a community lives." Key elements are the types of employment and the kinds of leisure activities predominant within the community and important to community members. Changes which greatly alter the employment structure, or substantially reduce or preclude the opportunity to undertake desired leisure activities, are unfavorable with respect to this variable.

Community Values and Traditional Beliefs: This is the set of values and beliefs important to community members. With respect to forest management on the Peninsula, there are three main value sets: the "timber ethic", the "conservation ethic", and the cultural/religious beliefs of the American Indian communities. Forest management patterns which conflict significantly with predominant community values or preclude activities associated with traditional beliefs are unfavorable with respect to this variable.

Community Cohesion: There are two distinct aspects of this variable. The first consists of the degree of solidarity within a community. If community members are generally comfortable with and supportive of each other in their beliefs and lifestyles, the community is said to be "cohesive." The second aspect deals with community/Forest Service relationships. Conflict between a community and the Forest Service is an important consideration. If Forest management generates a substantial amount of this conflict, the situation is undesirable (even though it may enhance community cohesion per se). Management practices and policies which create or intensify conflict, either within a community or between a community and the Forest Service, are unfavorable with respect to this variable.

Community Stability: This variable deals with the potential for disruptive change within a community. Determination of effects is based largely on the performance of an alternative with respect to the other variables under consideration. If an action would lead to lifestyle disruption, value and belief conflicts, and/or heightened tension levels sufficient to threaten the established patterns of community life, the action is considered to be unfavorable with respect to stability.

Population: It is unlikely that any of the alternatives will sufficiently alter social and economic conditions on the Peninsula to cause significant population changes. While the Forest does influence the principal factors involved in population change (health of the timber industry and availability of natural resource amenities), its effect is relatively minor when all aspects of these factors are considered. Potential population changes are still an important consideration in assessing effects on communities, and are included in the social effects analysis.

DIRECT AND INDIRECT EFFECTS OF ALTERNATIVES ON LOCAL COMMUNITIES

Effects of the alternatives are estimated under the assumption that current conditions within local communities will continue. These conditions include the employment patterns discussed in Chapter III ("Local Economy") and the community group characteristics covered in Chapter III ("Local Communities"). The effects analysis focuses on the first twenty years of the planning horizon.

Because each of the community groups under consideration is distinct from the others, anticipated effects of the alternatives are discussed by community group. Effects are described as they relate to the community group and social variables affected. Anticipated effects of alternatives are related to present conditions. When the output mix or allocation pattern of a given alternative is expected to lead to a substantial change from the present with respect to a particular community group and variable, the nature and direction of the change are described. For a brief summary of the most significant of the effects projected below, refer to the "Conclusions" section immediately following the discussions of individual community groups.

EASTSIDE COMMUNITY GROUP

Because this community group is characterized by diversity of value sets and lifestyles, any alternative is likely to result in mixed effects. Alternatives that emphasize timber production will increase employment opportunities and satisfaction with Forest management among those whose values and lifestyles are centered around the "timber ethic." Alternatives that stress amenity outputs, on the other hand, will be more favorably received by the large segment of this community group whose values and lifestyles are environmentally oriented.

Alternative B-Departure (Modified)

Alternative B-Departure (Modified) is the only alternative expected to provide a substantial increase in employment opportunities on the east side, and would be favored by those oriented toward the "timber ethic." This alternative is expected to reduce recreation-based employment opportunities considerably, and increase conflict between management patterns and environmentally-oriented values.

Alternative A-Current Direction (No Action)

Alternative A-Current Direction (No Action), although its overall emphasis is timber production, is expected to result in decreased opportunity for harvest-based employment on the east side. Despite this, the allocation patterns of this alternative result in the base for amenity outputs decreasing in the long run. This alternative is not expected to increase satisfaction with management patterns among community group members holding either of the predominant Eastside value sets.

Alternative NC-No Change

Like Alternative B-Departure, Alternative NC-No Change is expected to provide an increase in employment opportunities and comfort with management among those oriented toward the "timber ethic." These changes would be less substantial than in the case of Alternative B-Departure. Because Alternative NC includes recreation allocations parallel to those of Alternative A-Current Direction, it is also expected to reduce recreation-based employment opportunities and increase conflict between management patterns and environmentally-oriented values. The base for amenity outputs is expected to decrease more quickly in Alternative NC than in Alternative A due to the higher harvest level of the former.

Alternatives C-Preferred (Modified) and H (Modified)

These two alternatives are expected to have roughly equivalent effects within this community group. Alternatives C-Preferred (Modified) and H (Modified) are likely to involve decreases in harvest-based employment opportunity and a reduction in satisfaction among those valuing the "timber ethic." Concurrently, the increased amenity emphasis of these alternatives is expected to increase recreation-based employment opportunity and the quality of Forest-based leisure activity. Alternative H (Modified) is expected to be the more favorable of the two to community group members with environmentally oriented value sets.

Alternative I

Alternative I is expected to result in substantial reductions of harvest-based employment opportunity and lead to a sharp decrease in comfort with management patterns among those whose values center around the "timber ethic." This alternative is also expected to generate the largest increases in recreation-based employment opportunity and quality of Forest-based leisure activity. Thus, this alternative is expected to be quite consistent with the values of environmentally oriented community group members.

General

Because of the different values and lifestyles within the Eastside community group, it is possible that any of the alternatives could lead to increased polarization between groups having conflicting value sets. Regardless of the alternative selected, competing demands will be placed on a limited resource base. Consequently, community cohesion could be reduced to some extent by any management strategy. Alternatives that represent the most substantial changes from present management (Alternatives B-departure (modified) and I) are most likely to have this effect.

Conflict between components of this community group and the Forest Service could also increase under any of the alternatives. Those which emphasize amenity outputs could result in increased conflict with community group members who value the "timber ethic," while the reverse is true for commodity-oriented alternatives.

WESTSIDE COMMUNITY GROUP

Unlike the Eastside, this community group is characterized by relative uniformity of values and lifestyles. The timber industry is the primary source of employment and income, and the majority of the population has grown up with the "timber ethic." Alternatives that maintain or increase timber production are expected to be favorably received within this community group, while those reducing timber production are not.

Alternative B-Departure (Modified)

Alternative B-Departure (Modified) has the heaviest emphasis on timber production, and is expected to result in substantial increases in opportunities for harvest-based employment. This alternative is likely to increase satisfaction with management patterns and decrease conflict between the Forest Service and members of the Westside community group. Increases in satisfaction could be moderated, however, by the magnitude of the harvest increase of Alternative B-Departure. The departure from nondeclining flow of this alternative in the first two decades is quite substantial. To the extent that nondeclining flow is viewed as an essential component of conscientious harvest management, this departure could result in some concern.

Alternative NC-No Change

Alternative NC-No Change involves a moderate increase in timber harvest level, and is expected to be somewhat similar to Alternative B-Departure in its effects on this community group. Increased employment opportunity is anticipated, accompanied by increased satisfaction with land management patterns and decreased conflict between community group members and the Forest Service. These changes are likely to be less substantial than those associated with Alternative B-Departure.

Alternative A-Current Direction (No Action)

Alternative A-Current Direction (No Action) entails a moderate decrease in timber production level, equivalent to roughly 25 percent of the 1980-88 harvest volume. With respect to Westside community group values and lifestyles, this alternative is expected to result in decreased opportunity for harvest-based employment and lead to increases in dissatisfaction with land management and conflict between community group members and the Forest Service.

Alternatives C-Preferred (Modified) and H (Modified)

Alternatives C-Preferred (Modified) and H (Modified) are expected to result in substantial decreases in opportunity for harvest-based employment, with Alternative H (Modified) entailing the greater effect. These two alternatives are likely to be inconsistent with predominant community values, and are expected to result in increased conflict between community group members and the Forest Service.

Alternative I

The effects of Alternative I, which almost entirely eliminates harvest from the Westside, can be expected to be considerably greater than those of the other alternatives. Harvest-based employment opportunity is likely to be reduced quite significantly, resulting in Alternative I having the greatest probability of increasing conflict between community group members and the Forest Service.

General

Because of the relative uniformity of interest within the Westside community group, community cohesion is not likely to be affected by any of the alternatives. General agreement as to the relative merit of a given land management pattern is likely. However, the degree to which the community group, as a whole, is in agreement with the Forest Service is likely to vary substantially from alternative to alternative, as discussed above.

SHELTON CSYU COMMUNITY GROUP

This community group is similar to the Eastside in that it is characterized by diversity of values and lifestyles. The principal difference lies in the relative predominance of the "timber ethic" within the Shelton CSYU community group. Because of this, alternatives emphasizing timber production are more likely to be favorably received by the majority of community group members than are amenity-oriented alternatives. Nonetheless, a substantial segment within this community group is likely to have a favorable view of alternatives with higher levels of amenity output. Of particular interest to this segment is the distribution of timber harvest between National Forest land and Simpson Timber Company land. Those with environmentally oriented values tend to favor low harvest levels from National Forest land.

Alternative NC-No Change

Alternative NC-No Change includes a timber harvest level considerably above that which occurs at present. This should result in increased satisfaction with management patterns among those whose values and lifestyles are centered around the "timber ethic." The high harvest level of this alternative, and the high first decade harvest from National Forest land in particular, are likely to decrease satisfaction with management patterns among those whose values are environmentally oriented. It is likely to result in an increase in tension among community group members, since it entails by far the highest harvest level from National Forest land.

Alternatives A-Current Direction (No Action) and B-Departure (Modified)

These two alternatives also include timber harvest levels above that which occurs at present. This is expected to result in increased satisfaction with management patterns among those whose values and lifestyles are centered around the "timber ethic." As with Alternative NC, the high harvest levels of Alternatives A-Current Direction (No Action) and B-Departure (Modified) are likely to decrease satisfaction with management patterns among those whose values are environmentally oriented. This, and the relatively high first decade harvest level from National Forest land associated with each of these alternatives, could result in some increase in tension among community group members.

Alternative C-Preferred (Modified)

Alternative C-Preferred (Modified) also involves an increase in timber harvest, although it is very slight. For this reason, this alternative is expected to have little effect among those whose values and lifestyles are centered around the "timber ethic." Opportunities for harvest-based employment and level of satisfaction with management patterns should be roughly as they are at present. Unlike the previous three alternatives, the first-decade harvest level from National Forest land in Alternative C is quite low. This alternative will likely increase satsifaction with Forest management among community group members whose values and lifestyles are environmentally oriented.

Alternatives H (Modified) and I

The effects of Alternatives H (Modified) and I are expected to be similar, since the Shelton CSYU harvest levels of the two are virtually identical. Reductions in harvest-based employment opportunity are expected, along with a substantial increase in comfort among community group members with environmentally oriented values and lifestyles. Alternative I is likely to be most favorable to this segment of the community group. The lower harvest levels of these two alternatives could lead to some increase in tension among community group members.

General

Because of the variety of values and lifestyles within the Shelton CSYU community group, it is possible that any of the alternatives could lead to increased polarization between groups having conflicting value sets. Consequently, community cohesion could be reduced to some extent by any management strategy. Alternatives representing the most substantial changes from present management (Alternatives H (Modified) and I) and those maintaining continued high harvest levels from National Forest land (Alternative NC-No Change in particular) are most likely to have this effect.

Conflict between components of this community group and the Forest Service could also increase under any of the alternatives. Those which emphasize amenity outputs could result in increased conflict with community group members who value the "timber ethic," while commodity-oriented alternatives and alternatives emphasizing harvest from National Forest land could lead to increased conflict with environmentally oriented community group members.

One component of the Shelton CSYU community group which does not fit the above generalization regarding harvest from National Forest land is the Squaxin Island Tribe (also a component of the American Indian community group). The majority of this tribe's fishery drains Simpson Timber Company land within the CSYU. As a result, this tribe is most concerned about the level of harvest from Simpson land rather than National Forest land. Alternatives with low Simpson harvest are likely to be most favorable to this group. Alternative NC-No Change, which maintains the current distribution of harvest between Simpson and National Forest land, entails the lowest Simpson harvest level. Alternative C-Preferred (Modified) represents the most substantial increase in Simpson harvest.

URBAN COMMUNITY GROUP

The principal concerns of this community group with respect to Forest management are the scenic quality of the Eastside zone and the availability and quality of Forest-based recreation opportunities. The lifestyles and value sets within this community group (in the limited context of its relationship to Olympic National Forest) are essentially oriented toward environmental quality. Alternatives that emphasize amenity outputs, particularly from the Eastside zone, are likely to be most consistent with the predominant values within this community group. Alternatives emphasizing timber production are likely to have the opposite effect.

Alternative B-Departure (Modified)

Alternative B-Departure (Modified), with its strong timber output emphasis and lack of emphasis on scenic quality and recreation, is expected to be quite incompatible with the values and lifestyles of the urban community group. This alternative has the potential to result in a significant increase in dissatisfaction with Forest management patterns within this community group.

Alternatives A-Current Direction (No Action) and NC-No Change

Alternatives A-Current Direction (No Action) and NC-No Change also emphasize timber outputs, and are also expected to result in reductions in scenic quality and recreation opportunity. The effects of these alternatives, are likely to be less substantial or immediate than those of Alternative B-Departure. Alternative NC, because of its higher early decade harvest level, will result in a more rapid amenity base reduction than will Alternative A. These two alternatives are likely to increase dissatisfaction with Forest management patterns within the urban community group, although to a lesser extent than Alternative B.

Alternative C-Preferred (Modified)

Alternative C-Preferred (Modified) includes increased emphasis on amenity production and is expected to maintain or improve scenic quality and the opportunity for Forest-based leisure activity. As a result, this alternative is likely to result in increased satisfaction with management patterns among those with environmentally oriented values.

Alternatives H (Modified) and I

Like Alternative C-Preferred (Modified), these alternatives include increased emphasis on amenity production. Both are expected to maintain or improve scenic quality and opportunity for Forest-based leisure activity. The amenity emphasis of these alternatives is more pronounced than that of Alternative C, making Alternatives H and I the most likely to result in increased satisfaction with management patterns among those with environmentally oriented values. Alternative I is expected to have the greatest favorable effect in this regard.

General

The likelihood that any alternative could affect cohesion within the urban community group is remote. The level of conflict between community group members and the Forest Service, however, could change. It is likely that Alternatives A-Current Direction (No Action), B-Departure (Modified), and NC-No Change would lead to increases in such conflict, while the remaining alternatives could result in conflict reduction.

AMERICAN INDIAN COMMUNITY GROUP

As pointed out in Chapter III ("Local Communities"), the interests and concerns of this community group are diverse and varied. Unlike the other groups, American Indians live throughout the Peninsula, both on tribal reservations and within the general population. The American Indian community represents a cross section of the wide range of interests typical of the entire spectrum of community groups. While many individuals within this group have their own specific opinions, interests, and concerns, there is often a very cohesive and uniform response that reflects the common goals, objectives, and cultural heritage of all American Indian people.

As individuals, and as a group, the American Indian community has a strong interest in the commodity-oriented use of forest resources, including those of the Olympic National Forest. A broad segment of this community group is directly or indirectly dependent on commodity-oriented utilization of National Forest resources. On the other hand, this group is no less interested in amenity-oriented values and environmentally sensitive approaches to forest management that preserve and enhance these values. Polarized opinions may exist within this group, but there is unanimity that the integrity/quality of fishery habitats and validation of all treaty rights be diligently preserved.

To that end, tribal entities have expressed a strong preference for forest management practices and Forest Plan alternatives that favor fisheries values, especially protection and enhancement of fish habitat. Similar preference has been expressed for management strategies that provide environments conducive to cultural, ceremonial, religious, and traditional uses of the Olympic National Forest. Availability of western redcedar for its many uses and purposes, a scenic and pristine setting, and other opportunities for traditional uses and experiences are values and benefits that the American Indian community desires to maintain and retain (see also the Effects on Cultural Resources and American Indians discussed earlier in this chapter). Perhaps more than any other group, the American Indian community reflects a need for a balanced approach to forest management strategies, a balance of commodity-oriented goods and services combined with an equally strong emphasis on the protection and enhancement of amenity values.

Alternatives NC-No Change and B-Departure (Modified)

The American Indian community would probably least favor Alternatives NC-No Change and B-Departure (Modified). While these alternatives offer greater opportunity for harvest-based employment and other associated benefits, the attendant reduction in the quality of amenity values and fishery habitat would not be a welcome tradeoff.

Alternative A-Current Direction (No Action)

Alternative A-Current Direction (No Action), with its slight decline in harvest level and the concurrent improvement in fish habitat quality, would be more likely to be consistent with the overall goals of the American Indian community than are Alternatives NC and B-Departure. The slight reduction in harvest-based employment of this alternative is not likely to be viewed negatively within this community group.

Alternative C-Preferred (Modified)

Alternative C-Preferred (Modified) entails a substantial reduction in opportunity for harvest-based employment relative to Alternative A. Concurrently, this alternative results in an increased level of fish habitat quality and amenity output emphasis. It is anticipated that the mix of harvest-based employment and fish habitat quality associated with Alternative C is likely to be compatible with the objectives of this segment of the Peninsula community.

Alternatives H (Modified) and I

Alternatives H (Modified) and I entail progressively greater reductions in opportunity for harvest-based employment and increasing levels of fish habitat quality and amenity output emphasis. The reductions in harvest-based employment associated with these alternatives may be severe enough to be potentially disruptive within this community group. This is particularly true in the case of Alternative I.

CONCLUSIONS

Most of the effects discussed above are important primarily when considering only the relationships between Forest activities and the affected community groups. They are likely to have relatively small impact when considered in the context of the community groups as a whole. Two of the alternatives, however, entail effects within specific community groups which have the potential to be quite disruptive. Alternatives B-Departure (Modified) and I, for entirely different reasons, could conceivably affect community stability in certain areas.

Alternative B-Departure (Modified), with its high harvest level and almost total lack of amenity emphasis, could affect community cohesion and lifestyles within the Eastside and American Indian community groups to the extent that stability is impaired. Alternative I, involving an extensive reduction in harvest level, could result in employment opportunity reductions severe enough to disrupt the stability of the Westside and American Indian community groups.

POPULATION CHANGES

The changes in employment availability associated with the different alternatives are likely to lead to changes in the total population of the Peninsula. It is expected that expansion or contraction of the labor force will, in the long run, result in in-migration or out-migration, influencing population level. It is unlikely that any of the alternatives will affect Peninsula population to a great degree. On the basis of employment changes projected for the alternatives (see "Local Economy" in this chapter), potential changes in population are estimated to range from an increase of roughly 2,900 (Alternative B-Departure (Modified)) to a decrease of about 8,000 (Alternative I). These figures are, respectively, 1.7 percent and 4.6 percent of the current Peninsula population of 175,500.

CUMULATIVE EFFECTS OF ALTERNATIVES ON LOCAL COMMUNITIES

The preceding discussion has been based on the assumption that current conditions in local communities, as a whole, will remain fairly stable. This is not expected to be the case. It is projected that the effects of timber supply reductions from non-National Forest sources (see the "Local Economy" discussion in this chapter) will precipitate a state of continuous change within Peninsula communities over the next 15-25 years. A decline in timber industry-related employment is expected to be an important factor in the pattern of overall change. At the same time, the emphasis on and relative importance of recreation and tourism is expected to increase. These combined elements could disrupt community groups where values centered around the "timber ethic" are in conflict with environmentally oriented values. It is quite likely that community group members whose values are based on the "timber ethic" will be less satisfied with future circumstances and changing emphases in forest management.

How do the projected effects of the alternatives relate to the expected changes within Peninsula communities? In the short run (i.e., the next 20 years), it is likely that alternatives more consistent with values based on the "timber ethic" (Alternatives A-Current Direction, B-Departure (Modified), and NC-No Change) would mitigate, to some extent, the concerns of timber-oriented community group members. Alternatives that emphasize amenity outputs (Alternatives C-Preferred (Modified), H (Modified), and I) are likely to further aggravate these concerns. In the long run (assuming that recreation and tourism do indeed increase in relative importance within Peninsula communities), the alternatives that are more amenity oriented may be most consistent with the ultimate mix of value sets and lifestyles on the Peninsula.

Regardless of the mix of community characteristics that ultimately evolves, conclusions may be drawn regarding probable interactions between the current state of change on the Peninsula and the effects of the alternatives. In community groups where there is conflict between timber-oriented and environmentally oriented values, polarization is likely to increase. The effects of alternatives expected to increase polarization between interest groups are likely to be intensified by the predicted changes in overall community conditions. Similarly, the effects of alternatives that are likely to foster differences between the Forest Service and those with timber-oriented interests are likely to be emphasized by the expected trends affecting the community as a whole.

MITIGATION MEASURES AND EFFECTIVENESS

Much attention has been focused in recent years on issues commonly referred to as the "Old Growth," "Ancient Forests," and "Spotted Owl" issues. The emergence of these issues (and many others), and the importance attached to them, suggests that long-term, cumulative trends will result in a decline in timber industry oriented employment and the economic stability of the Olympic Peninsula. Concerns of individuals, State and Federal officials, and the Pacific Northwest Congressional delegation center on the avoidance of sudden, abrupt, and perhaps precipitous changes. In addition to the normally cyclical nature of periodic "boom" and "bust" within the timber industry, long-term change is anticipated and considered to be inevitable.

State and local officials, including the Governor of Washington, have formed action groups and committees to address these social, political, and economic trends. Perhaps the most effective potential forum for mitigating the effects of change would involve coordinated action by various State, Federal, and other government and private agencies to help resource dependent communities prepare for and manage their future. Potential participants include Departments of Community and Economic Development, the Small Business Administration, County Commissioners, the Western Forestry Association, County Extension Specialists, and political officeholders.

Potentially effective mitigation can also result from encouraging new industry, as well as from investment in and development of recreational opportunities to promote tourism. Retraining, rehabilitation, relocation, and assistance strategies can also minimize impacts. These can be accomplished through sponsorship of effective legislation and coordinated efforts by Federal, State, and local government agencies. Promotion of intensive forestry practices (such as fertilization and reforestation efforts) can also mitigate adverse effects to some degree by providing employment opportunity.

RELATIONSHIP TO PLANS OF OTHERS

As mentioned under "Mitigation" above, major political officeholders, as well as many Federal, State, and local government agencies, are involved in and concerned about the economic stability of local communities and regional areas like the Olympic Peninsula. The Forest Service can serve as a catalyst to bring these various elements together, and can also serve as an information resource to help make mitigation endeavors as successful as possible.

INCOMPLETE OR UNAVAILABLE INFORMATION

Predictions of effects were made with the most current information available. The following information used to predict those effects is either unavailable or incomplete; additional information is needed on these topics:

- Effects of introducing non-indigenous plant species.
- Age at which a timber stand reaches an old-growth condition. The structural and functional characteristics of old-growth ecosystems. Minimum stand size for old-growth ecosystems.
- Techniques for developing or enhancing old-growth characteristics in managed stands.
- Effects of management activities on plant and animal diversity and on the stability of special habitats such as mature conifer or SOHAs.
- Effects of genetically selected stock on stand growth and yield, pathogen and insect population dynamics, and nutritional quality of wildlife forage.
- Long-term effects of the creation of abrupt boundaries between tree stands of different ages.
- The economic and effective use of natural regeneration following timber harvest.
- Effects of fertilization on conifer yields, other tree species, water quality and soils.
- Site-specific effects of changes in erosion rates and stream channel structure on watershed condition and fish habitat.
- Degree of loss of site productivity following intense burns, removal of woody debris, and soil compaction.
- Site-specific changes in fish habitat as a result of management activities (for all streams).
- Documentation of recovery rates of stream systems following disturbance.
- The amount of instream large woody debris necessary to maintain productivity of fish habitat.
- Cumulative effects of timber management activities on stream stability.
- Effects of fish habitat enhancement and rehabilitation projects on fish populations and stream hydrology.
- Minimum flow levels needed in major streams to support fish populations.
- Estimates of maximum distances that can be allowed between habitat areas for all management indicator species.

- Statistically reliable estimates of marten populations on the Olympic Peninsula.
- Accurate determination of deer and elk winter ranges and the portion which is necessary for winter survival.
- Effects of introduced wildlife species on native plant species or communities.
- Research or additional information on future demand for recreation opportunities is needed.
- Demand for Wildernesses.
- Potential for escape of prescribed fires, blowdown, and pest infestations as a result of timber harvest that will be located around the periphery of the Wildernesses.
- Demand for and use of the undeveloped areas.
- Potential for escape of prescribed fires, blowdown, and pest infestations as a result of timber harvest that will be located around the periphery of undeveloped areas.
- The future effects on scenery of wildfire, windthrow, and pest outbreaks.
- The amount and rate of future harvest on private lands within scenic viewsheds.
- Future social and economic trends that would influence local communities. For example, the effects of Forest timber supplies on local communities might be amplified or offset by changes in the national and international demand for wood products, advances in mill technology, and incentives for timber supplies from other land owners. Also, the aesthetic ties between the Forest and the communities would be influenced by demographic and economic trends of the local population.
- Future management and resource outputs on lands other than the Olympic National Forest.
- Community specific information on effects.
- Data on nonlinear relationships between resource outputs and jobs/income.
- Changes in the relationship between Forest outputs and jobs and income that have occurred during the latest national economic cycle.
- Additional information and research needs are discussed in Chapter II of the Forest Plan. This list of needs will be used to direct research and inventory activities to the areas where the need is greatest.
- Chapter V and Appendix B of the Forest Plan detail the monitoring processes and activities. Monitoring is directed at preventing any significant adverse impact to the environment. Refer to the Record of Decision for more information on how the Preferred Alternative, Alternative C (Modified) mitigates significant adverse environmental effects.

THE RELATIONSHIPS BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Short-term uses of the environment include both consumptive and nonconsumptive activities that occur on the Forest over the 50-year planning horizon for each alternative. The possible effects of these activities on long-term productivity are considered over a much longer time frame, in order to identify relatively long-lasting changes in productivity. Four types of activities have been identified that have potential, long-term effects on productivity.

1. **Road construction.** This activity affects productivity in two ways. While a road is being used, the productive potential of the land is entirely foregone. If a road is closed, the land may be returned to growing space for trees. However, it is often the case that the productivity of this land is lower than it was prior to road construction. The duration of such a productivity reduction could range from a few years to several hundred. This would depend on the type of soil involved, the extent to which soil characteristics have been altered by road construction and use, and the measures taken to restore productivity at the time of road closure.

2. **Mineral extraction.** At present, the principal mineral extraction activity on the Forest is the development of rock pits as sources of common variety materials for use in road construction. The effects of this on long-term productivity are similar in nature to those associated with road construction. In the case of rock pits, reductions in productivity are, generally, fairly long-term, due to the degree of site disturbance, even though rehabilitation measures are prescribed.

3. **Development of recreation sites.** The effects of this activity are also similar to those of road construction. While a recreation site is used, productive potential is foregone on the developed portions of the site (roads, tent sites, etc.). If a site is closed, management of the area for vegetative production may be resumed, but often at a reduced level of productivity. As with roads, the duration of the productivity reduction could range from a few years to several hundred.

4. **Logging and slash treatment.** The relationship between these activities and long-term productivity is, at present, far from fully understood. While it is known that erosion and soil compaction associated with logging, and loss of soil nutrients and micro-organisms resulting from hot slash burns can result in loss of productivity, the extent and duration of productivity changes are largely unknown. The relationship between nutrient removal (through harvest) and long-term productivity are currently under study, and fuller understanding should be attained in the future. At present, it can only be said that these activities may result in some reduction in long-term productivity.

All alternatives involve some level of each of the activities discussed above. Existing and proposed recreation developments are the same in all alternatives. The level of road construction, common variety mineral extraction, logging and slash burning will vary with timber harvest level. For this reason, the alternative most likely to have the greatest effect on long-term productivity is Alternative B-Departure (Modified). This alternative is followed by Alternatives NC, Alternative A-Current Direction, and Alternative I.

All alternatives include standards and guidelines and Best Management Practices (BMPs) designed to mitigate undesired effects and maintain productivity during logging and slash treatment. This also includes the restoration of productivity when facilities are closed and returned to the growth of vegetation, primarily trees for timber production. Monitoring will determine whether the Standards and Guidelines and BMPs are effective and are being correctly applied.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

IRREVERSIBLE COMMITMENTS OF RESOURCES

These are defined as commitments of resources that are essentially nonrenewable, or renewable only over a long period (200 years or more), to uses that consume or eliminate the resource in question. Three resources that will be irreversibly committed to some extent in the alternatives have been identified.

EXTRACTED MINERALS

Common variety minerals used in road construction and reconstruction will be fully consumed through use, and cannot be regenerated. The same is true of other minerals, should their development and extraction occur. Alternatives NC-No Change, B-Departure (Modified), A-Current Direction, and C-Preferred (Modified) involve the most extensive commitment of common variety minerals.

AREAS PROVIDING PRIMITIVE/SEMI-PRIMITIVE RECREATION OPPORTUNITIES

Road construction and timber harvest activities will eliminate the qualities which define these areas. Therefore, when these areas are developed, their potential for providing this kind of recreation is foregone. Although the necessary qualities can be reestablished, the timespan required to do so is lengthy enough to make the commitment essentially irreversible. With the exception of Alternatives H (Modified) and I, all alternatives involve some commitment of this resource. Alternative B-Departure (Modified) results in the greatest commitment with the others falling between the extremes.

OLD-GROWTH HABITAT

Harvest of old-growth timber stands removes the qualities that define this component of the environment. While old-growth qualities can be reestablished, the length of time required (160 years or more) makes the commitment essentially irreversible. All alternatives (except I) involve some reduction of the existing old-growth base. Alternative B-Departure (Modified) involves the greatest commitment of the old-growth resource followed by Alternative NC-No Change and Alternative A-Current Direction. No old-growth is intentionally removed in Alternative I and existing old-growth on big game winter range is retained in Alternative H (Modified).

IRRETRIEVABLE COMMITMENTS OF RESOURCES

These are short-term commitments of resource outputs that result from land use actions or allocations. Timber output foregone due to allocation of an area to Primitive/Semi-Primitive recreation is an example of such a commitment. While the commitment is not irreversible since the allocation could be revised at some future date, the additions to timber output that could have been realized under an intensive timber managment prescription (salvaged mortality, accelerated growth, etc.) are irretrievably lost while the recreation allocation is in effect. Four types of resources will be subject to commitments of this nature in the alternatives.

1. **Timber output.** All land allocations that preclude or limit timber harvest reduce timber growth potential. Alternative I involves the greatest commitment of this resource, followed by Alternative H (Modified).

2. **Scenic quality.** Except for Alternatives H (Modified) and I, the alternatives include some acreage allocations to managment prescriptions that are not designed to meet the currently inventoried visual quality objectives on the Forest. When such prescriptions are implemented, the scenic quality (as defined by scenic quality managment guidelines) of the harvested area is foregone until the necessary characteristics become reestablished. The time required to develop these characteristics varies with both site conditions and the visual quality objective. In most cases, the period between a change of allocation (to "meet visual quality objectives") and attainment of the desired conditions would be relatively "short-term" (i.e., up to 100 years). Alternatives B-departure (Modified), NC and A-Current Direction involve the most extensive commitment toward reducing scenic quality.

3. **Fish habitat effectiveness and water quality.** Alternatives that include relatively high levels of road construction and timber harvest (Alternatives A-Current Direction, B-Departure (Modified), and NC-No Change, because of the concentrated activity) involve the largest degree of irretrievable commitment of these resources. Fish production potential is reduced during, and up to 20 years after, sediment generating activity. Water quality reductions are generally periodic and of short duration, and are not expected to be substantial enough to result in water quality not meeting established standards.

4. **Wildlife habitat (other than old-growth).** Vegetative manipulation can result in reduction of overall habitat quality (diversity, seral stage mix, etc.). When this occurs, additional wildlife outputs that would have been associated with the original condition (as opposed to the "new" condition) are reduced until a more productive habitat mix becomes reestablished. Alternatives NC-No Change, A-Current Direction, and B-Departure (Modified), and I result in the biggest changes in overall wildlife habitat quality because of their tendency to create large areas of even-aged vegetative conditions.

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

Implementation of any of the alternatives involves some degree of unavoidable adverse environmental effect. The seven principal resource areas where adverse effects are probable are listed below. The degree to which each alternative affects these environemtal components is the focus of this chapter; further comparisons of alternatives may be found in Chapter II.

1. **Scenic quality.** With the exception of Alternatives H (Modified) and I, all alternatives involve some additional reductions in the overall scenic quality of the Forest. In general, these are associated with timber harvest and road construction activities.

2. **Old-growth habitat.** The timber harvest prescriptions associated with all alternatives except Alternative I involve some reduction of old-growth habitat availability.

3. **Fish habitat effectiveness and water quality.** Activity-generated sediment, generally the result of logging, road construction and road use, will affect the productive potential of fish habitat in all alternatives to varying degrees. Water quality will also be affected by sediment, although not to the extent that established quality standards would not be met.

4. **Wildlife habitat (other than old-growth).** All alternatives involve substantial changes in vegetative composition over time. The treatments applied (or not applied as with Alternatives H (Modified) and I), and the resultant vegetative patterns, will be beneficial to some wildlife species and detrimental to others.

5. **Primitive/Semi-Primitive recreation opportunities.** With the exception of Alternatives H (Modified) and I, all alternatives result in some reduction of acreage providing this type of recreation opportunity. Reductions are associated with road development and timber harvest.

6. **Air quality.** All alternatives include broadcast burning as the principal means of slash treatment. While precautions with respect to timing of slash burns will generally assure that air quality is maintained, occasional periods of reduced air quality are probable.

7. **Soil movement - geologic processes.** It is probable that the implementation of management activities, especially road construction and timber harvesting, will result in some mass soil movement. The probability of this occuring is proportional to the amount of road construction and timber harvest in each alternative. Therefore, Alternative B-Departure (Modified) has the highest probability, and Alternative I the least.

EFFECTS OF THE ALTERNATIVES ON CONSUMERS

Effects on consumers, resulting from implementation of the alternatives, are expected to be minimal. The most likely consequence in this area is a possible adjustment in prices of lumber and other wood products in response to changed harvest levels. Alternatives with high harvest volumes could result in slightly lower prices than those involving lower timber output.

EFFECTS OF THE ALTERNATIVES ON CIVIL RIGHTS, MINORITIES AND WOMEN

The most relevant variable in this area is the level of employment associated with each alternative. See Table IV-31. As a general rule, the employment rate among minorities and women fluctuates more than that of the workforce as a whole. This being the case, it is likely that alternatives associated with higher employment levels (i.e., those emphasizing timber production) will have a relatively greater positive effect on the employment of minorities and women than they will on the overall employment rate. Conversely, alternatives that generate fewer jobs are likely to have a relatively greater adverse effect on minority and female employment.

ENVIRONMENTAL CONDITIONS UNCHANGED BY ALTERNATIVES

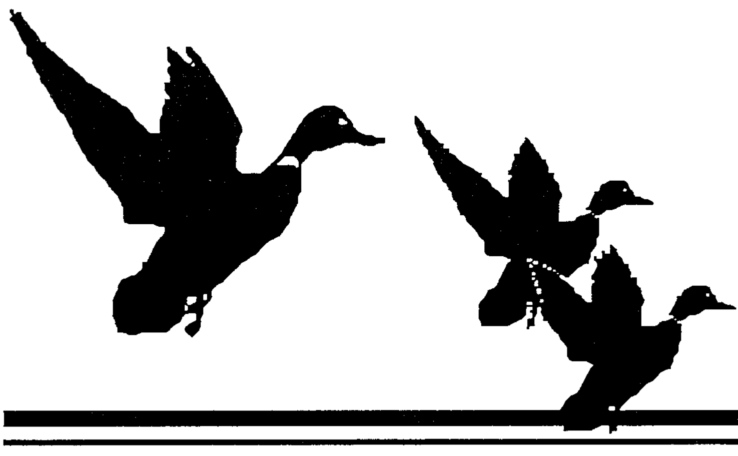
WILDERNESS

Additional acreage is not considered for Wilderness designation during this planning cycle. The Washington State Wilderness Act of 1984 determined that for National Forest System lands reviewed during the RARE II process, the RARE II "review and evaluation or reference shall be deemed, for the purposes of the initial land management plans, to be adequate consideration of the suitability of such lands for inclusion in the National Wilderness Preservation System, and the Department of Agriculture shall not be required to review the wilderness option prior to the revision of the plans."

RESEARCH NATURAL AREAS

Environmental conditions and effects on the Quinault Research Natural Area are expected to be the same in all alternatives. This Research Natural Area was established by the Chief of the Forest Service and will receive equal protection in each alternative.

List of Preparers



Olympic National Forest

LIST OF PREPARERS

PRIMARY PREPARERS

BRANDAU, WILLIAM F. Jr., "FRED"

Position: Forest Fisheries Biologist, 1975-1987; Eastside Zone Fisheries Biologist, 1988 to present. Specialist for Fish and Riparian areas

Education: A.S. Metro State College, Denver, 1969
B.S. Fishery Science, Colorado State University, 1972
M.S. Fishery Science, Colorado State University, 1973

Experience: Jr. Research Assistant two years Colorado State University. Acquatic Entomologist Consultant and prepared environmental assessments two years. Member of the planning team since 1979. Provided fisheries inventory and habitat information used to develop the data base for the planning process. Analyzed effects of alternatives on fish habitat.

BURNS, ROBERT

Position: Fish, Wildlife, Watershed and Range Staff Officer

Education: B.S. Agriculture, 1958, Washington State University

Experience: Thirty-two years with the Forest Service. Eleven years as staff officer on the Olympic National Forest; two years as fish, wildlife and watershed staff. Four years as recreation and lands staff. Six years as District Ranger, Blue River Ranger District, Willamette National Forest. Six months as member of Forest Planning Team. Forest Service exprience covers three National Forests and six ranger districts. Three years as member of Citizens Planning Group, Upper McKenzie Planning Area, Lane County, Oregon. Two years as member of Lane County Planning Commission Citizens Advisory Panel.

COON, RALPH K.

Position: Natural Resource Analyst.
Specialist for Fire, Fuels, Air, Energy

Education: B.S. Forestry, University of Washington, 1950

Experience: Forty years with the U.S. Forest Service on four National Forests including six Ranger Districts and two Supervisor's Office assignments. District Ranger for 20 years on three Ranger Districts. Forest Aviation, Fire, Recreation and Lands Staff Officer 1980-88. In present position since January, 1989. Provided information for fire, fuels, air quality and biomass energy, including evaluations of implementability. Retired May, 1990.

ELDREDGE, KENNETH C.

Position: Forest Landscape Architect, Assistant Recreation Staff.
Specialist for Recreation, Scenery, Wilderness, Unroaded Areas.

Education: Bachelor of Fine Arts, Landscape Architecture, Utah State University, 1966
Graduate School, 1 year, University of Oregon, 1967

Experience: One year as Landscape Architect, Ogden City Parks, Ogden, Utah. Has served as the Forest Landscape Architect for the past 20 years. As I.D. Team member representing the recreation resource, provided recreation inventory data interpretation and developed recreation yield coefficients for the planning process. Analyzed effects of alternatives on recreation and scenic quality.

FOWBLE, DIANE E.

Position: Clerk Typist
Served as Lead Operator in Word Processing Center.

Education: Attended Business College, 1958-59.

Experience: Worked for the Forest Service for 11 years, 18 years experience as word processor. Was involved with typing and preparation of the Forest Draft Planning documents. Assisted in data base entry and continually excelled at meeting tight time schedules and producing planning documents.

HENDERSON, JAN A.

Position: Area Ecologist

Education: BS, Forest Management, Washington State University, 1968.
MS, Forest Ecology, Oregon State University, 1970.
Ph.D, Botany, Oregon State University, 1974.

Experience: Leader of the ecological classification project for the Olympic and Mt. Baker-Snoqualmie National Forests since 1979. Prior to that, Assistant Professor of Forest Ecology and Silviculture at Utah State University. Provided ecological information for the planning documents including recommendations for Research Natural Areas and Botanical Areas. Primary author of "Forested Plant Associations of the Olympic National Forest" June, 1989.

HILLER, JULIE A.

Position: Computer Clerk
Responsible for preparation of planning documents in Office Publisher format, typing and editing.

Education: BA Elementary Education, Washington Baptist Teachers College, Tacoma, 1987.

Experience: Computer Clerk, Olympic National Forest 1988 to present. Taught first grade, Tacoma Baptist Elementary, 1988. Information Specialist and Personnel Clerk, Colville National Forest 1977-1988. YMCA (National Youth Corps) Spokane, Washington 1977.

HOFFMAN, WARD L.

Position: Forester, Economist, Analyst
Specialist for transportation system, economics, social environment, and data analysis.

Education: B.S. and B.A. Forestry and Economics, University of California (Berkeley), 1972
M.S. Engineering Science/Transportation Analysis, University of California (Berkeley), 1977

Experience: Timber sale planning (including preparation of environmental assessments), layout and sale administration on Plumas National Forest for three years. District leader for timber sale planning, logging plans, resource coordinator, and environmental assessments on the Gifford Pinchot National Forest for three years. Served a detail on the Wallowa-Whitman National Forest helping prepare timber sales for insect-killed lodgepole pine. Since 1979 has served as the Economist and Analyst for the planning team and has been responsible for development of the socio-economic and transportation analysis for forest planning. A prime contributor to the data (FORPLAN) model, and preparation of the planning documents.

JENNINGS, J. WESLEY

Position: Forest Soil Scientist
Specialist for Forest Soil Resource Inventory (SRI), soil survey and mapping interpretations.

Education: Boise Junior College, Boise Idaho, 1957-1960
Centralia College, Centralia, WA 1964-1965
B.S. Forest Science, University of Washington, 1967
Graduate studies soil science, Oregon State University, 1972-1974
Soil Science Institute, Cornell University, 1978

Experience: Forester, five years, Illinois Valley Ranger District, Siskiyou National Forest, and Smith River Ranger District, Siuslaw National Forest. Interim positions in soil science, Oregon State University, Siuslaw National Forest, and Chatham Area, Region 10 (Alaska) 1972-1974. Soil Scientist, 15 years, DNR (Washington) and Olympic National Forest. Contributions to the Planning process include capability areas, unsuitable areas, erosion classes for sediment yield model, and productivity estimates. Retired January 1990.

LARSON, RICHARD J.

Position:	Forest Fish and Wildlife Planning Biologist Specialist for Fish, Wildlife and Threatened and Endangered species management.
Education:	B.S. Oregon State University, Corvallis, 1974 Major areas of study included Fish, Wildlife, and Chemistry. Post Baccalaureate study in Recreational Resource Management.
Experience:	Seasonal work with the Environmental Protection Agency, Oregon Department of Fish and Wildlife, and Columbia River Inter-Tribal Fish Commission. Served in the U.S. Peace Corps in El Salvador and Thailand. Worked 10+ years as District Fish and Wildlife Biologist for the Soleduck Ranger Distrct, Olympic National Forest. Assigned as Olympic National Forest Fish and Wildlife Planning Biologist from July of 1988 until transferring to the Colville National Forest in March 1990.

LESHER, ROBIN D.

Position:	Assistant Area Ecologist Specialist for Forest Ecological information
Education:	B.S. Biology, Western Washington University, 1979. M.S. Biology, Western Washington University, 1983.
Experience:	Assistant to the Area Ecologist since 1984.. Coauthor of "Forested Plant Associations of the Olympic National Forest." Several years doing botanical and ecological surveys in the North Cascades. Provided ecological information for Planning documents (Chapter III, Affected Environment). Prepared text for Research Natural Area, Botanical Area and Unusual and Sensitive Plant Communities. Analyzed effects of alternatives on vegetation.

MADRID, MARK

Position:	Forest Wildlife Biologist Specialist for Wildlife, Threatened and Endangered (T&E) Species.
Education:	B.S. Wildlife Management, Colorado State University, 1973 Silviculture Institute, University of Washington and Oregon State University, 1982-83.
Experience:	He served as a biologist on three Ranger Districts in Wyoming and Colorado. District Fish and Wildlife Staff Officer on the Wrangell Ranger District, Tongass National Forest in Alaska. Since 1984 served as Wildlife Biologist for the Olympic National Forest and member of the planning team. Provided wildlife inventory and habitat information used to develop yield coefficients for the Forest Plan data base. Analyzed effects of alternatives on wildlife habitat and populations. Since 1989, District Ranger, Cordova Ranger District, Chugach National Forest, Alaska.

MICHAELS, JANET

Position: Editorial Assistant
Performed basic text editing and coordination of printing and publication of final planning documents.

Education: Attended University of Albuquerque, 1975-76, Courses in English Composition. Government-sponsored courses in proofreading/editing.

Experience: Editorial Assistant, U.S. Fish and Wildlife Service, Office of Current Information, Washington, D.C. Public Information Clerk, U.S. Fish and Wildlife Service, Public Affairs Office, Albuquerque, New Mexico. Editor of Olympic National Forest Informational Newsletter, "Olympic Hilights." Served as basic text editor of Olympic National Forest DEIS, Appendices and Forest Plan.

NOTENBOOM, T.I. "DUTCH"

Position: Assistant Lands Staff
Specalist for Cultural Resource, American Indian Issues, Lands and Minerals.

Education: B.S. Forest Management, Oregon State University, 1962.

Experience: Thirty years with the Forest Service on four National Forests including assignments in Timber, Recreation, Fire, and Lands and Minerals. As Planning team member from 1985-1990, assisted in development and preparation of planning documents and speciality areas. Primary source of information and planning coordination with American Indian Tribes on the Olympic Peninsula.

POZZUTO, GEORGE R.

Position: Forester, Assistant Planning Staff, Interdisciplinary Team Leader (1977-1987). Generalist for all resource areas, specialist in planning process and NFMA.

Education: B.S. Forest Management, University of Maine, 1970

Experience: Began career on the Nez Perce National Forest in Wilderness Management (Selway-Bitterroot Wilderness). Pre-sale Forester on the Nez Perce and Flathead National Forests. Supervisory Pre-sale Forester-Silviculturist on the Ochoco National Forest and Environmental Analysis Coordinator. Assistant Planning Staff since 1977. Served as ID Team Work Leader throughout the Planning process. Coordinated data gathering, development, and analysis of the Forest FORPLAN model. Assisted in the completion of two previous land management plans while on the Olympic. A prime contributor to the preparation and drafting of the DEIS planning documents. Since 1987, District Ranger, Lake Wenatchee Ranger District, Wenatchee National Forest, Washington.

QUINN, THOMAS P.

Position: Interdiciplinary Planning Team Leader

Education: B.S. Forest Management, Rutgers University, 1977
M.S. Forest Resources (Forest Economics), University of Idaho, 1985
Course and Examination work completed toward Ph.D. in Forest Management, Michigan State University (degree is pending completion of dissertation)

Experience: Ten years of experience with the U.S. Forest Service on three National Forests in two Regions. Planning analyst/forest economist on the Malheur for three years; three years on the Boise National Forest, two as forest economist and one as interdisciplinary planner. Attended Forest Service one year training program in public land management and administration at Michigan State University in 1986-1987. Since 1987 has served as team leader on the Olympic, coordinating all aspects of Final Plan and FEIS preparation, including public involvement efforts. Served four month detail as Staff Officer for Fire, Aviation, Recreation, Lands and Minerals in 1989.

RODEHEAVER, JAMES R.

Position: Assistant Lands Staff
Land Exchange, Small Tracts Act, Minerals.

Education: B.S. Forest Management, Humboldt College, Arcata, California, 1970.

Experience: Sixteen years varied lands and minerals experience on the Winema, Siuslaw, Wenatchee and Olympic National Forests. Provided lands and minerals information for the planning documents.

ROSS, JANEY

Position: Civil Engineering Technician

Education: B.A. University of California at San Diego, 1966. Also attended Bakersfield Community College and University of Arizona.

Experience: Twelve years as Chief (Supervisory) Draftsperson and Graphics Designer with major mineral exploration, mining and geophysical firms in the Southwest 1967-78. Bonneville Power Administration, Portland, Oregon, Graphics and Drafting section 1979. Worked nine years in Civil Engineering and Geotechnical Sections, Olympic National Forest, quality control for planning and design standards. Responsible for graphics, typeset, layout and design of all Draft Forest Planning documents.

STEPHENS, ROGER K.

Position: Forest Hydrologist
Specialist for Soil, Water, Riparian Areas, Watersheds, Floodplains, Wetlands.

Education: A.A. Degree in Pre-Engineering, Menlo J.C. (California), 1956 B.S. Geological Engineering, University of Nevada, 1971
Two years graduate study in Hydrology

Experience: Five years electronic technician with private industry. Three years student assistant to Hydrology Professor, working in water quality testing and data compilation. Hydrologist with the Bureau of Land Management in Nevada. Since 1971 has been the Forest Hydrologist, conducting streamflow and water quality monitoring. Developed the sediment model used in FORPLAN analysis for the Forest Planning data base. Analyzed effects of alternatives on sedimentation rates, water quality.

VOSBURGH, JOHN C.

Position: Forester, Timber Management Planner
Specialist for Vegetation (Timber), Insects, Diseases, and Sustained Yield Units.

Education: B.S. Forest Management, University of Michigan, 1960

Experience: Thirty years with the Forest Service in timber management related activities. Pre-sale assignments on the Mt. Hood and Siuslaw National Forests. Assistant Inventory Leader on the Siuslaw. Timber Management Assistant on Snow Mountain District, Ochoco National Forest. Since 1976, has served as Timber Management Planner for the Olympic National Forest. Developed timber yield data and timber management prescriptions for FORPLAN analysis. Analyzed effects of alternatives on harvest volume and scheduling.

WILSON, ANDREW E.

Position: Natural Resource Analyst.
Specialist for computer programming and planning data base.

Education: B.S. Forestry, University of Idaho, 1983
M.S. forest Economics and Operations Research; University of Washington, 1989.

Experience: Seasonal work on Clearwater and Payette National Forest in Idaho, 1979-1982. Field and lab work in forest and range fire research Northern Forest Fire Laboratory, Missoula, MT, 1982-1983. Served in the Peace Corps (Philippines) as Agroforestry Extension Agent from September 1984 to November 1986. GIS Analysis, Department of Geography, University of Washington 1989. Provided support to the development and implementation of the FORPLAN model. Assisted in the analysis of data base for planning documents (Appendix B). Transferred to Tongass National Forest, Petersburg, Alaska in April 1990.

YATES, DAVID M.

Position: Supervisory Forester, Land Management Planning and Area Ecology Staff Officer. Staff direction for Forest Planning, Liaison with Regional Planning Office and Member, Forest Management Team.

Education: B.S. Forestry, Michigan State University, 1960
M.S. Forestry, Michigan State University, 1963

Experience: Thirty years with the Forest Service on five National Forests. Supervisory assignments for most resource management programs. District Ranger on the Okanogan National Forest for seven years. Served an assignment as Appeals and Litigation Coordinator in the Regional Office, Portland, Oregon. Has served in various Acting Forest Staff and Acting Forest Supervisor assignments. As Planning and Ecology Staff Officer since 1980, has primary responsibility for preparation of the DEIS, Supplement, FEIS and Forest Plan. Also contributed to the preparation of various planning documents.

CONTRIBUTORS

Colleen Adams
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David Peter
Thomas W. Sayre
Dick Simmons
John Simmons
Annie Wilson

SUPPORTERS

The Olympic National Forest Management Team 1979 to present.

The Olympic Ranger District Employees 1979 to present.

Other individuals, agencies and organizations too numerous to name.

List of Agencies, Organizations and Individuals to Whom Copies of this Statement Were Sent

Olympic National Forest

LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES OF THE STATEMENT ARE SENT

INTERNATIONAL AGENCIES

Japanese Consulate General

FEDERAL AGENCIES/OFFICIALS

Delaware River Basins Commission
Equal Opportunity Commission, Office of Economic Opportunity, Small Business Admin.
US Advisory Council on Historic Preservation
US Department of Agriculture, Animal and Plant Health Inspection Service
US Department of Agriculture, Forestry Sciences Laboratory
US Department of Agriculture, Forest Service, Chugach National Forest
US Department of Agricultue, Forest Service, Colville National Forest
US Department of Agriculture, Forest Service, Deschutes National Forest
US Department of Agriculture, Forest Service, Fremont National Forest
US Department of Agriculture, Forest Service, Gifford Pinchot National Forest
US Department of Agriculture, Forest Service, Malheur National Forest
US Department of Agriculture, Forest Service, Mount Baker-Snoqualmie National Forest
US Department of Agriculture, Forest Service, Mt. Hood National Forest
US Department of Agriculture, Forest Service, National Media Office
US Department of Agriculture, Forest Service, Ochoco National Forest
US Department of Agriculture, Forest Service, Okanogan National Forest
US Department of Agriculture, Forest Service, Region 1, Northern Region
US Department of Agriculture, Forest Service, Region 2, Rocky Mountain Region
US Department of Agriculture, Forest Service, Region 3, Southwest Region
US Department of Agriculture, Forest Service, Region 4, Intermountain Region
US Department of Agriculture, Forest Service, Region 6, Pacific Northwest Region
US Department of Agriculture, Forest Service, Region 8, Southern Region
US Department of Agriculture, Forest Service, Region 9, Eastern Region
US Department of Agriculture, Forest Service, Region 10, Alaska Region
US Department of Agriculture, Forest Service, Rocky Mountain Station
US Department of Agriculture, Forest Service, Rogue River National Forest
US Department of Agriculture, Forest Service, Siskyou National Forest
US Department of Agriculture, Forest Service, Siuslaw National Forest
US Department of Agriculture, Forest Service, Umatilla National Forest
US Department of Agriculture, Forest Service, Umpqua National Forest
US Department of Agriculture, Forest Service, Wallowa-Whitman National Forest
US Department of Agriculture, Forest Service,Wenatchee National Forest
US Department of Agriculture, Forest Service,Willamette National Forest
US Department of Agriculture, Forest Service, Winema National Forest
US Department of Agriculture, Office of Equal Opportunity
US Department of Agriculture, Rural Electrification Administration, Assistant Administrator for Management
US Department of Agriculture, Rural Electrification Administration, Environmental Policy Office
US Department of Agriculture, Stabilization and Conservation Service
US Department of Agriculture, Soil Conservation Service
US Department of Commerce, National Marine Fisheries Service
US Department of Commerce, NOAA Ecology and Conservation Division
US Department of Defense, Army Corps of Engineers
US Department of Defense, Deputy Assistant Secretary of Defense
US Department of Defense, Explosives Safety Board
US Department of Defense, US Air Force, Department for Environment & Safety
US Department of Defense, US Navy, Environment Protection Division
US Department of Energy, Bonneville Power Administration
US Department of Energy, Office of Environmental Compliance
US Department of Health and Human Services, Departmental Environmental Office
US Department of Housing and Urban Development, Environmental Officer, Region X
US Department of Housing and Urban Development, Office of Environment and Energy
US Department of the Interior, Bureau of Indian Affairs
US Department of the Interior, Bureau of Mines
US Department of the Interior, Environmental Project Review
US Department of the Interior, Fish and Wildlife Service
US Department of the Interior, Geological Survey
US Department of the Interior, National Park Service, Air

US Department of the Interior, National Park Service
Mt. Rainier National Park
US Department of the Interior, National Park Service,
North Cascades National Park
US Department of the Interior, National Park Service,
Olympic National Park
US Department of the Interior, National Park Service,
Pacific Northwest Region
US Department of the Interior, Office of Environmental
Affairs
US Department of Labor, Occupational Safety and Health
US Department of Transportation, Assistant Secretary
for Policy & International Affairs
US Department of Transportation, Division Administrator,
Olympia Office
US Department of Transportation, Federal Aviation
Administration
US Department of Transportation, Federal Highway
Administration
US Department of Transportation, Federal Railroad
Administration
US Department of Transportation, US Coast Guard,
Environmental Impact Branch
US Environmental Protection Agency, EIS Review Coordinator,
Region X
US Environmental Protection Agency, Office of Environmental
Review
US Environmental Protection Agency, Office of Federal
Activities
US Environmental Protection Agency, Region 8, Denver
US Federal Energy Regulatory Commission, Advisor on
Environmental Quality
US Federal Energy Regulatory Commission, Office of General
Counsel
US Federal Energy Regulatory Commission, Office of
Hydropower Licensing
US House of Representatives, Honorable Rodney Chandler
US House of Representatives, Honorable Norm Dicks
US House of Representatives, Honorable Tom Foley
US House of Representatives, Honorable Jim McDermott
US House of Representatives, Honorable John Miller
US House of Representatives, Honorable Sid Morrison
US House of Representatives, Honorable Al Swift
US House of Representatives, Honorable Jolene Unsoeld
US Interstate Commerce Commission, Section of Energy
and Environment
US National Aeronautics and Space Administration,
Office of the Comptroller
US Senate, Honorable Brock Adams
US Senate, Honorable Slade Gorton

STATE AGENCIES/OFFICIALS

Governor's Timber Team
Illinois State Department of Conservation
Oregon State Department of Fish and Wildlife
Washington State County Road Admin. Board
Washington State Department of Community Development
Washington State Department of Ecology
Washington State Department of Fisheries
Washington State Department of Natural Resources
Washington State Department of Natural Resources,
Financial Services
Washington State Department of Natural Resources,
South Puget Sound Region
Washington State Department of Trade and Economic
Development
Washington State Department of Wildlife
Washington State Geologic Investigations and Planning
Washington State Historical Preservation Officer
Washington State House of Representatives, Honorable
Bob Basich
Washington State House of Representatives, Honorable
Jennifer Belcher
Washington State House of Representatives, Honorable
Karen Fraser
Washington State House of Representatives, Honorable
James Hargrove
Washington State House of Representatives, Honorable
Evan Jones
Washington State House of Representatives, Honorable
Doug Sayan
Washington State House of Representatives, Honorable
Max Vekich
Washington State Mineral Council
Washington State Parks and Recreation Department
Washington State Road Department
Washington State Science and Environment Education
Program
Washington State Senate, Honorable Neil Amondson
Washington State Senate, Honorable Paul H. Conner
Washington State Senate, Honorable Arlie U. Desarmatt
Washington State Senate, Honorable Mike Kreidler
Washington State Senate, Honorable Brad Owen

COUNTY AGENCIES/OFFICIALS

Clallam County Board of Commissioners
Clallam County Economic Development Council
Clallam County Extension Agent
Clallam County PUD # 1
Clallam County Road Engineer
Grays Harbor County Board of Commissioners
Grays Harbor County Economic Development Council
Grays Harbor County Forestry Department
Grays Harbor County Road Engineer
Grays Habror County PUD
Jefferson County Board of Commissioners
Jefferson County Engineer
Jefferson County Plan/Bldg Department
Kitsap County Board of Commissioners
Kitsap County Community Development
Mason County Board of Commissioners
Mason County Department of General Services
Mason County Economic Development Council
Mason County Engineer
Mason County PUD #1 - EW
Mason County PUD #3 - E
Thurston County Board of Commissioners
Thurston County Regional Planning Council

Thurston County Road Administration Board

CITY/MUNICIPAL AGENCIES/OFFICIALS

City of Aberdeen
City of Forks
City of Hoquiam
City of McCleary
City of Montesano
City of Olympia
City of Port Angeles
City of Port Townsend
City of Quilcene
City of Seattle
City of Sequim
City of Shelton
City of Tacoma
Elma Police Department
Forks Chamber of Commerce
Grays Harbor Chamber of Commerce
Port of Olympia
Port of Port Angeles

INDIAN TRIBES

Chehalis Business Tribal Council
Hoh Indian Tribal Council
Jamestown Klallam Tribal Council
Lower Elwha Tribal Council
Makah Tribal Forestry
Nisqually Tribal Council
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Pt. Gamble Klallam Tribal Council
Quileute Tribal Council
Quinault Indian Nation Tribal Council
Quinault Tribal Fisheries Division
Quinault Tribal Forestry
Shoalwater Bay Tribal Council
Skokomish Tribal Council
Squaxin Island Tribal Council

BUSINESS AND INDUSTRY

American Rivers, Inc.
Bank of Grays Harbor
Biomass Energy Systems
Bloedel Timberland Development, Inc.
Blue Ribbon Coalition, Inc.
Bogle & Gates
Brunstad Logging
Buse Timber & Sales, Inc.
Cambridge Scientific Abstracts
CHEC
Coast Pacific Trading, Inc.
Columbia Helicopters
Cosmic Awareness Communications
D & R Cedar Products
Daishowa America
Davis, Graham & Stubbs
Paul F. Ehinger & Assoc.
Envirotest, Inc.
Georgia Pacific Corp.
Graysmarsh Farm
Hand Crafted Carvings
Hermann Brothers Logging & Construction, Inc.
Hosey & Associates Engineering Co.
Hurn Shingle Co., Inc.
Intermountain Contractor, F.W. Dodge
ITT Rayonier, Inc., Port Angeles
ITT Rayonier, Inc., Seattle
Lindsay, Hart, Niel & Weigler
Little River Enterprises
M. B. Logging, Inc.
M & R Inc.
Marys River Lumber Co.
Mason, Bruce & Girard
Merrill & Ring, Inc.
Mt. Baker Plywood, Inc.
OJI Paper Co., Ltd.
Olympic Reforestation, Inc.
Pacific Lumber & Shipping
Pacific Marine Technology
Pope & Talbot, Inc.
Puget Sound Surfacers, Inc.
Rainsong Co.
REI
R. W. Beck & Associates
Saltman & Stevens
Simpson Timber Co., Seattle
Simpson Timber Co., Shelton
Timber Data Co.
Verle's Sporting Goods
Washington Timberland Mgt., Inc.
Weyerhaeuser Co., Cosmopolis
Weyerhaeuser Co., Tacoma
Welco Lumber
Wood Craft By The Stoneman
Zonta International

COLLEGES/UNIVERSITIES

Environmental Resource Center, The
Evergreen State College

Grays Harbor Community College
Humboldt State University
National Technical Information Service
Northwestern University, Transportation Library
Skagit Valley College
University of Alabama
University of Calgary
University of California at Berkeley, J.S.P. Program
University of Oregon, Lands Coordinator, Survival Center
University of Washington
University of Washington, Office of Public Archaeology
University of Wyoming, Department of Economics

Utah State University, Department of Forestry and Outdoor Recreation
Washington State University
Washington State University, Agricultural Resource Service
Washington State University, Department of Natural Resource Sciences

LIBRARIES

Aberdeen Timberland Library
Brookings Public Library
Central Washington University Library
Colorado State University Library
Eastern Washington University Library
The Evergreen State College Library
Holland Library
Hoquiam Timberland Library
Hume Library, University of Florida
Kitsap Regional Library
Longview Public Library
Mortvedt Library, Pacific Lutheran University
North Olympic Library System
Olympia Timberland Library
Owen S&E Library
Pacific Southwest Science Literature Service
Port Townsend Library
Seattle Public Library
Tacoma Public Library
University of Washington Library
Washington State Library
Western Washington University Library
William G. Reed Public Library
Yakima Valley Regional Library

MEDIA

Aberdeen Daily World News Editor
Bremerton Sun News Editor
The Columbian News Editor
Cowlitz County Advocate News Editor
Daily World News Editor
Donrey Media News Editor
Environmental Outlook News Editor
Forestry Forum News Editor
Forks Forum and Peninsula Herald News Editor
Jimmy Come Lately Gazette News Editor
KAPY Radio News Editor
KAYO AM/FM News Editor
KBAM AM News Editor
KBRO AM News Editor
KCED FM News Editor
KDUX FM News Editor
KGY AM News Editor
KING TV News Editor
KITI News Editor
KLOG AM News Editor
KMAS News Editor
KPLU FM News Editor
KSTW TV News Editor
Montesano Vidette News Editor
Nisqually Valley News Editor
North Beach Beacon News Editor
Northwest Construction News Editor
Northwest Discovery News Editor
Northwest Woodlands News Editor
The Olympian News Editor
The Oregonian News Editor
Port Angeles Daily News Editor
Port Townsend Leader News Editor
Seattle Post-Intelligencer News Editor
Seattle Times News Editor
Signpost Magazine News Editor
Southern Lumberman Editor
The Sun Sports Editor
The Willapa Harbor Herald News Editor

ORGANIZATIONS

American Forestry Association, Pacific Office
Audubon Society, Lower Columbian Basin
Audubon Society, National
Audubon Society, Seattle
Audubon Society, Western Region
Audubon Society, Whidbey
Earth First!, Olympia
Earth First!, Seattle
Friends of Dungeness & Graywolf
Friends of the Earth, Seattle
Hood Canal Environmental Council
International Woodworkers of America
Kitsap Mineral & Gem Society
Lone Rock Community Club
Mazamas
Mountaineers
National Campers & Hikers Association
National Forest Products Association
National Rifle Assoc. of America
National Wildlife Federation
The Nature Conservancy
Northwest Forestry Association, Portland
Northwest Forestry Association, Tacoma
Northwest Forestry Association, Woodland
Northwest Independent Forest Manufacturers
Northwest Mining Association
Northwest Renewable Resources Center
Northwest Timber Association
Olympic Peninsula Interagency Coord. Group
Olympic Resource Council
Oregonians for Food & Shelter
Pacific NW 4-Wheel Drive Association
Peninsula Wilderness Club, Bremerton
Peninsula Wilderness Club, Port Orchard
Sierra Club Legal Defense Fund
Society of American Foresters
South Mason Timberland Library
South Sound Bioregional Network
Tacoma Mountain Rescue Unit
Washington Association of Realtors
Washington Council of Fly Fisherman

Washington Farm Forestry Association
Washington Forest Protection Association
Washington Native Plant Society, Olympic Peninsula Chapter
Washington Native Plant Society, Seattle
Washington Native Plant Society, South Sound Chapter
Washington Recreational River Runners Association
Washington State Snowmobile
Washington Trails Association
Washington Wilderness Coalition
Western Forest Industries Association
Western Wood Products Association
Wilderness Society, Northwest Representative

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Sprague Ackley
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Donna Alber
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Eleanor S. Zahn
Richard & Sandy Zielesch
Susan Zwinger

References

Olympic National Forest

REFERENCES

Adams, Darius M.; Haynes, Richard W.

Changing Perspectives on the Outlook for Timber in the United States. Journal of Forestry; January 1985.

Adams, Paul W.; Froehlich, Henry A.

Compaction of Forest Soils. Pacific Northwest Extension Publication. PNW 217; 1981.

Adelman, Eleanor Y.

Socio-Economic Overview of the Olympic Peninsula. Prepared under contract for the Olympic National Forest. Portland, OR: Eleanor Adelman; 1980. 71 p.

Alward, Gregory S.; Palmer, Charles J.

"IMPLAN: An Input-Output Analysis System for Forest Service Planning." Proceedings of the First North American Conference on Forest Sector Models, Williamsburg, Virginia. Oxford: A B Academic Publishing; 1981. 131-140.

Amoss, Pamela

Coast Salish Spirit Dancing: The survival of an Ancestral Religion. University of Washington Press; 1978.

Anderson, H.W.; Hoover, M.D.; Reinhart, K.G.

Forests and Water: Effects of Forest Management on Floods, Sedimentation, and Water Supply. General Technical Report PSW-18. Berkeley, CA: USDA Forest Service, Pacific Southwest Forest and Range Experiment Station; 1976. 115 p.

Banister, D'Arcy P.; Barnes, D.J.; Longwill, W.D.

Availability of Federal Land for Mineral Exploration and Development in the State of Washington. Geologic Map GM-30. State of Washington, Department of Natural Resources, Division of Geology and Earth Resources; 1984.

Bassett, Patricia M.; Oswald, Daniel D.

Timber Resource Statistics for the Olympic Peninsula, Washington. Resource Bulletin PNW-93. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station; 1981. 31 p.

Bergland, Eric O.

Lithic Remains from the Blue Mountain Area, Olympic National Park. Report on file. Seattle, WA: National Park Service, Pacific Northwest Regional Archaeologist's Office; 1982.

Olympic National Park Archaeological Base Map Study. Report on file. Seattle, WA: National Park Service, Pacific Northwest Region; 1984.

Site Boundary Estimation and Preliminary Assessment of Archaeological Significance, Slab Camp Prehistoric Site, Quilcene Ranger District, Olympic National Forest, Washington. Report on file. Olympia, WA: USDA Forest Service; 1983.

Summary Prehistory and Ethnography of Olympic National Park, Washington. National Park Service, Pacific Northwest Region, Division of Cultural Resources; 1983.

Bergstrom, Walt
[Telephone Communication.] State of Washington, Department of Ecology; May 1985.

Bodeutsch, Gary; Vleming, Jim
Annual Demographic Information: Service Delivery Area I. Olympia, WA: Washington State Employment Security Department; July 1989. 71 p.

Annual Demographic Information: Service Delivery Area II. Olympia, WA: Washington State Employment Security Department; July 1989.

Annual Demographic Information: Washington State. Olympia, WA: Washington State Employment Security Department; July 1989. 95 p.

BPA (Bonneville Power Administration)
[Unpublished printed material.] 1985.

Bradborg, Stewart M.
Life History and Management of the Mountain Goat in Idaho. Wildlife Bulletin No. 2. Idaho Department of Fish and Game; 1955.

Brown, Reade E.
Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington. USDA Forest Service, Pacific Northwest Region; June 1985.

Buckingham, Nelsa M.; Tish, Edward L.
Vascular Plants of the Olympic Peninsula, Washington. UW/CPSU Report B-79-2. National Park Service, Cooperative Park Studies Unit, College of Forest Resources, University of Washington; 1979. 74 p.

Bull, Evelyn L.
Habitat Utilization of the Pileated Woodpecker, Blue Mountains, OR. Corvallis, OR: Oregon State University; 1975. 58 p. M.S. Thesis.

Bull, Evelyn L.; Meslow, E. Charles
Habitat Requirements of the Pileated Woodpecker in Northeastern Oregon. Journal of Forestry 1975 (6): 334-337; 1977.

Burke, T.E.
Marten. Unpublished. Washington: Colville National Forest; 1982.

Burns, R.M., Technical Compiler
Silvicultural Systems for the Major Forest Types of the United States. Agriculture Handbook 445. Washington, DC: USDA; 1983. 191 p.

Camilleri, Ernie
[Personal Communication.] Modoc National Forest; 1981.

Campbell, C. Duncan
Future Market Conditions in Forest Products and Their Effect on Washington's Industry. State of Washington, Department of Natural Resources; December 1983.

Campbell, T.M.
Short-term Effects of Timber Harvest on Pine Marten Ecology. Ft. Collins, CO: Colorado State University; 1979. 71 p. M.S. Thesis.

Christensen, Alan G.; Madel, Michael J.
Cumulative Effects Analysis Process, Grizzly Habitat Component Mapping. USDA Forest Service, Kootenai National Forest; 1982.

Church, S.E.; Frisken, J.G.; Tabor, R.W.; Iverson, S.R.
Mineral Resource Potential of the Wonder Mountain Roadless Area, Mason County, Washington. Miscellaneous Field Studies Map MF-1418-B; U.S. Geological Survey; 1983. 10 p.

Clopper, Almon, et al.
1983: Interindustrial Forecasts of the American Economy. Lexington, MA: D.C. Heath and Company; 1974.

Collins, June M.
Valley of the Spirits. University of Washington Press; 1974.

Columbia Consulting Group, Inc.
Grays Harbor Area Timber Supply and Demand Outlook. Prepared for the Port of Grays Harbor. Lake Oswego, OR: Columbia Consulting Group, Inc.; 1989. 92 p.

North Olympic Peninsula Timber Resource Study. Prepared for the Port of Port Angeles. Lake Oswego, OR: Columbia Consulting Group, Inc.; 1989. 79 p.

Cooper, John A.
Environmental Impact of Residential Wood Combustion Emissions and Its Implications. Journal of the Air Pollution Control Association, Vol. 30, No. 8. 1980.

Curtis, Robert O., et al.
A New Stand Simulator for Coast Douglas-fir: DFSIM User's Guide. USDA Forest Service; 1981.

Daniel, T.W.; Helms, J.A.; Baker, F.S.
Practice of Silviculture. Second Edition. McGraw-Hill, Inc.; 1979. 500 p.

Deeming, John E.
Lesson Plan, Source Impact Determination, Fire Effects on Air Quality, presented at Air Quality/ Airshed Management Symposium. Redmond, OR: 1982.

Dell, John D.; Ward, Franklin R.
Logging Residues on Douglas-fir Region Clearcuts, Weights and Volumes. PNW-115. USDA Forest Service; 1971.

Dunn, Paul H.; Debano, Leonard F.
Fire's Effect on Biological and Chemical Properties of Chaparral Soils. In: Proceedings, Symposium on the Environmental Consequences of Fire and Fuel Management in Mediterranean Ecosystems. General Technical Report WO-3. Palo Alto, CA: USDA Forest Service; 1977. 75-84.

Dyrness, C.T., et al.
Research Natural Area Needs in the Pacific Northwest. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station; 1975.

Eells, Myron
Ten Years of Missionary Work Among the Indians. Facsimile reproduction 1972. Seattle, WA: Shorey Book Store (SJS#228); 1886.

The Indians of Puget Sound. American Antiquarian 9; 1887.

The Indians of Puget Sound, The Notebooks of Myron Eells. Edited with an Introduction by George Pierre Castile. The University of Washington Press; 1985.

The Twana, Chemakim and Klallam Indians. Smithsonian Annual Report for 1887. 1889.

Elmendorf, W.
The Structure of Twana Culture. Research Studies No. 28, Vol. 3, Monographic Supplement 2. Pullman, WA: Washington State University; 1960.

Forbes, R.D., Editor
Forestry Handbook Edited for the Society of American Foresters. New York: The Ronald Press Co.; 1961.

Fowells, H.A., Technical Compiler
Silvics of Forest Trees of the United States. Agriculture Handbook 271. Washington, DC: USDA; 1965. 762 p.

Fox, Alan
Timber Supply in the Pacific Northwest. USDA Forest Service, Pacific Northwest Region; 1989. 39 p.

Franklin, J.F.; Dyrness, C.T.
Natural Vegetation of Oregon and Washington. General Technical Report PNW-8. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station; 1973.

Franklin, J.F.; Emmingham, W.; Jaszkowski, Ralph
True Fir - Hemlock. In: Burns, Russell M., technical compiler. Silvicultural Systems for the Major Forest Types of the United States. Agriculture Handbook 445. Washington, DC: USDA; 1983.

Franklin, Jerry F.
Effects of Uneven-Aged Management on Species Composition. In: Uneven-Aged Silviculture and Management in the United States. In-Service Workshop 1975 July 15-17; Morgantown, W.V; and, In-Service Workshop; 1976 October 19-21; Redding, CA. Gen. Tech. Report WO-24. Washington, DC: USDA Forest Service, Timber Management Research; February 1978.

Franklin, Jerry F., et al.

Ecological Characteristics of Old-growth Douglas-fir Forests. General Technical Report PNW-118. Portland, OR: USDA Forest Service, Pacific Northwest Forest and Range Experiment Station; 1981. 48 p.

Federal Research Natural Areas in Oregon and Washington; USDA Forest Service; Pacific Northwest Forest and Range Experiment Station; 1972.

Interim Definitions for Old-growth Douglas-fir and Mixed-conifer Forests in the Pacific Northwest and California. Research Note PNW-447. Pacific Northwest Forest and Range Experiment Station; 1986. 7 p.

Freddy, David J.

Status and Management of the Selkirk Caribou Herd, 1973. Moscow, ID: University of Idaho; 1974. Ph.D. Thesis.

Froehlich, Henry A.

Soil Compaction: Why the Controversy? Logger's Handbook Vol. XXXVII. Portland, OR: Pacific Logging Congress; 1977. 20-22 p.

Grant, Robert A.

Report of Evaluation Mineral Resource Analysis Study on United States Forest Service Land - State of Washington. 1976. 93 p.

Guenther, K.; Kucera, T.

Wildlife of the Pacific Northwest. USDA Forest Service, Pacific Northwest Region; October 1978.

Gunther, Erna

A Further Analysis of the First Salmon Ceremony. University of Washington Publications in Anthropology. 2(5): 129-173; 1928.

Ethnobotany of Western Washington. University of Washington Press; 1945 (Revised 1973).

Klallam Ethnography. University of Washington Publications in Anthropology. 1(5): 171-314; 1927.

Hammond, Paul C.

Ecological Investigation Report: Oregon Silverspot Butterfly. December 1980.

Harr, D.R.

Effects of Clearcut Logging on Rain-on-Snow Runoff in Western Oregon: A New Look at Old Studies. Draft Copy. Water Resources Research; 1985.

Harris, A.S.; Johnson, David L.

Western Hemlock-Sitka Spruce. In: Burns, Russell M., technical compiler. Silvicultural Systems for the Major Forest Types of the United States. Agriculture Handbook 445. USDA Forest Service; 1983.

Hays, Jim; Barranco, Gary
Introduction to a Timber Sale Statement of Account Data Base (Cut Values) (and associated reports). [In-house papers dealing with timber values for use in Forest Planning.] USDA Forest Service, Rogue River National Forest; 1984.

Hendee, John C., et al.
Wilderness Management. Misc. Pub. 1365. USDA Forest Service; October 1978.

Henderson, Jan A.; Peter, David H.
Preliminary Plant Associations and Habitat Types of the Hoodsport and Quilcene Ranger Districts, Olympic National Forest. Olympia, WA. USDA Forest Service, Pacific Northwest Region; 1983. 146 p.

Preliminary Plant Associations and Habitat Types of the Quinault Ranger District, Olympic National Forest. Olympia, WA. USDA Forest Service, Pacific Northwest Region; 1981. 96 p.

Preliminary Plant Associations and Habitat Types of the Shelton Ranger District, Olympic National Forest. Olympia, WA. USDA Forest Service, Pacific Northwest Region; 1981. 110 p.

Preliminary Plant Associations and Habitat Types of the Soleduck Ranger District, Olympic National Forest. Olympia, WA. USDA Forest Service, Pacific Northwest Region; 1982. 141 p.

Henderson, Jan A.; Peter, David H.; Lesher, Robin D.; Shaw, David C.
Forested Plant Associations of the Olympic National Forest. R6 Ecol. Technical Paper 001-88. USDA Forest Service, Pacific Northwest Region; June 1989.

Howard, James O.
Logging Residue - Volume and Characteristics. Resource Bulletin PNW-44. USDA Forest Service; 1973.

Jackman, Siri M.; Scott, J. Michael (Dr.)
Literature Review of Twenty-three Selected Forest Birds of the Pacific Northwest. USDA Forest Service, Pacific Northwest Region; 1975. 382 p.

Jennings, J. Wesley
Soil Compaction in Perspective. Internal Report. Olympia, WA: Olympic National Forest; 1984.

Jennings, J. Wesley; May, Meredith; Sheehy, Gwen; Darling, Nancy
The Olympic National Forest Soil Resource Inventory Update Report. [One volume periodically updated.] Olympia, WA: Olympic National Forest; 1982.

Johnson, D.R.; Miller, Donald R.; Peek, James M.
Guidelines for Human Activity Within the Range of Mountain Caribou, Southern Selkirk Mountains. Misc. Pub. No. 3. Forest Wildlife, Range Experiment Station, University of Idaho; 1977 (Revised 1981). 7 p.

Johnson, K.
Westside Coordination Meeting Notes. [USDA Forest Service Memo.] 1983.

Johnson, Rolf
[Personal Communication.] State of Washington, Department of Wildlife; 1985.

Johnston, James M.
High Lake and Stream Survey Report, Olympic National Forest, Part I 1972, Part II 1973. Washington State Department of Game (now Wildlife).

Korb, Gary
A Paddler's Guide to the Olympic Peninsula: A Comprehensive Guide to 40 River Runs on Washington's Beautiful Olympic Peninsula. Undated.

Larmar, Inc.
Lake Quinault Lodge Master Plan; May 1983.

Larsen, David N., et al.
1982 Washington Mill Survey: Wood Consumption and Mill Characteristics. Olympia, WA: State of Washington, Department of Natural Resources; 1983.

1986 Washington Mill Survey: Wood Consumption and Mill Characteristics. Olympia, WA: State of Washington, Department of Natural Resources; 1990.

Larson, K.; Sidle, R.
Erosion and Sediment Catalog of the Pacific Northwest. R6-WM-050-1981. 1980.

Larson, W.A.; Evarts, R.C.
Map Showing Mineral Resource Potential of Proposed Wilderness Areas, Washington. Open-file Report OF 84-0347. State of Washington, Division of Geology and Earth Resources; 1984.

Lawrence, Fred
Water Power Resources of Hamma Hamma, Duckabush and Dosewallips Rivers. U.S. Geological Survey Circular 109. Prepared in cooperation with the Department of Conservation and Development. 1952.

Layser, Earle F.
A Review of the Mountain Caribou of Northeastern Washington and Adjacent Northern Idaho. Spec. Res. Iss. No. 3. Jerome: Idaho Academy of Science; 1974. 61 p.

Lewis, Robert C.
Policy Formation and Planning for Outdoor Recreation Facilities. In: Hughes, Jay M.; Lloyd, R. Duane. Advances in Application of Economics, Outdoor Recreation, 62-69. General Technical Report WO-2. USDA Forest Service; 1977.

Loomis, John; Sorg, Cindy
A Critical Summary of Empirical Estimates of the Values of Wildlife, Wilderness, and General Recreation Related to National Forest Regions. Denver, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station; 1982.

Mannan, R.W.
Territory Size and Habitat Preferences of Pileated Woodpeckers in Western Oregon. Ag. Exp. Sta. Tech. Paper 000. Corvallis, OR: Oregon State University; 1982.

Maxwell, Wayne G.; Ward, Franklin R.
Photo Series for Quantifying Forest Residues in the: Coastal Douglas-fir Hemlock Type; Coastal Douglas-fir Hardwood Type. Tech. Report PNW 51. USDA Forest Service; 1976.

McCorkle, David V.
Ecological Investigation Report: Oregon Silverspot Butterfly. September 1980.

McFarland
Oil and Gas Exploration in Washington 1900-1982. Information Circular 75. State of Washington, Department of Natural Resources, Division of Geology and Earth Resources; 1983.

Megahan, W.F.; Platts, W.S.; Kulesza, B.
Riverbed Improves Over Time: South Fork Salmon River. In: Proceedings, Symposium on Watershed Management, Vol. 1; New York: American Society of Civil Engineers; 1980. 380-395.

Meso, Stanley W.
Douglas-fir Cone and Seed Insects. Tree Seed Training Packet Handout No. 4. USDA Forest Service, Pacific Northwest Region; 1978. 18 p.

Miller, Paul R.; McBride, Joe R.
Effects of Air Pollutants on Forests from Responses of Plants to Air Pollution. Academic Press, Inc.; 1975.

Morrison, Peter
Ancient Forests on the Olympic National Forest. The Wilderness Society; May 1990.

Munger, Thornton T.
A look at selective cutting in Douglas-fir. Journal of Forestry. 48(2): 97-99.

Nomura, I.
Long Range Timber Demand/Supply Prospects in Japan and Some Problems. National Forestry and Forest Products Research Institute, Chief of Forest Economy Section; 1981.

Pacific Northwest River Basins Commission
Columbia-North Pacific Region Comprehensive Framework Study of Water and Related Lands, Appendix V, Volume 2. Water Resources. April 1970.

Pacific Northwest River Basins Commission, Hydrology and Hydraulics Committee
--River Mile Index Coastal Tributaries - Pacific Coast Basin, Washington. July 1969.
--River Mile Index Elwha, Dungeness, Little Quilcene, Big Quilcene, Dosewallips, Duckabush, Hamma Hamma and Skokomish Rivers - West Puget Sound Basin, Washington. December 1969.

Pacific Northwest River Basins Commission, Puget Sound Task Force
Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters. 1971.
--Appendix III Hydrology and Natural Environment
--Appendix VI Municipal and Industrial Water Supply
--Appendix VII Irrigation
--Appendix IX Power
--Appendix XII Flood Control

Pacific Northwest Utilities Conference Committee
Pacific Northwest Regional Hydroelectric Power Potential. August 1983.

Parker, Richard, Sequim Water System Superintendent
[Personal Communication.]

Phillips, C.A.; Roberts, R.
Documentation of Wildlife MMRs. [USDA Forest Service Memo.] June 4, 1985.

Phillips, et al.
Wildlife Habitats and Species Management Relationship Program. January 1981.

Pritchard, D.E.
What is an Estuary: Physical Viewpoint. In: Lauf, G.H., ed. Estuaries Pub. No. 83. Washington, DC: American Association for the Advancement of Science; 1967. 3-7.

Reid, L.
Sediment Production from Gravel-surfaced Forest Roads, Clearwater Basin, Washington. Seattle, WA: University of Washington, College of Fisheries, Fisheries Research Institute; March 1981. 247 p. M.S. Thesis.

Richardson, H.W.
Input-Output and Regional Economics. New York: John Wiley and Sons; 1972.

Righter, Elizabeth
Cultural Resource Overview of the Olympic National Forest, Vol. I. Portland: USDA; 1978.

Row, Clark, H; Kaiser, Fred; Sessions, John
Discount Rate for Long-Term Forest Service Investments. 1981.

Ruediger, Bill
[Personal Communication.] Gifford Pinchot National Forest; 1985.

Ruth, R.H.; Harris, A.S.
Management of Western Hemlock-Sitka Spruce Forests for Timber Production. General Technical Report PNW-88. USDA; 1979.

Sandberg, D.V.; Ward, D.E.
Increased Wood Utilization Reduces Emissions from Prescribed Burning, presentation to the 1982 West Coast Regional Meeting, National Council of the Paper Industry for Air and Stream Improvement, Inc. 1982.

Sandberg, David V.; Ward, Franklin R.
Predictions of Fire Behavior and Resistance to Control for Use with Photo Series for the Douglas-fir/ Hemlock Type and the Coastal Douglas-fir/ Hardwood Type. General Technical Report PNW-116. USDA Forest Service; 1981.

Sandberg, Ottmar, et al.
Fuel Consumption and Emissions Studies. Unpublished research notes. Olympic National Forest and other sites; 1989.

Schalk, Randall; Yesner, David
The Evolution and Diversification of Native Land Use Systems on the Olympic Peninsula: A Research Design. Submitted to National Park Service. Contract No. CX-900-4-E075. 1988.

Schallau, Con H.
Preliminary Working Papers and Data on the South, and the Pacific Northwest. Corvallis, OR: USDA Forest Service, Pacific Northwest Forest and Range Experiment Station; 1985 and 1986.

Schwarzbart, G.; Schmitz, P.L.
Methods for Evaluating Energy Effects of Forest Management Alternatives, Vol. I. Berkeley, CA: USDA Forest Service, Management Sciences Staff; March 1982.

Servheen, Christopher
Grizzly Bear Ecology and Management in the Mission Mountains, Montana. University of Montana; 1981. Ph.D. Thesis

Smith D.
The Practice of Silviculture. New York: John Wiley and Sons, Inc.; 1962. 578 p.

Snyder, Robert V.; Bush, George S.; Wade, John M.
Olympic National Forest Soils Resource Management Survey Report. Olympia, WA: Olympic National Forest; 1969. 158 p. with Atlas.

Sollins, Phillip
Input and Decay of Coarse Woody Debris in Coniferous Stands in Western Oregon and Washington. Canadian Journal of Forest Research. 12(1): 18-28; 1982.

Stallard, Bruce; Denman, Clayton
An Archaeological Site Survey on the Coast of Western Washington. Report on file. Seattle, WA: National Park Service, Pacific Northwest Regional Archaeologist's Office; 1955.

Stephens, R.K.
Effects of Forest Fertilization on Small Streams on the Olympic National Forest. Unpublished Report. Olympia, WA: Olympic National Forest; Spring 1976. 36 p.

Procedure to Estimate Sediment Yields for Watersheds on the Olympic National Forest. Unpublished Report. Olympia, WA: Olympic National Forest; April 1984. 30 p.

Water Temperature of Olympic National Forest Streams in Relation to Timber Harvesting. Unpublished Report. Olympia, WA: Olympic National Forest; 1974. 32 p.

Stevenson, Susan K.
Effects of Selective Logging on Arboreal Lichens Used by Selkirk Caribou. Province of British Columbia. Ministry of Forestry; 1979.

Suttles, Wayne
Economic Life of the Coast Salish Indians of Haro and Rosario Straits. University of Washington; 1951. Ph.D. Dissertation.

Swanston, D.; Swanson, F.
Timber Harvesting, Mass Erosion, and Steepland Forest Geomorphology in the Pacific Northwest. In: Coates, Donald R., ed. Geomorphology and Engineering. Strovdsburg, PA: Dowden, Hutchinson and Ross, Inc.; 1976. 199-221.

Tabor, R.W.; Cady, W.M.
Geology Map of the Olympic Peninsula, WA versus Geological Survey Map I - 994; 1978. 1:125,000.

Taber, Richard D.; Radaeke, Kenneth J.
Black-Tailed Deer of the Olympic National Forest. Final report to Olympic National Forest. Seattle, WA: University of Washington, College of Forest Resources; 1980. 90 p.

Status Report - Roosevelt Elk of the Olympic National Forest. Final Report to USDA Forest Service. Pacific Northwest Region, Olympic National Forest; February 1980. 107 p.

Teply, John L.
The Development and Projection of Standing Yield Tables, Region 6. Rough Draft. Portland, OR: USDA Forest Service, Pacific Northwest Region; 1976.

Theisen, Peter A.
Cone and Seed Insects. Tree Seed Training Packet Handout No. 5; USDA Forest Service, Pacific Northwest Region; 1976. 6 p.

Thomas, Jack Ward
Wildlife Habitats in Managed Forests: The Blue Mountains of Oregon and Washington. Agriculture Handbook No. 553. Washington, DC: USDA Forest Service; Edited 1979.

USDA Forest Service
A Method for Predicting Fish Response to Sediment Yields. Intermountain and Northern Regions. Working draft document. 1980.

A Report on Minimum Management Requirements for Forest Planning on the National Forests of the Pacific Northwest Region. June 1986.

America's Renewable Resources: A Supplement to the 1979 Assessment of the Forest and Range Land Situation in the United States. Washington, DC: RPA Staff; 1984.

Analysis of the Management Situation. Olympia, WA: Olympic National Forest; 1985.

Cultural Resource Overview of the Olympic National Forest, Washington, Volumes I and II. Olympic National Forest; 1978.

Draft Environmental Impact Statement, 1985-2030 Resources Planning Act Program, Appendix F. Washington, DC. 1984.

Ecoclass Coding System for Pacific Northwest Plant Associations. Pacific Northwest Region. 1988.

Effects of Fire on Soil. General Technical Report WO-7. 1979. 34 p.

Final Environmental Impact Statement for Managing Competing and Unwanted Vegetation. Portland, OR: Pacific Northwest Region; 1988.

Final Environmental Statement, Canal Front Planning Unit. Olympic National Forest. May 1979.

Final Environmental Statement, Quinault Planning Unit. Olympic National Forest. July 1976.

Final Environmental Statement, Soleduck Planning Unit. Olympic National Forest. March 1975.

Final Environmental Statement; Timber Resource Management Plan: Shelton Cooperative Sustained Yield Unit, Olympic National Forest; Cooperative Agreement. 1978. 149-164.

Forest Service Handbook 1109.12, Directive Preparation Handbook, Chapter 1, 1.31, Directive Writing Standards.

Forest Service Handbook 2309.11, RIM Handbook.

Forest Service Manual 1970--Economic and Social Analysis.

Forest Service Manual 2469--1 to 2469--6, Policy Statement for the Grays Harbor Federal Sustained Yield Unit. Olympic Supplement No. 86. 1984.

Forest Service Manual 2526, Riparian Area Management. R-6 Supplement 51. June 1987.

Forest Service Manual 2530.3. Region 6 Supplement 33. March 1985.

General Water Quality Best Management Practices. Pacific Northwest Region; November 1988.

Grizzly Bear Initiative 1984-1988. Northern Region. 1984.

Guidelines for Predicting Sediment Yields. Northern and Intermountain Regions. Ogden, UT: Intermountain Region, Division of Soil and Watershed Management; 1980. 110 p.

IMPLAN User's Guide; USDA Forest Service, Land Management Planning Systems. Ft. Collins, CO. 1983.

Inventory of Native American Religious Use, Practices, Localities and Resources; Mt. Baker-Snoqualmie National Forest; April 1981.

Management of Wildlife and Fish Habitat in Forests of Oregon and Washington. Publication No. R6-F and WL-192-1985, Part 1. Portland, OR: Pacific Northwest Region; June 1985. 332 p.

National Forest Landscape Management, Vol. I, USDA Handbook 434, February 1973; Vol. II, USDA Handbook 462, April 1974. (U.S. Government Printing Office, Washington, DC.)

Nature and Basis of Rights and Privileges of Northwest American Indians. Pacific Northwest Region; September 1982.

New Wilderness Study Areas, Roadless Area Review and Evaluation. October 1973.

Olympic National Forest Road Management Plan. Olympic National Forest. Olympia, WA. 1983.

Pacific Northwest Region, Draft Pacific Northwest Region Plan. Portland, OR. 1981.

Pacific Northwest Region, Region Six Appraisal Handbook. Portland, OR. 1983 edition.

Pacific Northwest Region, Region Six Direction for Land and Resource Management Planning. Portland, OR. 1983.

Pacific Northwest Region, Region Six Westside Logging Cost Guide. Portland, OR. 1983 edition.

RARE II Final Environmental Statement, Roadless Area Review and Evaluation. January 1979.

Recreation Information Management (RIM) Report 2300-1. Olympic National Forest; 1980.

Recreation Information Management (RIM). [Developed Site Visitor Days and Dispersed Visitor Days Use Computer Printouts by Year.] Olympic National Forest.

Regional Guide for the Pacific Northwest Region:

Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide (Two Volumes): Spotted Owl Guidelines (SEIS). Portland, OR: Pacific Northwest Region; 1988.

Final Environmental Impact Statement for the Pacific Northwest Regional Guide. Portland, OR: Pacific Northwest Region; 1984.

Regional Guide for the Pacific Northwest Region. Portland, OR: Pacific Northwest Region; 1984.

ROS Users Guide. Undated.

Uneven-aged silviculture and management in the United States. In: Proceedings, In-Service Workshop; 1975 July 15-17; Morgantown, WV; and, In-Service Workshop; 1976 October 19-21; Redding, CA. Washington, DC: USDA Forest Service, Timber Management Research; February 1978. 234 p.

Wild, Scenic and Recreation Rivers Eligibility Inventory and Evaluation, Analysis of the Management Situation. Pacific Northwest Region, Fremont National Forest; 1983.

USDA Soil Conservation Service

Soil Survey Manual. USDA Handbook 430-V. [One volume periodically updated.] 1981.

Soil Taxonomy: A Basic System of Soil Classification for Making and Interpreting Soil Surveys. USDA Handbook 436. 1975. 754 p.

U.S. Army Corps of Engineers

Pumped-Storage in the Pacific Northwest, An Inventory. North Pacific Division; January 1976.

U.S. Department of Commerce, Bureau of the Census

1980 Census: Social, Economic, and Housing Characteristics--Washington and Its Counties. Olympia, WA: State of Washington, Office of Financial Management, Forecasting and Estimation Division; 1982.

U.S. Department of Energy

U.S. Energy Consumption 1987. Annual Energy Review. 1988.

U.S. Environmental Protection Agency

An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources. A Procedural Handbook. Handbook EPA-600. Athens, GA: Environmental Research Laboratory; 1980.

Final Report on the Federal/State/Local Nonpoint Source Task Force and Recommended National Nonpoint Source Policy. Washington, DC: Office of Water; 1985. p. 17.

Nonpoint Source Controls and Water Quality Standards. Water Quality Standards Handbook, Chapter 2, General Program Guidance. August 19, 1987. 2-25.

USDI Federal Water Pollution Control Administration

Report of the Committee on Water Quality Criteria. April 1, 1968.

USDI Fish and Wildlife Service

Aleutian Canada Goose Recovery Plan. December 1978.

Bald Eagle Management Guidelines for Oregon and Washington. Portland, OR. November 1981.

Brown Pelican Recovery Plan. February 1983.

Draft Bald Eagle Recovery Plan. 1982.

Oregon Silverspot Butterfly Recovery Plan. 1982.

Pacific Coast Recovery Plan for the American Peregrine Falcon. August 1982.

USDI Heritage Conservation and Recreation Service

Nationwide Rivers Inventory: A Report on Natural and Free-Flowing Rivers in the Northwestern United States. Northwest Region. August 1980.

Preservation Planning Series: Resource Protection Planning Process. Division of State Grants and Plans; September 1980.

USDI National Park Service

Proposed Master Plan, Final Environmental Statement. Northwest Region. Olympic National Park; June 30, 1976.

The Nationwide Rivers Inventory. Washington, DC: January 1982.

USDI Water and Power Resources Service

Western States Inventory of Low-Head Hydroelectric Sites Report. October 1980.

Washington, State of

Selected Laws Administered by Department of Natural Resources. 1979.

Washington Natural Heritage Program Data Base 1989, Area Ecology Data Base.

Washington State Forest Practices Act, Chapter 76.09, Revised Code of Washington. 1974.

Washington State Site Inventory. Olympia, WA: Office of Archaeology and Historic Preservation; Undated.

Washington State Department of Ecology

Proposed Washington State Implementation Plan Supplement to the Federal Clean Air Act of 1963. Amended. 1984.

Washington State Department of Fisheries

A Catalog of Washington Streams and Salmon Utilization. November 1975.
--Volume 1, Puget Sound
--Volume 2, Coastal Region

Washington State Department of Natural Resources

An Illustrated Guide to the Endangered, Threatened and Sensitive Vascular Plants of Washington. Washington Natural Heritage Program, Division of Lands and Water Conservation; 1984. 29 p.

Forest Land Management Program; Draft Environmental Impact Statement. 1979.

Forest Land Management Program; Final Environmental Impact Statement. Olympia, WA: 1983.

State of Washington Natural Heritage Plan. Olympia, WA: 1989. 164 p.

Washington Forest Resource Plan. 1985.

Washington State Department of Wildlife
Strategies for Washington's Wildlife. Olympia, WA. 1982. 139 p.

Washington State Interagency Committee for Outdoor Recreation
Washington Statewide Comprehensive Outdoor Recreation Plan (SCORP). Fifth Edition. Olympia, WA: 1979.

Washington State Parks and Recreation Commission
Washington State Scenic River Assessment. September 1980.

Washington Water Research Center
Assessment of Potential Hydroelectric Power and Energy for the State of Washington, Vol. III. 1981.

Wessen, Gary C.
Archaeological Reconnaissance and Appraisal of the Proposed North Shore Lake Quinault Deletion, Olympic National Park, Washington. Project Report 64. Washington Archaeological Research Center; 1978.

Wessen, Gary; Gallison, James D.; Virden, Jenel
A Cultural Resource Survey of a Portion of the Upper Canyon Creek Area, Quilcene District, Olympic National Forest. Submitted to USDA Forest Service, Contract No. 52-052-4-02954-N. Olympia: Western Heritage; 1985.

A Report of an Archaeological Surface Collection at Slab Camp, Quilcene District, Olympic National Forest, Washington. Submitted to USDA Forest Service. Olympia, WA: Western Heritage; 1986.

Wilderness Society, The
End of the Ancient Forests: Special Report on National Forest Plans in the Pacific Northwest. June 1988.

Willard, E.E.; Herman, Margaret
Grizzly Bear and Its Habitat. USDA Forest Service. No date.

Williamson, R.W.; Twombly, Asa D.
Pacific Douglas-fir. In: Burns, Russell M., technical compiler. Silvicultural Systems for the Major Forest Types of the United States. Agriculture Handbook 445. Washington, DC: USDA; 1983.

Wood, Robert L.
Across the Olympic Mountains: The Press Expedition, 1889-90. Seattle: The Mountaineers and University of Washington Press; 1967.

Men, Mules, and Mountains. Seattle: The Mountaineers; 1976.

Olympic Mountains Trail Guide, National Park and National Forest. 1984.

Trail Country Olympic National Park. Seattle: The Mountaineers; 1968.

Young, Raymond A.
Introduction to Forest Science: Forest Areas of the World, Table 2-1; World Wood Production, Table 20-2. J. Wiley and Sons; 1982.

Abbreviations and Acronyms

Olympic National Forest

ABBREVIATIONS AND ACRONYMS

* Term is defined in Glossary

AA	Analysis Area *
Ac.	Acre *
ADT	Average Daily Traffic *
AF	Acre-Foot *
AMS	Analysis of the Management Situation *
ASQ	Allowable Sale Quantity *
ATV	All-Terrain Vehicle *
AUM	Animal Unit Month *
BA	Botanical Area *
BEMA	Bald Eagle Management Area *
BF	Board foot *
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management *
BMP	Best Management Practices *
BTU	British Thermal Unit *
CC	Clearcut *
CCC	Civilian Conservation Corps
CEQ	U.S. Council on Environmental Quality *
CF	Cubic Feet *
CFL	Commercial Forest Land *

CFR	U.S. Code of Federal Regulations *
CFS	Cubic feet per second
CMAI	Culmination of Mean Annual Increment *
CRM	Cultural Resource Management
CRT	Cultural Resource Technician
CSYU	Cooperative Sustained Yield Unit
CT	Commercial Thinning
DBH	Diameter at Breast Height *
DEIS	Draft Environmental Impact Statement *
DFSIM	Douglas-fir Growth and Yield Simulator
DNR	Washington State Department of Natural Resources
DOE	Washington State Department of Ecology or Department of Energy
DSEIS	Draft Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide (Spotted Owl Guildlines)
EA	Environmental Analysis or Environmental Assessment *
EIS	Environmental Impact Statement *
EPA	Environmental Protection Agency *
EVC	Existing Visual Condition *
FERC	Federal Energy Regulatory Commission
FEIS	Final Environmental Impact Statement *
FIL	Fire Intensity Level *

ABBREVIATIONS AND ACRONYMS

* Term is defined in Glossary

AA	Analysis Area *
Ac.	Acre *
ADT	Average Daily Traffic *
AF	Acre-Foot *
AMS	Analysis of the Management Situation *
ASQ	Allowable Sale Quantity *
ATV	All-Terrain Vehicle *
AUM	Animal Unit Month *
BA	Botanical Area *
BEMA	Bald Eagle Management Area *
BF	Board foot *
BIA	U.S. Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management *
BMP	Best Management Practices *
BTU	British Thermal Unit *
CC	Clearcut *
CCC	Civilian Conservation Corps
CEQ	U.S. Council on Environmental Quality *
CF	Cubic Feet *
CFL	Commercial Forest Land *

CFR	U.S. Code of Federal Regulations *
CFS	Cubic feet per second
CMAI	Culmination of Mean Annual Increment *
CRM	Cultural Resource Management
CRT	Cultural Resource Technician
CSYU	Cooperative Sustained Yield Unit
CT	Commercial Thinning
DBH	Diameter at Breast Height *
DEIS	Draft Environmental Impact Statement *
DFSIM	Douglas-fir Growth and Yield Simulator
DNR	Washington State Department of Natural Resources
DOE	Washington State Department of Ecology or Department of Energy
DSEIS	Draft Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide (Spotted Owl Guildlines)
EA	Environmental Analysis or Environmental Assessment *
EIS	Environmental Impact Statement *
EPA	Environmental Protection Agency *
EVC	Existing Visual Condition *
FERC	Federal Energy Regulatory Commission
FEIS	Final Environmental Impact Statement *
FIL	Fire Intensity Level *

FMAS	Fire Management Analysis System
FMEI	Fire Management Efficiency Index
FORPLAN	FOrest PLANning Model *
FSEIS	Final Supplement to the Environmental Impact Statement (See DSEIS)
FSH	Forest Service Handbook *
FSM	Forest Service Manual *
FSYU	Federal Sustained Yield Unit *
F&WL	Fish and Wildlife
GIS	Geographic Information System
GWh	Gigawatt hours (of energy).*
HCI	Habitat Capability Index *
HCRS	Heritage Conservation and Recreation Service
HCV	High Clearance Vehicle
HEI	Habitat Effectiveness Indices
HQI	Habitat Quality Index *
ICO	Issues, Concerns and Opportunities *
IDT	Interdisciplinary Team *
IPM	Integrated Pest Management *
IRAA	Integrated Resource Analysis Area *
KV	Knudson-Vanderberg
LAC	Limit of Acceptable Change *
LOD	Large Organic Debris *

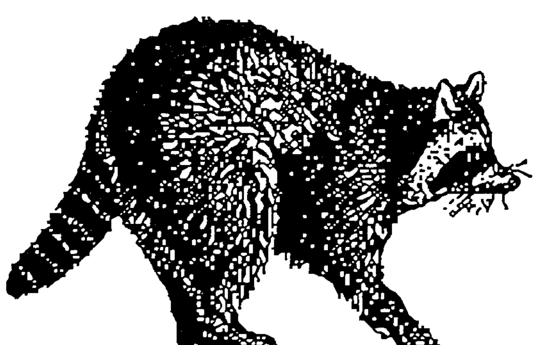
LTSYC	Long-Term Sustained Yield Capacity *
M	Modification *
M	Thousand
MAI	Mean Annual Increment *
MBF	One Thousand Board Feet
MCF	One Thousand Cubic Feet
MM	Maximum Modification *
MM	Million
MMBF	One Million Board Feet
MMCF	One Million Cubic Feet
MOU	Memorandum of Understanding *
MPN	Most Probable Number
MR	Management Requirement *
MSH	Maximum Sustained Harvest
NAS	National Accounting System
NDF	Nondeclining Flow (of timber volume) *
NEPA	(The) National Environmental Policy Act *
NF	National Forest *
NFMA	(The) National Forest Management Act *
NFS	National Forest Systems *
NOVA	Non-Highway Off-Road Vehicle Activity
NRT	National Recreation Trail *
NTU	Nephelometric Turbidity Unit
OG	Old-Growth (timber) *
ONF	Olympic National Forest

ONP	Olympic National Park
ORV	Off-Road Vehicle *
P	Preservation *
PAOT	Persons At One Time (Capacity) *
PCT	Precommercial Thinning *
PETS	Proposed Endangered, Threatened or Sensitive Species
PNV	Present Net Value *
PPM	Parts per million
PR	Partial Retention *
R	Retention *
RAM	Resource Allocation Model *
RARE II	The Second Roadless Area Review and Evaluation *
RD	Ranger District
RIM	(Forest Service) Recreation Information Management (system) *
R.M.	River Mile
RNA	Research Natural Area *
RO	Regional Forester's Office (Forest Service)
ROD	Record of Decision *
ROS	Recreation Opportunity Spectrum *
RPA	The (U.S.) Forest and Rangeland Renewable Resources Planning Act*
RVD	Recreation Visitor Day *
R/W	Right-of-Way *

S&Gs	Standards and Guidelines
SCORP	The Washington Statewide Comprehensive Outdoor Recreation Plan
SCSYU	Shelton Cooperative Sustained Yield Unit *
SHPO	Washington State Historic Preservation Officer, or the State of Washington Office of Archaeology and Historic Preservation.
SMU	Streamside Management Unit *
SO	Supervisor's Office (National Forest)
SOHA	Spotted Owl Habitat Area *
SPS	Stand Projection System
SRI	Soil Resource Inventory *
STARS	Sale Tracking and Reporting System
T&E	Threatened and Endangered Species *
T,E&S	Threatened, Endangered and Sensitive Species
TFW	Timber, Fish and Wildlife for non-Federal lands in the State of Washington
TIS	Transportation Inventory System
TSI	Timber Stand Improvement *
TSP	Total Suspended Particulates *
TSPIRS	Timber Sale Program Information Reporting System
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
VAC	Visual Absorption Capacity *
VQO	Visual Quality Objective *

WC	Working Circle *
WDF	Washington State Department of Fisheries
WDW	Washington State Department of Wildlife
WFUD	Wildlife and Fish User Day *
WIZ	Water Influence Zone *
WNH	Washington State Natural Heritage
WRS	Wilderness Resource Spectrum *
W&SRA	Wild and Scenic Rivers Act

Glossary



Olympic National Forest

GLOSSARY

Many of the definitions in this glossary are referenced to the following sources. The sources are identified by a number in parentheses following most glossary definitions. The glossary definition number corresponds to the list below. Some other terms will be referenced to Forest Service Manuals (FSM), Forest Service Handbooks (FSH), or other sources which are too numerous to list. Finally, many other definitions are not referenced, but are those in general use on the Forest.

SOURCE LIST

(1) 36 CFR 219 National Forest Management Act Regulations.
(2) Regional Guide for the Pacific Northwest Region, 1984.
(3) Forestry Terminology, A Glossary of Technical Terms Used in Forestry, Society of American Foresters 1971.
(4) The Random House College Dictionary, Revised Edition, 1975.
(5) Webster's New International Dictionary, 1957.
(6) Wildland Planning Glossary, Pacific Southwest Forest and Range Experiment Station, USDA Forest Service, General Technical Report PSW 13/1976.
(7) Webster's Third New International Dictionary, 1981.
(8) Wildlife Habitats in Managed Forests, The Blue Mountains of Oregon and Washington, 1979.
(9) A Glossary of Terms Used in Range Management.
(10) Forest Service Manual or Forest Service Handbook.
(11) A Dictionary of Statistical Terms, Third Edition, M.G. Kendal and W. R. Buckland.
(12) An Approach to Water Resources Evaluation of Non-Point Silvicultural Sources (CA Procedural Handbook), Environmental Protection Agency, Report #EPA-IAG-D6-0660, 8/80.
(13) Ecology Field Glossary - A Naturalists Vocabulary, Walter H. Lewis.
(14) Eric Forsman, Consulting Wildlife Biologist, Olympia WA.
(15) Glossary of Engineering Terms, Pacific Northwest Forest and Range Experiment Station, USDA Forest Service, 1979.
(16) Management of Wildlife and Fish Habitats in Forest of Western Oregon and Washington, USDA Forest Service, Pacific Northwest Region, 1985.
(17) National Forest Landscape Management, Volume 2, the Visual Management System, Chapter 1.
(18) New American Dictionary.
(19) Random House Dictionary of the English Language, College Edition, 1969.
(20) Webster's New Collegiate Dictionary.

A

Abnormally heavy storms - Storms with a 10- to 100-year return period. That is, a 10-year storm occurs on the average of once every 10 years, a 20-year storm occurs on the average of once every 20 years, and so forth.

Access - Usually refers to a road or trail route over which a public agency claims a right-of-way for public use; a way of approach. (4)

Acquired lands - Lands added to the National Forest system by purchase, transfer, or donation under authority of the *Weeks Law* or related acts. Also, lands obtained by the Forest Service by exchange for other acquired lands.

Acre (Ac.) - A unit of area of land measurement equal to 43,560 square feet. (20)

Acre equivalent - Used to adjust actual acres of habitat improvement or improvement structures to reflect overall habitat benefits derived. It reflects the zone of influence of the habitat improvement for the benefiting species. (2)

Acre-foot (AF) - A measure of water or sediment volume, equal to the amount which would cover an area of one acre to a depth of one foot (i.e., 43,560 cubic feet or 325,851 gallons). (6)

Activity - An action, measure or treatment undertaken that directly or indirectly produces, enhances, or maintains forest and rangeland outputs, or achieves administrative or environmental quality objectives (FSM 1309, Management Information Handbook). An activity can generate multiple outputs. (2)

Activity fuels - Fuels generated or altered by a management activity. (10)

Administrative site - Buildings and other facilities which are used in the management of a National Forest.

Administrative unit - An area under the administration of one line officer, such as a District Ranger, Forest Supervisor, or Regional Forester. (6)

Aerial logging system - A timber yarding system employing aerial means, e.g., balloons or helicopters, to lift the log or logs. (3)

Age class - The average age of a timber stand, usually expressed in decades. (3)

Age group distribution - Age class distribution; the location and/or proportionate representation of different age classes in a forest. (3)

Airshed - A geographic area that, because of topography, meteorology, and climate, shares the same air. (2)

Allocation - See *Land Use Allocation* or *Resource Allocation*.

Allotment - Usually associated with grazing permits. A permitted area for grazing a specified number of cows, sheep, or horses for a special duration.

Allowable sale quantity (ASQ) - The quantity of timber that may be sold, from the area of suitable land covered by the Forest Plan, for a time period specified by the Plan. This quantity is usually expressed on an annual basis as the "average annual allowable sale quantity." (6) (1)

All-terrain vehicle (ATV) - A vehicle characterized by its ability to negotiate most kinds of terrain, by virtue of traction devices such as wide tracks, large, low-pressure rubber tires and/or four-wheel drive.

Alternative - One of several policies, plans, or projects proposed for decisionmaking. (2) (10)

Amenity - An object, feature, quality, or experience that gives pleasure or is pleasing to the mind or senses. The terms "amenity values" or "amenity resources" are typically used in land management planning to describe those resources for which monetary values are not or cannot be established (such as clean air and water, or scenic quality).

Anadromous fish - Those species of fish that mature in the sea and migrate into streams to spawn. Salmon, steelhead, and sea-run cutthroat trout are examples.

Analysis area (AA) - A delineated area of land subject to analysis of: (1) responses to proposed management practices in the production, enhancement, or maintenance of forest and rangeland outputs and environmental quality objectives, and (2) economic and social impacts. (FSM 1905) Tracts of land with relatively homogeneous characteristics in terms of the outputs and effects that are being analyzed in the FORPLAN model. (See FEIS Appendix B, Section entitled "Development of Analysis Areas.")

Analysis of the management situation (AMS) - A determination of the ability of the planning area to supply goods and services in response to society's demand for those goods and services. (6)

Animal Unit Month (AUM) - The amount of forage required by one mature (1,000 lb.) cow or its equivalent for one month (based upon average forage consumption of 26 lbs. dry matter per day). Animal Month is one month's use and occupancy of the range by one animal. For grazing fee purposes, it is a month's use and occupancy of range by one weaned or adult cow with or without calf, bull, steer, heifer, horse, burro, or mule, or five sheep or goats. (6)

Annual sale quantity (ASQ) - The quantity of timber that may be sold annually from the area of suitable land covered by the Forest Plan. (See also *Allowable Sale Quantity*.)

Anomalies - A deviation from the common rule, type, or form. An incongruity or inconsistency. (4)

Appropriated funds - Monies authorized by an act of Congress which permit Federal agencies to incur obligations and to make payments out of the U.S. Treasury for specified purposes.

Aquaculture - The cultivation of the natural produce of water. An example is commercial oyster cultivation. (20)

Aquatic ecosystems - Stream channels, lakes, marshes or ponds, and the plant and animal communities they support.

Aquifer - A geological formation or structure that contains water in sufficient quantity to supply needs for water development. (6)

Artifact - An object made or modified by humans. (4)

Assigned values - Monetary values given to nonmarket resources, based on estimates from comparable market transactions. For example, the benefits of dispersed recreation are given assigned monetary values for their production.

Association (wildlife) - A group of wildlife species whose requirements for habitat are satisfied by similar successional stages within given plant communities.

Available forest land - Land which has not been legislatively or administratively withdrawn by the Secretary of Agriculture or Forest Service Chief from timber production.

Average Daily Traffic (ADT) - The average 24-hour volume of traffic, being the total volume of traffic during a stated period divided by the number of days in that period. (6)

B

Background - See *Distance Zone.*

Bald Eagle Management Areas (BEMAs) - Areas managed for the protection of the bald eagle. BEMA's provide nesting, roosting and foraging habitat for the bird on each plot.

Basal area - The area of the cross-section of a tree stem near the base, generally at breast height and inclusive of bark. (3)

Base sale schedule - A timber sale schedule formulated on the basis that the quantity of timber planned for sale and harvest for any future decade is equal to or greater than the planned sale and harvest for the preceding decade, and this planned sale and harvest for any decade is not greater than the long-term sustained yield capacity. (This definition expresses the principle of nondeclining flow.) (1)

Basic resource - One of the principal resources; a resource upon which the production of other resources is dependent; e.g., the production of vegetation is dependent upon basic resources such as soils and water.

Benchmark - The analytical basis from which the alternatives were developed. The use of assessed land capability as a basis from which to estimate the effects of alternative patterns of management on the land. (6)

Benchmark - Reference points that define the bounds within which feasible management alternatives can be developed. Benchmarks may be defined by resource output or economic measures.

Benefit (value) - Inclusive terms used to quantify the results of a proposed activity, project or program expressed in monetary or nonmonetary terms. (10) Also:

1. *Direct benefit.* A primary benefit that responds to specified objectives of the policy, program, project, or expenditure. (10)

2. *Induced benefit.* A primary benefit that is incidental to the objectives of the policy, program, project, or expenditure. (10)

3. *Primary benefit.* A benefit accruing to resource owners from a primary output and that may be direct or induced or may be a residual asset. Primary benefits are components of net public benefits. (10)

4. *Secondary benefit.* A benefit accruing to parties other than the resource owners, including effects on local, Regional, and national economies and consumers. Secondary benefits are not necessarily included in net public benefits. (10)

Benefit/cost ratio - A measure of economic efficiency computed by dividing total discounted primary benefits by total discounted economic costs. (10)

Best Management Practices (BMP) - A practice or combination of practices that is determined by a State (or designated area-wide planning agency) after problem assessment, examination of alternative practices, and appropriate public participation, to be the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals (Federal Register, Volume 40, No. 230 dated 11/28/75).

Big game - Large mammals hunted for sport. On the National Forest these include animals such as deer, elk, and bear. (8)

Big game summer range - An area, usually at higher elevations, used by deer and elk during the summer. Summer ranges are usually much more extensive than winter ranges. (8)

Big game winter range - An area, usually at lower elevations, used by migratory deer and elk during the winter months; usually more clearly defined and smaller than summer ranges. (8)

Biological control - A method to control insect populations or tree diseases through the use of applied technology. Also used in noxious plant control. (3)

Biological growth potential - The average net growth attainable in a fully stocked natural forest stand. (1)

Biological potential - The maximum production of a selected organism that can be attained under optimum management. (8)

Biomass - The total quantity (at a given time) of living organisms of one or more species per unit of space (species biomass), or of all the species in a biotic community (community biomass).

Biosphere - The part of the world in which life can exist including parts of the lithosphere, hydrosphere and atmosphere. (7)

Blowdown - A tree or trees uprooted or felled by wind.

Board foot (BF) - The amount of wood equivalent to a piece of wood one foot by one foot by one inch thick. (3)

Board foot/cubic foot conversion ratio - Both board foot and cubic foot volumes can be determined for timber stands. The number of board feet per cubic foot of volume varies with tree species, diameter, height, and form factors. A specific factor by species is applied to the cubic foot FORPLAN outputs to give board foot estimates.

Botanical Area - A designated area which contains specimens or groups of plants, and plant communities which are significant because of form, color, occurrences, habitat, location, life history, arrangement, ecology, environment, rarity and/or other features.

British Thermal Unit (BTU) - The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2 degrees F. (20)

Broadcast burn - A prescribed fire over a designated area within well-defined boundaries for reduction of fuel hazard or as a silvicultural treatment, or both.

Browse - Twigs, leaves, and young shoots of trees and shrubs on which animals feed; in particular, those shrubs which are used by big game animals for food. (6)

Brush - A growth of shrubs or small trees usually of a type undesirable to livestock or timber management.

Bureau of Land Management (BLM) - An agency within the Department of the Interior, with land management responsibility for the Public Domain lands.

C

Cable logging - Refers to methods used to skid or pull logs to a central landing or collection area by a cable connected to a remote power source. (6)

Canopy - The more-or-less continuous cover of branches and foliage formed collectively by the crown of adjacent trees and other woody growth. (3)

Capability - The potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices at given levels of management intensity. Capability depends upon current conditions and site conditions such as climate, slope, landform, soils and geology, as well as the application of management practices, such as silviculture or protection from fire, insects, and disease. (1)

Capability area - Geographic delineations used to describe characteristics of the land and resources in integrated forest planning. Capability areas may be synonymous with ecological land units, ecosystems, or land response units. (10)

Capital formation - Used in IMPLAN as the value of purchases from sectors both inside and outside the Region by individuals, governments, and industries in the area as investment (land, plant, and equipment used in production processes). (10)

Capital investment - Activities that create or improve capital assets for desired benefits during several planning periods. (10)

Carrying capacity - 1) The number of organisms of a given species and quality that can survive in, without causing deterioration of, a given ecosystem through the least favorable environmental conditions that occur within a stated interval of time. 2) In recreation, refers to the number of people that can occupy an area for a given social and experience goal. 3) In range, refers to the maximum stocking rate possible on a given range without causing deterioration to vegetation or related resources. (3)

Cavity - The hollow excavated in trees by birds or other natural phenomena; used for roosting, food storage, and reproduction by many birds and mammals. (2)

Cavity-dependent species - A wildlife species that digs or chips out cavities in wood to provide itself or its mate with a site for nesting, roosting, or foraging. (16)

Channel or stream scour - Erosion of the channel bottom caused by high flows of water, loss of channel stability, or debris torrents.

Characteristic landscape - In reference to the USDA Forest Service visual management system; the overall impression created by a landscape's unique combination of visual features (land, vegetation, water, structures), as seen in terms of form, line, color and texture; synonymous with "visual landscape character." (6)

Chargeable volume - All timber volume included in the growth and yield projections for the selected management prescriptions used to arrive at the allowable sale quantity, based on regional utilization standards. (10)

Clearcut (CC) - The cutting method that describes the silviculture system in which the old crop is cleared over a considerable area at one time. Regeneration then occurs from (a) natural seeding from adjacent stands, (b) seed contained in the slash or logging debris, (c) advance growth, or (d) planting or direct seeding. An even-aged forest usually results. (3)

Climatic regimes - A generalized climatic classification which applies to a specific land area; generally that area can be expected to experience that kind of climate in any given year.

Climax - The culminating stage in plant succession for a given site where the vegetation has reached a highly stable condition. (6)

Climax species - Those species that dominate a climax stand in either numbers per unit area or biomass.

Closure - An administrative order restricting either location, timing, or type of use in a specific area.

Coastal Douglas-Fir Zone - The area west of the crest of the Cascade Mountain Range in the States of Oregon and Washington.

Code of Federal Regulations (CFR) - A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. (1)

Commercial Forest Land (CFL) - 1. Historical use in Timber Management (TM) Plans: Forest land that is capable of producing commercial crops of wood not withdrawn from timber use by statute or administrative regulation; includes areas suitable for management to grow crops of industrial wood and generally capable of producing in excess of 20 cubic feet per acre of annual growth; includes both accessible and prospectively accessible areas and both operable and prospectively operable areas. 2. Definition in revised TM Handbook: Land that is producing, or is capable of producing, crops of industrial wood and (1) has not been withdrawn by Congress, the Secretary of Agriculture, or the Chief of the Forest Service; (2) land where existing technology and knowledge is available to ensure timber production without irreversible damage to soil productivity or watershed conditions; and (3) land where existing technology and knowledge, as reflected in current research and experience, provides reasonable assurance that adequate restocking can be obtained within 5 years after final harvesting.

Commercial thinning - Any type of tree thinning that produces merchantable material at least equal in value to the direct costs of harvesting. (3)

Commodities - A transportable resource with commercial value; all resource products that are articles of commerce. (6)

Common varieties - Nonmineralized sand, gravel, stone, etc. (See *Mineral Materials*.)

Community Cohesion - The degree of unity and cooperation evident in a community as it defines problems and attempts to resolve them. (10)

Community Group - An aggregation of individual communities having similar types and patterns of lifestyle and values related to Forest management.

Community stability - A community's capacity to handle change without major hardships or disruptions to component groups or institutions. Measurement of community stability requires identification of the type and rate of proposed change and an assessment of the community's capacity to accommodate that level of change. (10)

Compaction - The packing together of soil particles by forces exerted at the soil surface, resulting in increased soil density.

Composite - A reference to special planning areas designated under the Land and Water Conservation Act of 1965; an area identified for unique recreation and/or fish and wildlife values.

Composite Plan - A documented analysis which, at one time was required to justify the use of Land and Water Conservation Funds for acquisition of private lands within a designated composite.

Concern - A point, matter, or question raised by management that must be addressed in the planning process.

Condition class - 1) Timber: a grouping of timber strata into size-age-stocking classes for Forest planning. 2) Range: one of a series of arbitrary categories used to classify range conditions, usually expressed as excellent, good, fair, or poor. (9)

Congressionally Classified and Designated Areas - Areas that require congressional enactment for their establishment, such as Wildernesses, National Wild and Scenic Rivers, and National Recreation Areas.

Conifer - A tree belonging to the most important order of the Gymnospermae, comprising a wide range of trees that are mostly evergreens. Conifers bear cones (hence coniferous) and needle-shaped or scale-like leaves and produce timber known commercially as softwood. (3)

Constraint - In FORPLAN, a limit (either ceiling or floor) which may be placed on the level of inputs to or outputs from a forest.

Consumptive use - A use of resources that permanently reduces the supply, such as mining. (See also *Nonconsumptive Use*). (6)

Conversion period - The duration of a change from one silvicultural system to another or from one tree species to another. (3)

Core area - An area (as related to the spotted owl) encompassing at least 300 contiguous acres of old growth suitable for nesting and reproduction. The area consists of a pair's territory, in part, the nest site, and principal roost areas.

Corridor - A linear strip of land identified for the present or future location of transportation or utility rights-of-way within its boundaries. (1)

Cost, capital investment - The cost of manmade structures, facilities, or improvements in natural resources used as inputs in production processes to produce outputs over one or more planning periods. (FSM 1905)

Cost-effective - Achieving specified outputs or objectives under given conditions for the least cost. (6)

Cost-efficiency - The usefulness of specified inputs (costs) to produce specified outputs (benefits). In measuring cost efficiency, some outputs, including environmental, economic, or social impacts, are not assigned monetary values, but are achieved at specified levels in the least costly manner. Cost efficiency is usually measured using present net value, although use of benefit-cost ratios and internal rate-of-return may be appropriate. (1)

Costs -

1. *Direct cost.* A cost that directly contributes to the production of primary outputs of an activity, project, or program. (10)

2. *Economic cost.* Total fixed and variable costs for inputs, including costs incurred by other public parties and, if appropriate, opportunity costs and cost savings. (10)

3. *Fixed cost.* A cost that is commited for the time horizon of planning or the decision being considered. Fixed costs include fixed ownership requirements, fixed protection, short-term maintenance, and long-term planning and inventory costs. (10)

4. *Investment cost.* A cost of creating or enhancing capital assets, including costs of administrative or common-use transport facilities and resource management investments. (10)

5. *Joint cost.* A cost contributing to the production of more than one type of output. (10)

6. *Non-Forest Service cost.* A cost of investment and operating activities paid by cooperators or other non-Forest Service agencies which are part of Forest Service management programs, or which contribute to the outputs included in the analysis. (10)

7. *Opportunity cost.* The value of a resource's foregone net benefits in its most economically efficient alternative use. (10)

8. *Unit cost or cost per unit.* Total cost of production divided by the number of units produced. (10)

9. *Variable cost.* A cost that varies with the level of controlled outputs in the time horizon covered by the planning period or decisions being considered. (10)

Cost sensitivity analysis - A type of analysis done to estimate how a particular problem's solution would change if the costs were increased or decreased.

Council on Environmental Quality (CEQ) - An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters. (Abstracted from the National Environmental Policy Act of 1969, as Amended.)

Cover/forage ratio - The mixture of cover and forage areas on a unit of land, expressed as a ratio.

Created opening - An opening in the Forest created by the silvicultural practices of: final removal harvest of shelterwood; clearcutting; seed tree cutting; or group selection cutting. (2)

Crown height - In a standing tree, the vertical distance from ground level to the base of the crown, measured either to the lowest live branch whorl, or to the lowest live branch (excluding shoots arising spontaneously from buds on the stem of a woody plant), or to a point halfway between. (3)

Cubic foot (CF) - The amount of timber (or water) equivalent to a piece of wood (or water) one foot by one foot by one foot. (3)

Culmination of mean annual increment (CMAI) - The age at which average annual growth is greatest for a stand of trees. Mean annual increment is expressed in cubic feet measure, and is based upon expected growth according to the management intensities and utilization standards assumed in accordance with 36 CFR 219.16(a)(2)(i) and (ii). Culmination of mean annual increment includes regeneration harvest yields and any additional yields from planned intermediate harvests. (10)

Cultural resource - The remains of sites, structures, or objects used by humans in the past--historic or prehistoric. (2)

Cumulative effects or impacts - Cumulative effect or impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7 - these regulations use effects and impacts synonymously.)

Current Direction Alternative - This term is often used interchangeably with the "No Action" Alternative required by the National Environmental Policy Act. It is Alternative A in this EIS.

Cutting cycle - The planned lapse of time between successive cuttings in a stand. (6)

D

Data - Any recorded measurements, facts, evidence, or observations reduced to written, graphical, tabular, or computer form. The term implies reliability, and therefore provides an explanation of source, type, precision and accuracy. (6)

Debris slide - A shallow landslide of soil, rock, and organic material that occurs on steep slopes.

Debris torrent - A large debris slide that is charged with water and confined to a steep stream channel. Debris torrents may travel several thousand feet.

Decadent (stands) - Decaying; deteriorating. (4)

Decision Criteria - Essentially the rules or standards used to evaluate alternatives. They are measurements of indicators that are designed to assist a decisionmaker in identifying a preferred choice from an array of possible alternatives.

Deer winter range - See *Big Game Winter Range.*

De facto outputs - Resource outputs produced from lands not necessarily being managed or allocated for the specific production of these outputs. De facto resource outputs are most commonly recreation and wildlife opportunities. For example, an area may not be allocated to emphasize recreation management and, in fact, may be scheduled for timber harvest in a later decade. However, the area can usually continue to provide recreation opportunities until it is entered for harvesting.

De facto supply - In dispersed recreation, those acres that are available for timber harvests but not entered.

Demand - The amount of an output that users are willing to take at a specified price, time period, and condition of sale. (10)

Demand Analysis - A study of the factors affecting the schedule of demand for an output, including the price-quantity relationship, if applicable. (10)

Department of Energy (DOE) - A department of the Executive branch of the Federal Government which oversees national matters involving the development and use of energy.

Departure - A schedule which deviates from the principle of nondeclining flow by exhibiting a planned decrease in the timber sale and harvest schedule at any time in the future. (10)

Dependent communities - Communities whose social, economic, or political life would change in important respects if market or nonmarket outputs from the National Forests were substantially altered.

Designated Area (Air Quality) - Those areas delineated in the Washington Smoke Management Plan as centers of air quality concern.

Design standard - Approved design and construction specifications used mainly for recreation facilities and roads--includes specified materials, colors, dimensions, etc.

Desirable residual vegetation - The remaining vegetation after application of harvest cutting methods that meets management area objectives. The vegetation may be trees, shrubs, grass, or a combination.

Developed recreation - Recreation that requires facilities that, in turn, result in concentrated use of an area. Examples of developed recreation areas are campgrounds and ski areas; facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, ski lifts, and buildings. (2)

Developed recreation site - Relatively small, distinctly defined areas where facilities are provided for concentrated public use; e.g., campgrounds, picnic areas, swimming areas, and downhill ski areas. (6)

Developed Site Management Schedule - A document identifying management direction for operating and maintaining developed recreation sites and their facilities.

Diameter at breast height (DBH) - The diameter of a tree measured 4 feet 6 inches above the ground. (6)

Discount rate - An interest rate that represents the cost or time value of money in determining the present value of future costs and benefits. A "real" discount rate is one adjusted to exclude the effects of inflation. (6) (10)

Discounting - An adjustment, using a discount rate, for the value of money over time so that costs and benefits occurring in the future are reduced to a common time, usually the present, for comparison. (6) FSM 1905

Dispersed recreation - Synonomous with undeveloped recreation. A general term referring to recreation use outside developed recreation sites; this includes activities such as scenic driving, hiking, backpacking, hunting, fishing, snowmobiling, horseback riding, cross-country skiing, and recreation in primitive environments. (2)

Distance zone - One of three categories used in the Visual Management System to divide a view into near and far components. The three categories are:

1. *Foreground* - The visible terrain between the observer and middleground. The detailed landscape found within 0 to 1/4 to 1/2 mile from the observer. (6)

2. *Middleground* - The visible terrain between the foreground and background. The area located from 1/4 to 1/2 to 3 to 5 miles from the observer. (6)

3. *Background* - The visible terrain beyond the middleground where individual trees are not visible, but are blended into the total fabric of the stand. The view beyond 3 to 5 miles from the observer, and as far as the eye can detect objects. (6)

Diversity - The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan. (2) (1)

Doghair stand - Excessively overstocked and stagnated timber stands occupying substantial areas of potentially productive forest land on the east side of the Olympic National Forest.

Douglas-fir Type - An association of tree species in which Douglas-fir is recognized as one of the principal seral species.

Draft Environmental Impact Statement (DEIS) - The draft statement of environmental effects which is required for major federal actions under Section 102 of the National Environmental Policy Act, and released to the public and other agencies for comment and review. (6)

Dry Ravel - The slow to very rapid gravity driven movement of dry soil. Dry ravel usually occurs when the organic materials in the surface layers of the soil are severely altered by fire. Dry ravel occurs most likely where soils are medium to coarse textured and slopes are over 60 percent gradient.

Duff - Organic matter in various stages of decomposition on the floor of the forest. (4)

E

Early forest succession - The early stage or condition of a plant community that occurs during its development from bare ground to climax. (6)

Eastside Zone - The portion of the Olympic National Forest that includes the Hood Canal and Quilcene Ranger Districts.

Economic efficiency - The usefulness of inputs (costs) to produce outputs (benefits) and effects when all costs and benefits that can be identified and valued are included in the computations. Economic efficiency is usually measured using present net value, though use of benefit-cost ratios and rates-of-return may sometimes be appropriate. (10)

Economic growth - Increased economic output in real terms over time. (6)

Economic impacts -

1. *Direct economic impact.* Effects caused directly by forest product harvest or processing or by forest uses. (10)

2. *Indirect economic impact.* Effects that occur when supporting industries sell goods or services to directly affected industries. (10)

3. *Induced economic impact.* Effects that occur when employees or owners of directly or indirectly affected industries spend their income within the economy. (10)

Ecosystem - An interacting system of organisms considered together with their environment; for example, marsh, watershed, and lake ecosystems. (2)

Edge - An area where plant communities meet or where successional stages or vegetation conditions within the plant communities come together. (2)

Effects - Environmental changes resulting from a proposed action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time or further removed in distance, but which are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in this FEIS are synonymous. Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic quality, historic, cultural, economic, social, or healthy effects, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects, even if on balance the agency believes that the effects will be beneficial. (40 CFR 1508.8, 2)

Electronic sites - Formally-designated areas of National Forest System land suitable for the location of electronic communication equipment. Equipment may include: receive-only passive reflectors, antennas, satellite dishes, etc., or transmit/receive facilities for two-way radio, microwave, and AM-FM broadcast characterized by continuous transmission when operating.

Employment - Labor input into a production process, measured in the number of person-years or jobs. A person-year is 2,000 working hours by one person working year long or by several persons working seasonally. (10)

Endangered species - Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act. (6)

Endemic Plant - A plant confined to a certain country or region and with a comparatively restricted geographic distribution.

Ending Inventory Constraint - The standing volume left in the inventory at the end of the planning horizon. The constraint insures that there is enough standing inventory at the end of the planning horizon to perpetuate long-term sustained yield capacity harvest levels on a nondeclining flow basis.

Enhancement - A short-term management practice having the specific purpose of increasing the positive aspects of a resource, such as enhancing scenic variety where little variety now exists.

Environment - The aggregate of physical, biological, economic, and social factors affecting all organisms in an area.

Environmental Analysis (EA) - A comprehensive evaluation of alternative actions and their predictable short- and long-term environmental effects, which include physical, biological, economic, social, and environmental design factors and their interactions. (2)

Environmental Assessment (EA) - The concise public document required by the regulations for implementing the procedural requirements of the National Environmental Policy Act. (40 CFR 1508.9, 2)

Environmental Consequences - The effects upon a given environment as a result of a proposed action.

Environmental Impact Statement (EIS) - A statement of the environmental effects of a proposed action and alternatives to it. It is required for major federal actions under Section 102 of the National Environmental Policy Act (NEPA), and released to the public and other agencies for comment and review. It is a formal document that must follow the requirements of NEPA, the Council on Environmental Quality (CEQ) guidelines, and directives of the agency responsible for the project proposal. (6)

Environmental Protection Agency (EPA) - An agency of the Executive Branch of the Federal Government which has the responsibility for environmental matters of national concern.

Ephemeral draw - A drainage way which conveys surface water for short periods of time in direct response to snowmelt or rainfall runoff.

Erosion - (1) The wearing away of the land surface by running water, wind, ice, or other geologic agents, including such processes as gravitation creep; or (2) detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of erosion:

> *Accelerated Erosion* - Erosion which is much more rapid than natural erosion, with the increase in erosion rate resulting primarily from the influence of human activities, or, in some cases, of other events that expose mineral soil surfaces, such as wildfire.

Gully erosion - The erosion process whereby water accumulates in narrow channels, and over short periods, removes the soil from this narrow area to considerable depths, ranging from 4 inches to as much as 75 to 100 feet.

Rill erosion - An erosion process in which numerous small channels less than 4 inches deep and 6 inches wide are formed.

Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by runoff water.

Erosion Hazard Rating - A rating system (low, medium, and high) which denotes the susceptibility of a land area to surface and mass wasting erosional processes.

Escapement - The numbers of adult anadromous fish that successfully escape commercial and sport fishing pressure and return to their streams of origin to spawn.

Estuary - A semiclosed body of water which has a free connection with the open sea. The sea water in an estuary is measurably diluted with fresh water from streams, rivers, or ground water.

Eutrophic - Of habitats, particularly soils and water, that are rich or adequate in nutrients. (3)

Even-aged management - The application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands. (1)

Even-aged stands - Stands in which all trees are about the same age. (A spread of 10 to 20 years is generally considered one age class.) Cutting methods producing even-aged stands are clearcut, shelterwood, or seed tree systems.

Exchange reserved - Lands which have been added to the National Forest System by exchange under the General Exchange Act for reserved/proclaimed National Forest System Lands.

Existing visual condition (EVC) - An inventory of existing visual impacts as seen from sensitive travel corridors or use areas; measures visual changes to the landscape caused by natural or human activities.

Exports - As used in IMPLAN are defined as outputs or products produced but not consumed or used in production of other outputs in the impact area. Includes both exports to other areas of the U.S. and international exports. (10)

Extended rotation - A period of years that is longer than the time necessary to grow timber crop to a specified condition of maturity. (3)

Extensive forest management - A low investment level of management on regulated timberlands that requires initial harvest, regeneration, and final harvest. Some precommercial thinning may be done to prevent stagnation and disease buildup.

F

Facility Condition Class Inventory - A Recreation Information Management (RIM) system for classifying the existing condition of recreation facilities.

Fault - A ground surface fracture or fracture zone along which there has been a displacement of one side with respect to the other. (6)

Fault scarp - An abrupt change in surface elevation resulting from earthquake activity. Fault scarps may vary from as little as a few inches to two or three thousand feet.

Federal Sustained Yield Unit (FSYU) - A Federal timber management unit established under the authority of the Sustained Yield Forest Management Act of 1944.

Fee Site - A developed recreation site in which the visitor is charged a user fee for overnight camping. The amount of the fee will vary from site to site depending on the facilities and services provided.

Feral - Non-native species, or their progeny, which were once domesticated but have since escaped from captivity and are now living free. (6)

Final cut - See *Final Removal Harvest*.

Final Environmental Impact Statement (FEIS) - The final version of the statement of environmental effects required for major federal actions under section 102 of the National Environmental Policy Act. It is a revision of the draft environmental impact statement to include public and agency responses to the draft. (6)

Final removal harvest - The removal of the last seed bearers or shelter trees after regeneration is established under a shelterwood system. (6)

Fire management - All activities required for protection of resources from fire and for the use of fire to meet land management goals and objectives. (6)

Fire Intensity Level (FIL) - An expression of the amount of energy released as fuel is consumed in a fire.

Fire suppression - Action to limit the spread of and/or prevent damage by wildfire.

Fisheries habitats - Streams, lakes, and reservoirs that support fish populations.

Flood plain - The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a one percent or greater chance of flooding in any given year. (2)

Forage - All browse and nonwoody plants that are available to livestock or game animals and used for grazing or harvested for feeding. (6)

Forb - Any herb other than grass. (7)

Foreground - See *Distance Zone*.

Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) - An Act of Congress requiring the preparation of a program for the management of the National Forests' renewable resources, and the preparation of land and resource management plans for units of the National Forest System. It also requires a continuing inventory of all National Forest System lands and renewable resources. (6)

Forest land - Land at least 10 percent occupied by forest trees or formerly having had such tree cover and not currently developed for nonforest use. Lands developed for nonforest use include areas for crops, improved pasture, residential, or administrative areas, improved roads of any width, and adjoining road clearings and powerline clearings of any width. (1) (10)

Forest Program - A forest program is the summary or aggregation of project or activity information that makes up an integrated (multifunctional) course of action for a given level of funding on a national forest that is consistent with the Forest plan.

Forest Service Handbook (FSH) - For Forest Service use, directives that provide detailed instructions on how to proceed with a specialized phase of a program or activity. (10)

Forest Service Manual (FSM) - A system of manuals which provides direction for Forest Service activities.

Forest succession - The orderly process of change in a forest as one plant community or stand condition is replaced by another, evolving towards the climax type of vegetation. (16)

Forest system roads - Roads that are part of the Forest development transportation system, which includes all existing and planned roads as well as other special and terminal facilities designated as Forest development transportation facilities. (See *Arterial Roads*, *Collector Roads,* and *Local Roads.*)

Forest type - A classification of forest land based upon the tree species presently forming a plurality of basal area stocking in live trees.

Formally dedicated area - An area of the Forest set aside for a specific use by virtue of a formal ceremony or congressional designation.

FORPLAN - A linear programming system used for developing and analyzing forest planning activities. (10)

Free-to-grow - A term used by silviculturists to indicate that trees are free of growth restraints, the most common of which is competing, over-topping vegetation.

Fuel break - A zone in which fuel quantity has been reduced or altered to provide a position for suppression forces to make a stand against wildfire. Fuel breaks are designated or constructed before the outbreak of a fire. Fuel breaks may consist of one or a combination of the following: natural barriers, constructed fuel breaks, constructed barriers. (6)

Fuel management - The practice of planning and executing the treatment or control of living or dead vegetative material in accordance with fire management direction. (10)

Fuel treatment - The rearrangement or disposal of natural or activity fuels (generated by management activity, such as slash left from logging) to reduce fire hazard. Fuels are defined as both living and dead vegetative materials consumable by fire.

Fuels - Combustible wildland vegetative materials. While usually applied to above ground living and dead surface vegetation, this definition also includes roots and organic soils such as peat. (10)

Fuelwood - Wood which is primarily used by residential homeowners for heating purposes.

Full cable suspension - A cable yarding system capable of lifting and transporting logs above the ground and vegetation to a landing, resulting in minimum disturbance to the environment. Not all cable yarding systems have this capability. (16)

Full-service management - Management of developed recreation sites to furnish the full range of amenities and maintenance for the public enjoyment. Management objectives are based on site capacity, site protection needs, seasonal demands for public use, and desired levels of service to enhance visitor's experience and convenience and provide optimum maintenance.

Furbearing species - See *Game Species*.

G

Game species - Any species of wildlife or fish for which seasons and bag limits have been prescribed and which are normally harvested by hunters, trappers, and fishermen under state or federal laws, codes, and regulations. (6)

Genetic seedlings - Tree seedlings from a genetically superior seed source. The seeds are collected from trees displaying exceptional form and raised in nurseries before outplanting. The seedlings usually have faster growth rates than naturally regenerated seedlings.

Genetic tree improvement - A general term including all practices designed to produce genetically better trees, such as forest tree breeding, selection and protection of superior seed trees. (3)

Genetic Integrity - Refers to a normal, healthy genetic pool (foundation) within a biological population to provide for long-term maintenance and survival of the species. Of specific concern in management direction is the prevention of loss of genetic variance (heterozygosity) and the avoidance of inbreeding depression, an important part of a given population's genetic integrity within the gene pool. (2)

Geomorphology - The science that deals with land and submarine relief features of the Earth's surface and seeks a genetic interpretation of them, using the principles of physiography in its descriptive aspects and dynamic and structural geology in its explanatory phases. (6)

Geothermal - Of or pertaining to the internal heat of the earth. (4)

Gigawatt hour (GWh) - A unit of energy equal to 1 billion watt hours.

Goal - A concise statement that describes a desired condition to be achieved sometime in the future. It is normally expressed in broad, general terms and is timeless in that it has no specific date by which it is to be completed. Goal statements form the principal basis from which objectives are developed. (2) (1)

Goods -

1. *Nonmarket good*. An output that is not normally exchanged for money in a market. Usually no market has evolved because ownership of the good is not clear, exclusive use is not possible under current laws, or it is not possible to consistently define good. (10)

2. *Public good*. An output for which it is impractical to impose a charge, either because it must be supplied to all if it is supplied to one or because the costs of collection and control exceed likely revenue. (10)

Goods and services - The various outputs, including on-site uses, produced from forest and rangeland resources. (2,1)

Grass/forb - An early forest successional stage where grasses and forbs are the dominant vegetation.

Grays Harbor Federal Sustained Yield Unit - Includes all National Forest land managed by the Quinault Ranger District. At present, 50 percent of the timber harvested from the District must receive primary manufacturing within Grays Harbor County.

Group selection cutting - See *Uneven-Aged Silvicultural Systems*.

Growing season - That part of the year when temperature and moisture are favorable for vegetation growth.

Guideline - An indication or outline of policy or conduct; i.e., any issuance that assists in determining the course of direction to be taken in any planned action to accomplish a specific objective. (2)

H

Habitat - The place where a plant or animal naturally or normally lives or grows. (2)

Habitat capability - The estimated ability of an area, given existing or predicted habitat conditions, to support a wildlife, fish or plant population. It is measured in terms of potential population numbers.

Habitat Capability Index (HCI) - A numerical expression of habitat capability measured in terms of potential population numbers.

Habitat diversity - The distribution and abundance of different plant and animal communities and species within a specific area.

Habitat Quality Index (HQI) - A numerical estimate of habitat quality expressed as a percentage of optimum.

Hardwood - A broad-leaved flowering tree.

Harvest cutting method - A combination of interrelated actions whereby forests are tended, harvested, and replaced. The combination of management practices used to manipulate the vegetation results in forests of distinctive form and character. Harvest cutting methods are classified as even-aged and uneven-aged.

Harvest dispersion (factor) - The dispersion of cutting units over the land base in order to meet clearcut size limitations, or other resource constraints. An example of a harvest dispersion constraint is: no more than 25 percent of an analysis area may be harvested in one decade.

Headwaters - The upper tributaries of a river. (4)

Herbaceous - An adjective describing seed-producing plants that do not develop persistent woody tissue, but die down to ground level at the end of the growing season.

Herbicide - An agent used to destroy or inhibit plant growth. (20)

Hiding cover - Vegetation that will hide 90 percent of an adult deer or elk from the view of a human at a distance of 200 feet or less. The distance at which the animal is essentially hidden is called a "sight distance."

High-lead logging - A system of cable logging wherein the main lead block is placed on a spar tree, generally 100 to 125 feet above the ground, giving a lifting effect to the incoming logs.

High-site timbered lands - A relative measure of resource productivity.

Hog fuel - Waste wood shredded into bits to be utilized as fuel. (3--Definition modified)

Human Resource Programs - Programs providing human and natural resource benefits through work, training, and education for the unemployed, the underemployed, the elderly, the young and others with special needs.

Hydrology - The scientific study of the properties distribution and effects of water in the atmosphere, on the earth's surface, and in soil and rocks.

Hydropower - Hydroelectric power; of or relating to production of electricity by waterpower. (20)

I

ID Team - See *Interdisciplinary Team.*

Impacts - See *Effects.*

IMPLAN - A computer-based system used by the Forest Service for constructing nonsurvey input/output models to measure economic input. The system includes a data base for all countries in the U.S. and a set of computer programs to retrieve data and perform the computational tasks for input/output analysis. (10)

Imports - Used in IMPLAN and defined as purchases of products for use in production of other products and for final consumption from outside the impact area. Includes both imports from other areas of the U.S. and international imports. Competitive imports are the same as local domestic products which are not produced in quantities sufficient to meet local demands or which obtain a share of the local market formerly supplied by local producers. Noncompetitive imports are products not produced locally. (10)

Improved genetic stock - Group of plants (trees) that have been improved genetically (4).

Income - Employee compensation, profits, rents, and other payments to households. (10)

Indicator species - See *Management Indicator Species.*

Indirect outputs - Outputs caused by an action, but which are later in time or farther removed in distance, although still reasonably foreseeable. (See *Effects.*)

Individual (single) tree selection - See *Uneven-Aged Silvicultural Systems.*

Induced outputs - Outputs in the private sector induced by the direct outputs produced on the Forest. (6)

Influence zone - See *Zone of influence.*

Input/output analysis - A quantitative study of the interdependence of a group of activities, based on the relationship between inputs and outputs of the activities. The basic tool of analysis is an input-output model for a given period that shows simultaneously for each economic sector the value of inputs and outputs, as well as the value of transactions within each economic sector. It has especially been applied to estimate the effects of changes in Forest output levels on local economic activity. (3)

Insecticide - A pesticide for control of insects. (16)

Instream flows - A prescribed level (or levels) of streamflow, usually expressed as a stipulation in a permit authorizing a dam or water diversion, for the purpose of meeting National Forest System management objectives.

Integrated pest management (IPM) - A process for selecting strategies to regulate forest pests in which all aspects of a pest-host system are studied and weighed. The information considered in selecting appropriate strategies includes the impact of the unregulated population on various resource values, alternative regulation tactics and strategies, and benefit/cost estimates of those alternative strategies. Regulatory strategies are based on sound silvicultural practices and ecology of the pest-host system, and consist of a combination of tactics such as timber stand improvement plus selective use of pesticides. A basic principle in the choice of strategy is that it be ecologically compatible or acceptable. (2) (1)

Integrated Resource Analysis Areas (IRAA) - An area of the Forest, generally defined by watershed or basin boundaries, which is used for planning, analysis, and scheduling of project activities.

Integrated resource management - A management strategy which emphasizes no resource element to the exclusion or violation of the minimum legal standards of others. (FSM 1905)

Intensive management (intensive forest management) - A high investment level of timber management that includes use of precommercial thinnings, commercial thinnings, genetically improved stock, and control of competing vegetation. (2)

Interdisciplinary Team (IDT) - A group of individuals with different training assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad to adequately solve the problem. (6)

Intermediate cutting - Any removal of trees from a stand between the time of its formation and the regeneration cut. Most commonly applied intermediate cuttings are release, thinning, improvement, and salvage. (6)

Intermingled ownerships - Lands that are owned by private interests or other government agencies and located within the National Forest boundaries or surrounded by National Forest land.

Intermittent stream - A stream with running water in most months, but without water in the summer season during most years.

Intertie - A link between two points, objects, or concepts. (5)

Inventory data and information collection - The process of obtaining, storing, and using current inventory data appropriate for planning and managing the Forest. (6)

Irretrievable - Applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the timber production from an area is irretrievably lost during the time an area is used as a winter sports site. If the use is changed, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible. (10)

Irreversible - Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options. (10)

Issue - A point, matter, or question of public discussion or interest to be addressed or decided through the planning process. (See also *Public Issue*.) (2)

L

Land allocation - The assignment of management emphases to particular land areas with the purpose of achieving goals and objectives of a specific alternative.

Land and Water Conservation Fund (L&WCF) - Funds collected from sales of surplus Government real property, motorboat fuels taxes, recreation use fees, etc. which are available to purchase and develop certain qualifying lands for recreational purposes.

Land class - The topographic relief of a unit of land. Land classes are separated by degrees of slope, and is a classification system used in the timber inventory process. The three land classes used in the Olympic National Forest Plan are defined by the following slope ranges: 0 to 40 percent; 40 to 60 percent; and greater than 60 percent.

Land exchange - The acquisition of non-Federal land and/or interests in exchange for National Forest System land or interests.

Landform - An area of that is defined by its particular combination of bedrock and soils, erosion processes and climatic influences.

Landing - Any place where round timber is handled and assembled for further transport. (3)

Land management - The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions. (6)

Landownership pattern - The National Forest System resource land base, in relation to other land ownerships within given boundaries. (2)

Landscape management - The art and science of planning the use of Forest lands in ways that visual resouce values are protected or enhanced. The planning and design of the visual aspects related to multiple-use land management.

Lands not appropriate for timber production - Includes lands that: 1) are proposed for resource uses that preclude timber production, such as Wilderness; 2) have other management objectives that limit timber production to the point where management requirements set forth in CFR 219.27 cannot be met; or, 3) are not cost efficient over the planning horizon in meeting forest objectives including timber production. (1)

Lands not suited (unsuitable) for timber production - Includes lands that: 1) are not forest land as defined in CFR 219.3; 2) are likely, given current technology, to suffer irreversible resource damage to soils productivity, or watershed conditions; 3) cannot be adequately restocked as provided in 36 CFR 219.27(c)(3); or, 4) have been withdrawn from timber production by an Act of Congress, the Secretary of Agriculture, or the Chief of the Forest Service. In addition, Forest lands in alternatives that are otherwise suited (items 1,2,3 and 4), but are located in Management Areas with prescriptions that preclude management timber production, such as Wilderness or Research Natural Areas.

Lands suitable for timber production - Includes all lands not classified as either Not Suited or Not Appropriate for Timber Production.

Landtype - A portion of the Forest mapped in the National Forest Soil Resource Inventory that has a defined arrangement of specific landforms that reacts to management activities in generally predictable ways. Landtypes range from 60 to 600 acres in size.

Landtype association - A group of landtypes that make up a large portion of the Forest. The landtypes are sufficiently homogeneous to be considered as a whole for modeling the future outputs and effects of planned management activities. Landtype Associations do not usually follow watershed boundaries and are defined on the basis of general similarities in geology, climate, landform and vegetation.

Land use allocation - The commitment of a given area of land or a resource to one or more specific uses--for example, to campgrounds or wilderness. (6)

Large organic debris (LOD) (Large woody debris) - Large downed trees, primarily conifers, that accumulate on land or in streams or other water bodies. This material is important for wildlife and fishery habitat and stream channel stability.

Large saw timber - A stand condition in which the average tree diameter exceeds 21 inches DBH.

Leasable minerals - Coal, gas, oil, phosphate, sodium, potassium, oil shale, sulphur, geothermal steam. Also includes other minerals on acquired National Forest lands. (6)

Least-cost analysis - Determination of the least cost means of attaining specified results. (10)

Level IV Law Enforcement Officer - A Forest Service employee who has graduated from the Federal Law Enforcement Academy and holds a law enforcement commission signed by the Regional Forester. District Level IV officers generally perform other duties as well as law enforcement.

Lifestyle - The characteristic way people live, indicated by consumption patterns, work, leisure, and other activities. (10)

Limit of Acceptable Change (LAC) - The amount of change to be allowed while maintaining the desired Wilderness conditions.

Linear programming - A mathematical method used to determine the cost-effective allocation of limited resources between competing demands when both the objective (e.g., profit or cost) and the restrictions on its attainment are expressible as a system of linear equalities or inequalities. (6)

Locatable minerals - Those hardrock minerals which can be obtained by filing a claim on Public Domain or National Forest System lands reserved from the Public Domain. In general, the locatable minerals are those hardrock minerals which are mined and processed for the recovery of metals, but may also include certain nonmetallic minerals and uncommon varieties of mineral materials. (6)

Logging residues - See *Slash*.

Long-term sustained yield capacity (LTSYC) - The highest uniform wood yield from lands being managed for timber production that may be sustained under a specified management intensity, consistent with multiple-use objectives. (1)

M

Management Area - An area with similar management objectives and a common management prescription. (1) (10)

Management concern - An issue, problem, or condition which influences the range of management practices identified by the Forest Service in the planning process. (1)

Management direction - A statement of multiple use and other goals and objectives, and the associated management prescriptions, and standards and guidelines for attainment. (1)

Management emphasis - That portion of a management scheme which receives the most stress or is of the greatest significance or importance. It may be the resources being produced, or it may be the way in which they are produced.

Management indicator species - A species selected because it's welfare is presumed to be an indicator of the welfare of other species using the same habitat. A species whose condition can be used to assess the impacts of management actions on a particular area. (8)

Management intensity - The management practices or combination of management practices and associated costs to obtain different levels of goods and services (1). In FORPLAN management prescriptions, a set of activities designed to accomplish a particular management emphasis (see also *Management Prescription*).

Management practice - A specific activity, measure, course of action, or treatment. (1)

Management prescription - The management practices and intensity selected and scheduled for application on a specific area to attain multiple use and other goals and objectives (1). In FORPLAN, the combination of a management emphasis and associated management intensities with a variety of timing choices for implementation. (2)

Management Requirement (MR) - Standards for resource protection, vegetation manipulation, silvicultural practices, even-aged management, riparian areas, wildlife population viability, soil and water protection and diversity, to be met in accomplishing National Forest System goals and objectives. (1)

Management Strategy - See *Management Prescription.*

Marginal timber component - Timber on which the income just equals or could just equal the costs of production under a given form of management. (3)

Market - The processes of exchanging a good or service for money or other goods or services according to a customary procedure. A market may occur in a specific place or throughout an area by individual transactions. (10)

Market area - The area from which a market draws or to which it distributes its goods or services and for which the same general price structure and price influences prevail. (10)

Market value - The unit price of an output normally exchanged in a market after at least one stage of production. Market value is expressed in terms of prices as evidenced by market transactions. (10)

Mass movement (mass wasting) - A general term for any of the variety of processes by which large masses of earth material are moved downslope by gravitational forces - either slowly or quickly. (6)

Mature timber - Trees that have attained full development, particularly height, and are in full seed production. When used for seral stage, it refers to trees which are 9 inches DBH to 20.9 inches DBH. When used for wildlife habitat, it refers to stands of conifer trees with a multi-layered canopy of at least two layers. The overstory trees will be dominated by conifers, 21 inches DBH or larger. (3)

Mature saw timber - Trees or stands of trees which generally have reached culmination mean annual increment. (10)

Maximum modification (MM) - See *Visual Quality Objective.*

Mean annual increment (MAI) (of growth) - The total volume of a tree or stand of trees up to a given age divided by that age. (2)

Memorandum of Understanding (MOU) - A written plan between the Forest Service and non-Federal parties for carrying out their separate activities in a coordinated and mutually beneficial manner. Each party directs its own activities and uses its own resources. A Memorandum of Understanding is not a fund obligating document. (10)

Mesotrophic - Habitats, particularly soil and water, of moderate nutrient capacity. (3)

Middleground - See *Distance Zone.*

Mineral entry - The filing of a mining claim upon public domain or related land to obtain the right to any minerals it may contain. (6)

Mineral entry withdrawal - The exclusion of mining locations and mineral development work on areas required for administrative sites by the Forest Service and other areas highly valued by the public. (6)

Mineral materials - Deposits such as sand, stone, gravel, and clay. (6)

Mineral soil - Weathered rock materials usually containing less than 20 percent organic matter. (6)

Minimum level management - FORPLAN term designating lands that will not be actively managed for timber or forage production. Often, these are lands that have high costs and low benefits associated with their management.

Minimum streamflows - A specified level of streamflow that must be maintained to benefit biological, physical, or other purposes.

Mining claim - A portion of public land which a claimant takes and holds in accordance with mining laws. (6)

Mitigation - Mitigation includes: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or elimination the impact over time by preservation and maintenance operations during the life of the action; and, (e) compensating for the impact by replacing or providing substitute resources or environments. (40 CFR Part 1508.20)

Mitigation measures - Actions to avoid, minimize, reduce, eliminate, or rectify adverse impacts of management practices.

Model - A representation of reality used to describe, analyze, or understand a particular concept. A "model" may be a relatively simple qualitative description of a system or organization, or a highly abstract set of mathematical equations. (6)

Modification (M) - See *Visual Quality Objective*.

Monitoring and evaluation - The periodic evaluation of Forest Plan management practices on a sample basis to determine how well objectives have been met.

Monoculture - The raising of a crop of trees consisting of only one species; such crops are usually even-aged. (16)

Mortality - In wildlife management, the loss in a population from any cause, including hunter kill, poaching, predation, accident, and disease. In forestry, trees in a stand that die of natural causes. (8)

Mountain pine beetle - A tiny black insect, ranging in size from 1/8 to 3/4 inch, that bores its way into a tree's cambium and cuts off its supply of nutrients, thus killing the tree.

Multiple use - The management of all the various renewable surface resources of the National Forest System so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some lands will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land and with consideration being given to the relative values of the various resources; and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output. (1)

Multiplier - A ratio of a measure of total change in income or employment to the direct income or employment change. The measure to total change may be direct plus indirect change (Type I Multipliers); or direct, indirect, and induced change (Type II Multipliers); or direct, indirect, and interactive increased induced demands based on population increase (Type III Multipliers). (10)

Municipal watershed - A watershed which provides water for human consumption and Forest Service management could have a significant effect on the quality of water at the intake point. Water is utilized by a community or any other water system that regularly serves: (1) at least 25 people at least 60 days in a year, or (2) at least 15 service connections. In addition to cities, campgrounds, residential developments, and restaurants may be included under regulations and standards applicable to municipal watersheds. (10)

N

National Direction - Statements of missions, goals, and objectives that guide Forest Service planning. (FSM 1905)

National Environmental Policy Act (NEPA) of 1969 - An Act, "to declare a National policy which will encourage productive and enjoyable harmony between humankind and the environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality." (The Principal Laws Relating to Forest Service Activities, Agriculture Handbook No. 453, USDA, Forest Service, 359 pp.)

National Forest Land and Resource Management Plan - A Plan which "... shall provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long-term net public benefits in an environmentally sound manner." (1)

National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of Regional Guides and Forest Plans and the preparation of regulations to guide that development.

National Forest Systems (NFS) - All National Forest lands reserved or withdrawn from the public domain of the United States, all National Forest lands acquired through purchase, exchange, donation, or other means, the National Grasslands and land utilization projects administered under Title III of the Bankhead-Jones Farm Tenant Act (50 Stat. 525, 7 U.S.C. 1010-1012), and other lands, waters, or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system. (16 U.S.C. 1608)

National Recreation Trails (NRT) - Trails designated by the Secretary of the Interior or the Secretary of Agriculture as part of the National system of trails authorized by the National Trails System Act. National Recreation Trails provide a variety of outdoor recreation uses. (6)

National Recreation Strategy - A conceptual framework aimed at finding creative and imaginative ways to take advantage of outdoor recreation opportunities by working with people to strengthen and round out the multiple-use management of the National Forests.

National Register of Historic Places - A register of cultural resources of national, state, or local significance maintained by the USDI, National Park Service. (10)

National Wilderness Preservation System - All lands covered by the Wilderness Act and subsequent Wilderness designations, regardless of the governmental department having jurisdiction.

Natural barrier - A natural feature that restricts livestock or wildlife movements, such as a dense stand of trees or a cliff.

Natural regeneration - Reforestation of a site by natural seeding from the surrounding trees. Natural regeneration may or may not be preceded by site preparation.

Net cash flow - The difference between the annual receipts of an alternative and costs required to implement that alternative.

Net public benefits - An expression used to signify the overall long-term value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs), whether they can be quantitatively valued or not. Net public benefits are measured by both quantitative and qualitative criteria rather than a single measure or index. The maximization of net public benefits to be derived from management of units of the National Forest System is consistent with the principles of multiple use and sustained yield. (1)

Net receipts - Receipts minus costs.

Net returns to the Treasury, net cash flow - The difference between the total dollar receipts projected for an alternative and the total budget required to implement the alternative.

Nitrogen-fixing (Nitrogen fixation) - Conversion of free nitrogen by plants such as red alder into combined forms useful in nutrient cycles and other functions in the biosphere.

No Action Alternative (Alt. A) - This alternative is the "No Action" alternative required by the National Environmental Policy Act. It analyzes the effects of continuing management under direction established by the Olympic National Forest's Timber Management Plans, using updated timber resource inventories and yield tables. Often used interchangeably with "Current Direction" Alternative throughout the EIS.

No Change Alternative (Alt. NC) - This alternative would implement the Olympic National Forest Timber Management Plans, using the yield tables and timber resource inventories developed for the Plans. This alternative does not include all management requirements and would not meet the intent of the National Forest Management Act of 1976.

Nominal value - A monetary value relative to time that does not account for the effects of inflation.

Nonchargeable volume - All volume not included in the growth and yield projections for the selected management prescriptions used to arrive at the allowable sale quantity. (FSH 2409.13)

Noncommodity outputs - Resource outputs that are not normally bought and sold, or cannot be bought and sold, such as air quality or scenic beauty.

Nonconsumptive use - That use of a resource that does not reduce the supply. For example, nonconsumptive use of water includes hydroelectric power generation, boating, and swimming. (2)

Nondeclining flow (NDF) - Where the quantity of timber planned for sale and harvest for any future decade is equal to or greater than the planned sale and harvest for the preceding decade, and this planned sale and harvest for any decade is not greater than the long-term sustained yield capacity. (1)

Nonforest land - Lands that never have had or that are incapable of having 10 percent or more of the area occupied by forest trees; or lands previously having such cover and currently developed for nonforest use. (6)

Nongame species - Animal species which are not hunted, fished, or trapped.

Nonmarket value - The unit price of a nonmarket output normally not exchanged in a market at any stage before consumption; it is thus necessary to impute nonmarket value from other economic information. (10)

Nonmarket valued outputs - Assessed value of a goods or service which is not traded in the market place and has no market value. Because it is not bought and sold, some measure other than price must be used in establishing the value. (6)

Nonpoint source pollution - Pollution whose source is general rather than specific in location. It is widely used in reference to agricultural and related pollutants. For example, production of sediments by logging operations, agricultural pesticide applications, or automobile exhaust pollution. (6)

Nonpriced outputs - Nonpriced outputs are those for which there is no available market transaction evidence and no reasonable basis for estimating a dollar value. Subjective nondollar values are given to nonpriced outputs.

No surface occupancy - A clause used in mineral leases to prevent activities in sensitive areas. Sometimes results in closure of an area and sometimes has little impact if directional drilling can tap resources underlying restricted area.

Noxious weeds - Undesirable plant species that are unwholesome to the range or to animals. (6)

O

Objective - A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals. (1)

Off-road vehicle (ORV) - Any motorized vehicle designed or capable of cross-county travel or travel on trails or low-standard roads (e.g., motorbikes, ATVs, 4-wheel drive vehicles, snowmobiles). (2)

Old-growth deficit - A forest without the excess volume of mature/overmature old-growth trees that could be used to offset reductions in programmed harvest volume resulting from allocation changes.

Old-growth habitat - Habitat for certain wildlife that is characterized by overmature coniferous forest stands with large snags and decaying logs.

Old-growth stand (old-growth) (OG) - Any stand of trees 10 acres or greater generally containing the following characteristics: 1) contain mature and overmature trees in the overstory and are well into the mature growth stage; 2) will usually contain a multilayered canopy and trees of several age classes; 3) standing dead trees and down material are present; and 4) evidences of man's activities may be present, but do not significantly alter the other characteristics and would be a subordinate factor in a description of such a stand. See the Regional Guide. (2)

Oligotrophic - Lakes characterized by a low accumulation of dissolved nutrient salts, supporting only sparse plant and animal life, and having a high oxygen content, owing to the low organic content. (4)

Open to entry - With respect to minerals management, lands available for mineral exploration and development under the mining laws.

Operational costs - Those costs associated with administering and maintaining National Forest facilities and resource programs.

Operational Plan - A document approved by the Forest Supervisor which specifies at the project level, implementation of the management direction established in the Forest Plan. (6)

Opportunity - A proposal that is considered in developing alternative activities, projects or programs where an option exists to invest profitably to improve or maintain a present condition.

Opportunity cost - The net value that is foregone when a given resource is employed in something other than its most efficient alternative use.

Optimal cover - Habitat for deer and elk which has tree overstory and understory, shrub and herb- aceous layers; the overstory canopy generally exceeds 70% crown closure, and dominant trees generally exceed 21" DBH, which provide snow intercept, thermal cover, and maintenance forage.

Output - A good, service, or on-site use that is produced from forest and rangeland resources. See FSH 1309.11 for forest and rangeland outputs codes and units measure. Examples: X06-Softwood Sawtimber Production MBF; X80-Increased Water Yield - Acre Feet; W01-Primitive Recreation Use RVD's. (FSM 1905)

Output, Market - A good, service, or on-site use that can be purchased at a price. (FSM 1905)

Output, Nonmarket - A good, service, or on-site use not normally exchanged in a market. (FSM 1905)

Overbid - To bid more than the appraised value. (4)

Overmature timber - The stage at which a tree declines in vigor and soundness. For example, a stage past the period of rapid height growth. (2)

Overstory - That portion of the trees, in a Forest or stand with more than one crown canopy, that forms the uppermost canopy. (3)

Overuse (overutilization) - Utilizing an excessive amount of the current year's growth which, if continued, will result in overgrazing and range deterioration.

Overwood removal - A harvest method that removes the overstory of a two-story stand and leaves the smaller understory for further treatment (thinning or harvesting).

P

Partial cut - Covers a variety of silvicultural practices where a portion of the stand is removed and a portion is left.

Partial retention (PR) - See *Visual Quality Objective.*

Particulates - Small particles suspended in the air and generally considered pollutants. (See *Total Suspended Particulates.*) (5)

Perennial stream - A stream that flows year round.

Permittee - Any person or business formally allowed to graze livestock on the land of another person or business (e.g.; on state or federal land). (3)

Personal use - Normally used to describe the type of permit issued for removal of wood products (firewood, posts, poles, and Christmas trees) from National Forest land when the product is for home use and not to be resold for profit.

Persons-at-one-time (PAOT) - A recreation capacity measurement term indicating the number of people who can use a facility or area at one time. (2)

Pests - Any animal or plant that, during some portion of its life cycle, inhibits the establishment or growth of some other species of plant or animal favored by man.

Pesticide - A substance intended for controlling insects, rodents, weeds, and other forms of plant or animal life that are considered to be pests. (16)

Phenology - The science dealing with the influence of climate on the recurrence of such annual phenomena of animal and plant life as bird migrations, budding, etc. (4)

Physiographic province - A Region having a particular pattern of relief features or land forms that differs significantly from that of adjacent Regions. (6)

Planned ignition - A fire started deliberately, and controlled to accomplish a resource management objective.

Planning area - The area of the National Forest System covered by a Regional guide or forest plan. (1)

Planning criteria - Criteria prepared to guide the planning process. Criteria applied to collection and use of inventory data and information, analysis of the management situation, and the design, formulation, and evaluation of alternatives. (1)

Planning horizon - The overall time period considered in the planning process. It spans all activities covered in the analysis or plan and all future conditions and effects of proposed actions which would influence the planning decisions (1). In this FEIS and Forest Plan, the planning horizon is considered to be 15 decades.

Planning period - One decade. The time interval within the planning horizon that is used to show incremental changes in yields, costs, effects, and benefits. (1)

Planning records - The body of information documenting the decisions and activities which result from the process of developing a Forest Plan, revision, or significant amendment.

Plan of Operations - A document required from any person proposing to conduct mineral-related activities which utilize earth moving equipment and which will cause disturbance to surface resources or involve the cutting of trees. (36 CFR 228.4)

Plant associations - Abstract units of the potential vegetation which are characterized by the same overstory and understory dominants.

Plant community - A vegetative complex unique in its combination of plants; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soils, temperature, elevation, solar radiation, slope, aspect, and rainfall; as used in this publication: plant associations where composition or structure provide significantly different wildlife habitat characteristics (e.g., herbaceous wetland, conifer/hardwood forest, high-temperate coniferous forest). (16)

Pole/sapling - A Forest successional stage in which trees between five and nine inches in diameter are the dominant vegetation. (See also *Size Class.*)

Pole timber - Trees of at least five inches in diameter at breast height, but smaller than the minimum utilization standard for sawtimber. (See also *Size Class.*)

Policy - A guiding principle upon which is based a specific decision or set of decisions. (FSM 1905)

Potential yield - (*This term is in reference to the 1979 Timber Resource Plan only.*) Optimum sustained yield of timber harvest volume attainable with intensive forestry on available commercial forest land (forest lands able to produce 20 cubic feet of timber per acre per year or more) while considering the interrelationship with other forest resources and uses. Intensive forestry includes planting only with genetic stock, precommercial thinning, commercial thinning and release. Programmable net salvage volume and volume from marginally economical lands are also included (in reference to 155.2 MMBF per year in the 1979 TM Plan).

Practices - Those management activities that are proposed or expected to occur.

Precommercial thinning (PCT) - The practice of removing some of the trees less than marketable size from a stand so that the remaining trees will grow faster. (2)

Prehistoric site - An area which contains important evidence and remains of the life and activities of early societies which did not record their history.

Preparatory cut - The removal of trees near the end of a rotation, which permanently opens the canopy and enables the crowns of seed bearers to enlarge, to improve conditions for seed production and natural regeneration. Typically done in the shelterwood system. (3)

Prescribed fire - A wildland fire burning under specified conditions which will accomplish certain planned objectives. The fire may result from either planned or unplanned ignitions. Proposals for use of unplanned ignitions for this purpose must be approved by the Regional Forester. (2)

Prescription - A written direction for harvest activities and regeneration methods.

Present net value (PNV) - The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area. (1)

Preservation (P) - See *Visual Quality Objective.* (2)

Presuppression - Activities organized in advance of fire occurrence to ensure effective suppression action. (2)

Price - The unit value of an output expressed in dollars. (10)

Price elasticity - A measure of the sensitivity of the quantity of a good or service exchanged to changes in price. (10)

Priced outputs - Priced outputs are those that are or can be exchanged in the market place. The dollar values for these outputs fall into two categories: market or nonmarket (assigned values).

Price-quantity relationship - A schedule of prices that would prevail in a market for various quantities of the output exchanged. (10)

Price trend analysis - An analysis done to estimate how a particular FORPLAN solution would change if predicted price trends were increased or decreased.

Primary cavity excavator - Wildlife species that excavate cavities in snags (dead trees). (16)

Primary manufacture - The cutting of logs into rough green products (lumber, veneer, chips, shingles, or shakes) of various dimensions.

Proclaimed land - Lands reserved from the Public Domain for National Forest purposes by presidential proclamation.

Program - Sets of activities or projects with specific objectives, defined in terms of specific results and responsibilities for accomplishments. (10)

Program Budget - A plan that allocates annual funds, work force ceilings, and targets among agencies. (10)

Program Budget Level - A single, comprehensive integrated program responsive to the Chief's direction that specifies a level of production attainable from a given investment of dollars and other resources. Each budget level represents a complete, full, and independent package within the criteria and constraints identified. (10)

Programmatic Memorandum of Agreement - An agreement between the USDA Forest Service, Pacific Northwest Region, the Washington State Historic Preservation Office (SHPO), and the Advisory Council on Historic Preservation on the management of two types of cultural resource sites found on the Forest: Depression-era administrative structures and prehistoric lithic scatters.

Programmed harvest - The amount of timber on the Forest that is scheduled for harvesting. The programmed harvest is based on current demand, funding, and multiple-use considerations.

Project - An organized effort to achieve an objective identified by location, timing, activities, outputs, effects, and time period and responsibilities for executions. (10)

Project design - The process of developing specific information necessary to describe the location, timing, activities, outputs, effects, accountability, and control of a project.

Public Involvement - A Forest Service process designed to broaden the information base upon which agency decisions are made by (1) informing the public about Forest Service activities, plan, and decisions, and (2) encouraging public understanding about and participation in the planning processes which lead to final decisionmaking. (10)

Public Issue - A subject or question of widespread public interest relating to management of the National Forest System. (1)

Public participation - Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about Forest Service planning. (2)

Public participation activities - Meetings, conferences, seminars, workshops, tours, written comments, survey questionnaires, and similar activities designed or held to obtain comments from the general public and specific publics.

Purchaser credit - Credit earned by the purchaser of a National Forest timber sale by construction of contract-specified roads. Earned purchaser credit may be used by the purchaser as payment for National Forest timber removed. (2)

R

Range management - The art and science of planning and directing range utilization to secure sustained maximum production of livestock, milk, and/or cut forage, consistent with other uses and conserving natural resources. (3)

Raptors - Predatory birds, such as falcons, hawks, eagles, and owls.

Rate of return - The financial yield per unit cost determined as the rate of interest at which total discounted benefits equal total discounted costs. (Internal rate of return is a similar measure appropriate to the benefits and costs that affect private firms or individuals.) (10)

Real dollar value - A monetary value that compensates for the effects of inflation. (1)

Rearing habitat - Aquatic environments that have chemical properties and physical and biological characteristics suitable for raising juvenile fish species.

Receipts - Those priced benefits for which money will actually be paid to the Forest Service: recreation, timber harvest, mineral leases and special use fees.

Receipt shares - The portion of receipts derived from Forest Service resource management that is distributed to State and county governments, such as the Forest Service 25-percent fund payments. (1)

Record of Decision (ROD) - A document separate from, but associated with, an Environmental Impact Statement which states the decision, identifies all alternatives, specifies which alternatives were environmentally preferable, and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and if not, why not. (40 CFR 1505.2)

Recreation capacity - The number of people that can take advantage of the recreation opportunity at any one time without substantially diminishing the quality of the recreation experience or the biophysical resources. (2)

Recreation Information Management (RIM) - A computer-oriented system for the organization and management of information concerning recreation use, occupancy, and management of National Forest resources.

Recreation opportunity - The availability of choice for a user to participate in a preferred activity within a preferred setting, in order to realize desired, satisfying, recreational experiences.

Recreation Opportunity Spectrum (ROS) - A framework for stratifying and defining classes of outdoor recreation environments, activities, and experience opportunities. The settings, activities, and opportunities for obtaining experiences have been arranged along a continuum or spectrum divided into seven classes: Primitive, Semi-Primitive Non-Motorized, Semi-Primitive Motorized, Roaded Modified, Roaded Natural, Rural, Urban.

1 - **Primitive** - Area is characterized by an essentially unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is not permitted.

2 - **Semi-Primitive Non-Motorized** - Area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that subtle, minimum on-site controls and restrictions may be present. Motorized recreation use is not permitted, but local roads used for other resource management activities may be present on a limited basis. Use of such roads is restricted to minimize impacts on recreational experience opportunities.

3 - **Semi-Primitive Motorized** - Area is characterized by a predominantly natural or natural-appearing environment of moderate to large size. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions, use of local primitive or collector roads with predominantly natural surfaces, and trails suitable for motor bikes are permitted.

4 - **Roaded Natural** - Area is characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of humans. Such evidence usually harmonizes with the natural environment. Interaction between users may be moderate to high, with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and design of facilities.

5 - **Roaded Modified** - A subclass of the Roaded Natural ROS class. Involves areas that are characterized by predominantly natural-appearing environments with high evidence of the sights and sounds of humans. Such evidence may not harmonize with the natural environment. Interaction between users may be moderate to high, with evidence of other users prevalent. Resource modification and utilization practices are evident and may not harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and design of facilities.

6 - **Rural** - Area is characterized by a natural environment that has been substantially modified by development of structures, vegetative manipulation, or pastoral agricultural development. Resource

modification and utilization practices may be used to enhance specific recreation activities and maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate user densities are present in areas adjacent to developed sites. Facilities for intensified motorized use and parking are available.

7 - **Urban** - Area is characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Renewable resource modification and utilization practices are often used to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of humans are predominant on site. Large numbers of users can be expected both on site and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site.

Recreation Visitor Day (RVD) - A measure of recreation use, in which one RVD equals twelve visitor hours, which may be aggregated continuously, intermittently, or simultaneously by one or more persons. (2)

Recreational river - See *Wild and Scenic River.*

Reduced service management - Management of developed recreation facilities below optimum maintenance standards.

Reforestation - The natural or artificial restocking of an area with forest trees. (2)

Regeneration - The renewal of a tree crop, whether by natural or artificial means. Also, the young crop itself, which is commonly referred to as reproduction. (2)

Region - An area covered by a Regional guide. See FSM 1221.3 for organizational definitions. (10)

Regional Forester - The Forest Service official responsible for administering a single Region.

Regional Guide - The guide developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended. It guides all natural resource management activities, and establishes management standards and guidelines for the National Forest System lands within a given Region. It also disaggregates the assigned Regional RPA objectives to the Forests within that Region.

Regulations - Generally refers to the Code of Federal Regulations, Title 36, Chapter II, which covers management of the Forest Service. (2)

Rehabilitation - Action taken to restore site productivity, water quality, or other resource values over a period of time.

Release - Freeing trees from competition for light, water, and nutrients by removing or reducing the vegetation growth that is overtopping or closely surrounding them.

Removal cut (final cut) - The removal of the last seed bearers or shelter trees after regeneration is established under a shelterwood method. (6)

Renewable resources - Resources that are possible to use indefinitely, when the use rate does not exceed the ability to renew the supply.

Renewable Resources Assessment - An appraisal of the Nation's renewable resources that recognizes their vital importance and the necessity for long-term planning and associated program development. The Assessment meets the requirements of Section 3 of the Resources Planning Act and includes analyses of present and anticipated uses, demands, and supplies of the renewable resources; a description of Forest Service programs and responsibilities; and a discussion of policy considerations, laws, and regulations.

Research Natural Area (RNA) - An area set aside by a public or private agency specifically to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. In U.S.D.A. Forest Service usage, Research Natural Areas are areas designated to ensure representative samples of as many of the major naturally-occurring plant communities as possible. (6)

Reserved lands - Lands which have been removed from the acreage base used to calculate timber yields. These lands often have a preservation or protection status. Wildernesses, Research Natural Areas, and National Recreation Areas are examples of reserved lands. These areas are designated as reserved by the authority of the Chief of the Forest Service, or a higher official (see *Proclaimed Land*). (2)

Resident fish - Fish that do not require extended migrations to complete their life cycles. (16)

Residue - The vegetative material left on the ground after timber cutting and/or accumulating there as a result of storm, fire, or other damage. It includes unused logs, uprooted stumps, broken or uprooted stems, branches, twigs, leaves, bark, and chips.

Residual stand - The trees remaining standing after some activity such as selection cutting. (2)

Resource - Anything which is beneficial or useful - be it animal, vegetable, mineral, a location, a labor force, a view, an experience, etc. Resources, in the context of land use planning, thus vary from such commodities as timber and minerals to such amenities as scenery, scenic view points, or recreation opportunities. (6)

Resource allocation - The action of apportioning the supply of a resource to specific uses or to particular persons or organizations. (6)

Resource Allocation Model (RAM) - A mathematical model using linear programming which will allocate land to different management prescriptions and schedule implementation of those prescriptions simultaneously. The purpose of the model is to find a schedule and allocation that meets the goals of the Forest and optimizes some objective function, such as "minimize costs."

Resource Management Plan - A Plan developed prior to the Forest Plan that outlined the activities and projects for a particular resource element independently of considerations for other resources. Such Plans will be superseded by the Forest Plan.

Resource Planning Act (RPA) - The Forest and Rangeland Renewable Resources Planning Act of 1974. Also refers to the National Assessment and Recommended Program developed to fulfill the requirements of the Act. (2)

Responsible line officer - The Forest Service employee who has the authority to select and/or carry out a specific planning action. (1)

Retention (R) - See *Visual Quality Objective.*

Returns to counties - The portion of receipts derived from Forest Service resource management that is distributed to State and county governments such as the Forest Service 25 percent fund payments.

Right-of-way (R/W) - An accurately located strip of land with defined width, point of beginning, and point of ending; the area within which the user has authority to conduct operations approved or granted by the landowner in an authorizing document, such as a permit, easement, lease, license, or Memorandum of Understanding. (6)

Riparian - Pertaining to areas of land directly influenced by water. Riparian areas usually have visible vegetative or physical characteristics reflecting this water influence. Stream sides, lake borders, or marshes are typical riparian areas. (3)

Riparian area - Geographically delineated areas, with distinctive resource values and characteristics, that are comprised of aquatic and riparian ecosystems.

Riparian ecosystem - A transition between the aquatic ecosystem, and the adjacent upland terrestrial ecosystem. Identified by soil characteristics and distinctive vegetation communities that require free or unbound water.

Road - A general term denoting a way for purposes of travel by vehicles greater than 40 inches in width.

1. *Forest Arterial Road.* Provides services to large land areas and usually connects with public highways or other forest arterial roads to form an integrated network of primary travel routes. The location and standard are often determined by a demand for maximum mobility and travel efficiency rather than specific resource management service. It is usually developed and operated for long-term land and resource management purposes and constant service. (10)

2. *Forest Collector Road.* Serves smaller land areas than a forest arterial road and is usually connected to a forest arterial or public highway. Collects traffic from forest local roads and/or terminal facilities. The location and standard are influenced by both long-term multiresource service needs as well as travel efficiency. May be operated for either constant or intermittent service, depending on land use and resource management objectives for the area served by the facility. (10)

3. *Forest Local Road.* Connects terminal facilities with forest collector or forest arterial roads or public highways. The location and standard are usually controlled by specific resource activity requirements rather than travel efficiency needs. (10)

Roadless area - Areas studied during the Roadless Area Review and Evaluation process (RARE II) which are roadless and at least 5,000 acres in size.

Roadless Area Review and Evaluation II (RARE II) - The national inventory of roadless and undeveloped areas within the National Forest and Grasslands. This refers to the second such assessment, which was documented in the Final Environmental Impact Statement of the Roadless Area Review and Evaluation, January 1979. (2)

Rotation - Planned number of years between the formation of a generation of trees and its final harvest at a specified stage of maturity. Appropriate for even-aged management only. (6)

Roundwood products - Logs, bolts, or other round sections cut from trees.

Runoff - That part of precipitation which travels over the soil surface to the nearest outlet or channel.

Run-of-the-river facility - A hydropower project utilizing a diversion dam without a reservoir. Has some minor ponding, but generation is controlled by the available flow of the river.

S

Salable minerals - Mineral desposits outside the scope of the General Mining Law because of widespread occurrence and "common" nature (disposal under the Materials Act of 1947, as amended).

Sale preparation costs - Costs associated with preparing a timber harvest on Forest Service lands for sale to the public; usually include all administrative costs for developing sale layout, writing an Environmental Assessment and selling the timber sale.

Sale schedule - The quantity of timber planned for sale by time period, from the area of suitable land covered by a Forest plan. The first period, usually a decade, of the selected sale schedule provides the allowable sale quantity. Future periods are shown to establish that long-term sustained yield will be achieved and maintained. (1) For planning purposes, the sale schedule and the allowable sale quantity are synonymous for all periods or decades over the planning horizon. (1)

Salmonids - Fish within the family Salmonidae; e.g., salmon and trout. (16)

Salvage cuttings - Intermediate cuttings made to remove trees that are dead or in imminent danger of being killed by injurious agents. (10)

Sanitation cuttings - Intermediate cuttings made to remove dead, damaged, or susceptible trees to prevent the spread of pests or pathogens. (10)

Sanitation-salvage treatment - See *Salvage Cutting*; *Sanitation Cutting*.

Sawtimber - Trees containing at least one 12-foot sawlog or two noncontiguous 8-foot logs, and meeting regional specifications for freedom from defect. Softwood trees must be at least 9 inches in diameter and hardwood trees 11 inches in diameter at breast height.

Scarified - Land in which the topsoil has been broken up or loosened in preparation for regenerating by direct seeding or natural seedfall. Also refers to ripping or loosening road surfaces to a specified depth for obliteration or "putting a road to bed." (3)

Scenario - An account or synopsis of a projected course of action or event. (20)

Scenic River Areas - See *Wild and Scenic River*.

Scheduled timber harvests - Volumes and acres programmed for harvest which are within the allowable sale quantity. This does not include salvage and sanitation harvesting.

Scoping process - A part of the National Environmental Policy Act (NEPA) process; early and open activities used to determine the scope and significance of the issues, and the range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement. (40 CFR 1501.7)

Second growth - Forest growth that has become established following some interference, such as cutting, serious fire, or insect attack, with the previous Forest crop. (6)

Sediment - Earth material transported, suspended, or deposited by water. (6)

Sediment Yield Index - An estimate, derived from the Forest's sediment yield estimation model, of the total sediment (suspended load and bedload) that is transported by a stream. The estimates include sediment resulting from roading, logging, and broadcast burning activities.

Seed tree cutting - Removal in one cut of the mature timber from an area, except for a small number of seed bearers left singly or in small groups. (3)

Seedlings and saplings - Live trees less than five inches in diameter at breast height. (See also *Size Class.*) (3)

Selection cutting - The annual or periodic removal of trees (particularly mature trees), individually or in small groups, from an uneven-aged forest, to realize the yield and establish a new crop of irregular constitution. (3)

Sensitive species - Plant or animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species; that are on an official State list; or that are recognized by the Regional Forester as needing special management to prevent placement on Federal or State lists. (2)

Sensitivity analysis - A determination of the effects of varying the level of one or more factors, while holding the other factors constant. (6) (10)

Sensitivity level - A measure of people's concern for the scenic quality of the National Forests. Three sensitivity levels are employed, each identifying a different level of user concern for the visual environment.

LEVEL 1 - Highest sensitivity

LEVEL 2 - Average sensitivity

LEVEL 3 - Lowest sensitivity (2)

Separate suitability components (SSC lands) - Those forested lands tentatively suitable for timber production that grow less than 20 cubic feet per acre per year of timber but have greater than ten percent occupancy (trees cover more than ten percent of the acre).

Sequential Upper and Lower Bounds - A FORPLAN term referring to the constraint that sets upper and lower limits by which harvest levels can increase or decrease from decade to decade. This constraint constitutes a departure from nondeclining flow and allows the harvest to rise or fall by decade according to the bounds that are set. (See *Constraint.*)

Seral - A biotic community which is a developmental, transitory stage in an ecologic succession. (6)

Shelterwood - The cutting method that describes the silvicultural system which provides a source of seed and/or protection for regeneration, and the old crop (the shelterwood) is removed in two or more successive shelterwood cuttings. The first cutting is ordinarily the seed cutting, though it may be preceded by a preparatory cutting, and the last entry is the final cutting. Any intervening cutting is termed removal cutting. An even-aged stand results. (3)

Shelton Cooperative Sustained Yield Unit (SCSYU) - An area of land that includes both National Forest and private (Simpson Timber Company) lands. This area is cooperatively managed for a sustained yield of timber. Also referred to as "The Unit," or CSYU.

Silvicultural examination - The process used to gather the detailed in-place field data needed to determine management opportunities and direction for the timber resource within a small subdivision of a Forest area, such as a stand.

Silviculture - The art and science of controlling the establishment, composition, and growth of forests. (2)

Single-tree selection - See *Individual (Single) Tree Selection.*

Site Development Plan - A document containing information, data and drawings essential to the reconstruction of existing facilities or development of future facilities on a given site within the National Forest.

Site Index - A numerical evaluation of the quality of land for plant productivity, (6) . . .based on the height of dominant trees in a stand at an arbitrarily chosen age. (3)

Site preparation - 1) An activity (such as prescribed burning, disking, and tilling) performed in advance of reforestation, to ensure adequate survival and growth of the future crop; or 2) manipulation of the vegetation or soil of an area prior to planting or seeding. The manipulation follows harvest, wildfire, or construction in order to encourage the survival and growth of favored species. Site preparation may include the application of herbicides; burning, or cutting living vegetation that competes with the favored species; tilling the soil; or burning of organic debris (usually logging slash).

Site productivity - Production capability of specific areas of land.

Size class - For the purposes of Forest planning, size class refers to a range of stem diameters used for classifying timber in the Forest Plan data base.

SEEDLING / SAPLING = less than five-inch diameter
POLE / SAPLING OR POLE TIMBER = five-inch to nine-inch diameter
SAWTIMBER = greater than nine-inch diameter

Skidding - A general term for moving logs by sliding; not on wheels; developed originally from "skidways" to move logs from stump to roadside, deck, skidway, or other landing.

Skyline logging - A system of cable yarding in which all or part of the weight of the logs is supported by a suspended cable.

Slash - The residue left on the ground after timber harvest, and/or accumulations that result from storm, fire, girdling or poisoning. It includes unutilized logs, uprooted stumps, broken or uprooted stems, the heavier branchwood, etc.

Small game - Birds and small mammals normally hunted or trapped as defined by State regulations. (2)

Small sawtimber - Trees (9.0-20.9 inches DBH) that will yield logs suitable in size and quality for the production of lumber. (3--Definition modified)

Smolt - The juvenile life stage of salmon or steelhead trout migrating to the ocean and undergoing physiological changes from a freshwater existence to a saltwater existence. (16)

Snag - A standing dead tree.

Socioeconomic - Pertaining to, or signifying the combination or interaction of social and economic factors. (2)

Softwoods - Coniferous trees, usually evergreen, having needles or scale-like leaves.

Soil - The portion of the earth's surface consisting of disintegrated rock and humus. (7)

Soil productivity - The capacity of a soil to produce a specific crop such as fiber or forage under defined levels of management. Productivity is generally dependent on available soil moisture and nutrients, and length of growing season.

Soil Resource Inventory (SRI) - See *Soil Surveys*.

Soil surveys - Systematic examinations of soils in the field and in laboratories; their description and classification; the mapping of kinds of soil; the interpretation according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or for other purposes; and their productivity under different management systems. (6)

Soil texture - The relative proportions of the various soil separates in a soil, described by the classes of soil texture. Twelve basic soil texture classes are recognized, such as "loam." The textural classes may be modified by the addition of suitable adjectives when coarse fragments are present in substantial amounts; for example, "stony loam."

Spawning habitat - Aquatic environments that provide adequate gravel, water quality properties and flow characteristics suitable for spawning and subsequent egg incubation.

Special Interest Areas - Areas managed to make recreation opportunities available for the understanding of the earth and its geological, historical, archeological, botanical, and memorial features. (6)

Special Management Areas (SMA) - Areas of unusual public interest or other significance, e.g.; wilderness, primitive areas, scenic areas, or archeological areas. SMAs do not require formal designation, however, Special Interest Areas do. (10)

Special Use Permit - A permit issued under established laws and regulations to an individual, organization, or company for occupancy or use of National Forest land for some special purpose.

Spotted Owl Habitat Area (SOHA) - A habitat area designated to support one pair of northern spotted owls. (2)

Spotted owl network - All lands contained in SOHAs and all suitable spotted owl habitat contained in management prescriptions which preclude timber harvest.

Stand (tree stand, timber stand) - An aggregation of trees or other vegetation occupying a specific area and sufficiently uniform in species composition, age arrangement, and condition as to be distinguishable from the forest or other vegetation or land cover on adjoining areas. (2)

Stand diversity - Any attribute that makes one timber stand biologically or physically different from other stands. This difference can be measured by, but not limited to: different age classes; species; densities; or non-tree floristic composition.

Stand examination surveys - Procedures to collect data on Forest stands.

Standard - A statement which describes a condition when a job is done properly. Standards show how well something should be done, rather than what should be done. (6)

Standards and Guidelines - Principles specifying conditions or levels of environmental quality to be achieved.

Statewide Comprehensive Outdoor Recreation Plan (SCORP) - The Statewide Comprehensive Outdoor Recreation Plan for the State of Washington.

Stocking - The degree of land occupancy by trees as measured by basal area or number of trees and compared to a stocking standard that is the basal area or number of trees required to fully use the growth potential of the land.

Stream blockage - Accumulation of soil, rock, and organic material deposited in a stream channel by landslides that prevent fish from moving upstream.

Stream buffer - Vegetation left along a stream channel to protect the channel or water from the effects of logging, road building, or other management activity. (See *Vegetation Leave Area.*)

Stream class - Classification of streams based on the present and foreseeable uses of the water, and the potential effects of on-site changes on downstream uses. Four classes are defined:

> *CLASS I* - Perennial or intermittent streams that: provide a source of water for domestic use; are used by large numbers of fish for spawning, rearing or migration; and/or are major tributaries to other Class I streams.
>
> *CLASS II* - Perennial or intermittent streams that: are used by moderate though significant numbers of fish for spawning, rearing or migration; and/or may be tributaries to Class I streams or other Class II streams.
>
> *CLASS III* - All other perennial streams not meeting higher class criteria.
>
> *CLASS IV* - All other intermittent streams not meeting higher class criteria. (10)

Streamflow - The flow of water, generally with its suspended load, down a well-defined water course. (6)

Streamside Management Unit (SMU) - An area of varying width adjacent to a stream where practices that might affect water quality, fish, and other aquatic resources are modified to meet water quality goals, for each class of stream. The width of this area will vary with the management goals for each class of stream, characteristics of the stream and surrounding terrain, and the type and extent of the planned activity.

Stream structure - The arrangement of logs, boulders, and meanders which modify the flow of water, thereby causing the formation of pools and gravel bars in streams. Generally, there is a direct relationship between complexity of structure and fish habitat. Complex structure is also an indication of watershed stability.

Structural habitat components - The configuration of elements, parts, or constituents of a habitat. (3--Definition modified)

Stumpage (stumpage value) - The value of timber as it stands uncut, in terms of an amount per unit of volume. (6)

Substantive comment - A comment that provides factual information, professional opinion, or informed judgment germane to the action being proposed. (10)

Successional stage - A stage or recognizable condition of a plant community that occurs during its development from bare ground to climax; for example, coniferous forests in the Blue Mountains progress through six recognized stages: grass-forb; shrub-seedling; pole-sapling timber; young timber; mature timber; old-growth timber. (2)

Suitability - The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices. (1) (2) (FSM 1905)

Suitable Forest land - Land to be managed for timber production on a regulated basis.

Supply - The amount of an output that producers are willing to provide at the specified price, time period, and condition of sale.

Supply Schedule (Curve) - A schedule of amounts of an output that producers are willing to provide at a range of prices, at a given point in time and condition of sale. (See *Price-Quantity Relationship*.)

Suppression - The process of extinguishing or confining fire. (2)

Suspended sediment - Any material carried in suspension by water, which will ultimately settle to the bottom. (16)

Sustained-yield of products and services - The achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the National Forest System without impairment of the productivity of the land. (1) (6)

System trail - A narrow travel way which is managed and maintained on a regular basis to specific trail standards.

T

Technology change - A change in the relationship between inputs and outputs in a production process resulting from the implementation of new technology, or a new application of existing technology. (10)

Tentatively suitable Forest land - Forest land that is producing or is capable of producing crops of industrial wood and: (a) has not been withdrawn by Congress, the Secretary, or the Chief; (b) existing technology and knowledge is available to ensure timber production without irreversible damage to soils productivity, or watershed conditions; (c) existing technology and knowledge, as reflected in current research and experience, provides reasonable assurance that it is possible to restock adequately within five years after final harvest; and (d) adequate information is available to project responses to timber management activities.

The Nature Conservancy (TNC) - A private organization whose primary function consists of the acquisition of land which The Nature Conservancy believes should be under management by a public agency. The land usually has some specific environmental or conservation value attached to it; such as land which fits one of the ecological niches identified for inclusion in the Research Natural Area program, or which has some unique values for wildlife management.

Theoretical capacity - The maximum annual amount of recreation use a developed site is designed to accommodate.

Thermal cover - Cover used by animals to ameliorate effects of weather.

Thinning - A felling made in an immature stand primarily to maintain or accelerate diameter increment and also to improve the average form of the remaining trees without permanently breaking the canopy. An intermediate cutting. (3)

Threatened species - Those plant or animal species likely to become endangered throughout all or a significant portion of their range within the foreseeable future. A plant or animal species identified by the Secretary of Interior as threatened in accordance with the 1973 Endangered Species Act. (See also *Endangered Species*.) (2)

Tiering - Refers to the coverage of general matters in broader environmental impact statements (such as National program or policy statements) with subsequent narrower statements or environmental analyses (such as Regional or Basin-wide program statements, or ultimately, site-specific statements) incorporating, by reference, the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. (40 CFR 1508.28)

Timber classification - Forest land is classified under each of the land management alternatives according to how it relates to the management of the timber resource. The following are definitions of timber classifications used for this purpose.

1. *Nonforest* - Land that has never supported forests and land formerly forested where use for timber production is precluded by development or other uses.

2. *Forest* - Land at least 10-percent stocked (based on crown cover) by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use.

3. *Suitable* - Commercial forest land identified as appropriate for timber production in the forest planning process.

4. *Unsuitable* - Forest land withdrawn from timber utilization by statute or administrative regulation (for example, wilderness) or identified as not appropriate for timber production in the forest planning process.

Timber harvest schedule - See *Sale Schedule.*

Timber Management - The management of the forest to enhance production of wood products for commercial use. (16)

Timber Management Resource Plan (TM Plan) - A functional resource plan which establishes a sale volume to be sold each year based upon an analysis of the most recent resource inventories. This plan is an integrated plan which considers implications to other resources on the Forest.

Timber production - The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. For purposes of Forest planning, the term "timber production" does not include production of fuelwood or harvest of unsuitable lands. (1) (2)

Timber Sale Program Quantity - The volume of timber planned for sale during the first decade of the planning horizon. It includes the allowable sale quantity (chargeable volume) and any additional material (nonchargeable volume) planned for sale. Expressed as the average for the first decade.

Timber stand improvement (TSI) - Measures such as thinning, pruning, release cutting, prescribed fire, girdling, weeding, or poisoning of unwanted trees aimed at improving the growing condition of the remaining trees. (2)

Topography - The configuration of a surface including its relief, elevation, and the position of its natural and human-created features. (6)

Total suspended particulates (TSP) - Any finely divided material (solid or liquid) that is airborne with an aerodynamic diameter smaller than a few hundred micrometers.

Tractor logging - Any logging method which uses a tractor as the motive power for transporting logs from the stumps to a collecting point--whether by dragging or carrying the logs. (3)

Tradeoff - The combination of benefits and costs which are gained and lost in switching between alternative courses of action. Trade-offs include only those portions of benefits and costs which are not common to all alternative courses of action under consideration. (6)

Trailhead - An area at the beginning of a trail with facilities ranging from roadside parking to a parking lot with toilets.

Trail Management Objective - The Primary Management Objective or planned type (hiker, ORV, stock, etc.), difficulty level (easiest, more difficult, and most difficult) and level of use (low, moderate or heavy) a trail is designed and maintained to serve.

Transitory range - Land that is suitable for grazing use of a nonenduring nature over a period of time; often found in the openings created by timber harvesting activities. For example, on particularly disturbed lands, grass may cover the area for a period of time before being replaced by trees or shrubs not suitable for forage. (6)

Treasury deposit - Forest cash income, less payments to counties. Calculated by subtracting direct costs and payments to counties from total Forest receipts. These represent actual deposits from the Forest to the Treasury.

Turbidity - The degree of opaqueness, or cloudiness, produced in water by suspended particulate matter, either organic or inorganic. Measured by light filtration or transmission and expressed in Jackson Turbidity Units (JTUs) or Nephelometric Turbidity Units (NTUs).

U

Unavailable Forest land - Land that can grow productive forest crops (timber) but has been legislatively or administratively allocated to forest uses that preclude timber harvest.

Understory - The trees and other woody species growing under a more-or-less continuous cover of branches and foliage formed collectively by the upper portion of adjacent trees and other woody growth. (6)

Undeveloped area - Portion of the National Forest that is essentially unroaded.

Undeveloped recreation - A general term referring to recreation use outside developed recreation sites; this includes activities such as scenic driving, hiking, backpacking, hunting, fishing, snowmobiling, horse-back riding, cross-country skiing, and recreation in primitive environments. (2)

Uneven-aged management - The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection. (1)

Uneven-aged silviculture systems - The combination of actions that result in the creation of forests or stands of trees, in which trees of several or many ages grow together. Cutting methods that develop and maintain uneven-aged stands are individual tree and group selecting cutting methods:

> *INDIVIDUAL TREE SELECTION CUTTING* - The removal of selected trees of all size classes on an individual basis.
>
> *GROUP SELECTION CUTTING* - The removal of all trees in groups for regeneration purposes. The size of the group will be small enough in area that all subsequent regeneration will be influenced by the surrounding uncut stand. Cuts are generally .25 - 2.0 acres in size.

Unplanned ignition - A fire started at random by either natural or human causes, or a deliberate incendiary fire.

Unsuitable Forest Land - Forest land not managed for timber production because: (a) Congress, the Secretary of Agriculture, or the Chief of the Forest Service has withdrawn it; (b) it is not producing or capable of producing crops of industrial wood; (c) technology is not available to prevent irreversible damage to soils, productivity, or watershed conditions; (d) there is no reasonable assurance, based on existing technology and knowledge, that it is possible to restock lands within five years after final harvest, as reflected in current research and experience; (e) there is, at present, a lack of adequate information about responses to timber management activities; or (f) timber management is inconsistent with or not cost-efficient in meeting the management requirements and multiple-use objectives specified in the Forest Plan. (10)

Utility corridor - A strip of land, up to approximately 600 feet in width, designated for the transportation of people, energy, commodities, and communications by: railroad, state highway, electrical power transmission (66 KV and above), and/or oil, gas, and coal slurry pipelines 10 inches in diameter and larger; and telecommunication cable and electronic sites for interstate use. (1)

Utilization standards - Standards guiding the projection of timber yields and the use and removal of timber. The standards are described in terms of minimum diameter at breast height, minimum length, and percent soundness of the wood, as appropriate. (1)

V

Variety Classes - A particular level of visual variety or diversity of landscape character. Variety Classes are obtained by classifying the landscape into different degrees of variety based on the premise that all landscapes have some value, but those with the most variety or diversity have the greatest potential for high scenic value.

There are three variety classes which identify the scenic quality of the natural landscape:

CLASS A (DISTINCTIVE) - Areas with landforms, water features, vegetative patterns, or rock formations that create a landscape of unusual and outstanding visual quality.

CLASS B (COMMON) - Areas with landscape features that provide an average amount of variety and create a landscape that is common to the area.

CLASS C (MINIMAL) - Areas with little change in their landscape features and little scenic quality.

Vegetation leave area - Area of land in which vegetation is left undisturbed in order to provide shade and organic debris to streams, or to prevent the acceleration of natural erosion processes. No regulated timber harvest is planned in these areas.

Vegetative management - Activities designed primarily to promote the health of the crop forest cover for multiple-use purposes.

Vertical relief - A contour variation of the land surface perpendicular in relation to the surrounding land. (3) (4)

Viable population - A population which has adequate numbers and dispersion of reproductive individuals to ensure the continued existence of the species population on the planning area. (FSM 1905)

Viewshed - Portion of the Forest that is seen from a major travel route, or high use location.

Viewshed Schedule - A document identifying management direction for meeting the goal and desired future condition described for areas allocated to the Scenic A2 management prescription.

Visual Absorption Capacity (VAC) - The physical capability of the land to support management activities without significantly affecting its visual character. Rated as high, moderate, and low.

HIGH (H) - High visual capability to absorb change.
MODERATE (M) - Moderate visual capability to absorb change.
LOW (L) - Low visual capability to absorb change.

Visual Enhancement - A short-term management alternative which is done with the express purpose of increasing positive visual variety where little variety now exists. (2)

Visual Management System - A process for identifying the visual characteristics of National Forest landscapes for the purpose of planning and analyzing ways to maintain or upgrade an area's scenic values and design resource management activities in order to minimize their visual effects as viewed from public use areas.

Visual Prescription - Management guidelines aimed at meeting Visual Quality Objectives. Visual prescriptions are identified by two major factors: Visual Quality Objective and Distance Zone.

Visually Sensitive Area - A viewshed seen from Visual Sensitivity Level One or Two--travel routes, use areas, or water bodies.

Visual quality objective (VQO) - Categories of acceptable landscape alteration measured in degrees of deviation from the natural-appearing landscape.

PRESERVATION (P) - Provides for ecological changes only.

RETENTION (R) - Management activities should not be evident but remain visually subordinate to the characteristic landscape.

MODIFICATION (M) - Management activities may dominate the characteristic landscape but must, at the same time, follow naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.

MAXIMUM MODIFICATION (MM) - Management activities may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

Visual resource - The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for visitors. (2)

Visual Sensitivity Level - A particular degree or measure of viewer interest in the scenic qualities of the landscape:

1. *LEVEL ONE* - High viewer interest.

2. *LEVEL TWO* - Moderate viewer interest.

3. *LEVEL THREE* - Low viewer interest. (17)

W

Water Influence Zone (WIZ) - An area comprised of aquatic, riparian, and adjacent terrestrial ecosystems. Includes flood plains, wetlands, and other lands adjacent to streams and lakes that can directly influence aquatic and riparian habitats. (10)

Water rights - Rights to divert and use water or to use it in place.

Water yield - The measured output of the Forest's streams. (6)

Watershed - The entire land area that contributes water to a drainage system or stream. (6)

Watershed impact area - Areas within a watershed that are being affected by harvesting, road building, etc. Impact areas are limited to a percent of the total watershed area by the Standards and Guidelines in Chapter IV of the Forest Plan.

Westside Zone - The portion of the Olympic National Forest that includes the Soleduck and Quinault Ranger Districts and the Satsop Block area of the Hood Canal Ranger District.

Wetlands - Areas that are inundated by surface or ground water often enough to support, and usually do support plants and animals that require saturated or seasonally saturated soil conditions for growth and reproduction. (E.O. 11990)

Wild and Scenic River - Those rivers or sections of rivers designated as such by congressional action under the 1968 Wild and Scenic Rivers Act, as supplemented and amended, or those sections of rivers designated as wild, scenic, or recreational by an act of the legislature of the state or states through which they flow. Wild and scenic rivers may be classified and administered under one or more of the following categories:

1. *WILD RIVER AREAS* - Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.

2. *SCENIC RIVER AREAS* - Those rivers or sections of rivers that are free of impoundments, with watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

3. *RECREATIONAL RIVER AREAS* - Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past. (2) (6)

Wilderness - Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation. Wildernesses are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or a primitive and unconfined type of recreation; are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecologic and geologic interest. Five Wildernesses were designated as a result of the Washington Wilderness Act of 1984. (2)

Wilderness Implementation Schedule - A document providing management direction aimed at meeting the goal and desired future condition for areas allocated to the Wilderness B1 management prescription.

Wilderness Resource Spectrum (WRS) - A framework for stratifying and defining classes of Wilderness environment, activities, and experience opportunities. The settings, activities, and opportunities for obtaining experiences have been arranged along a continuum or spectrum divided into the following classes:

CLASS I (LEAST PRISTINE)

An area that is characterized by a predominantly unmodified natural environment. The area generally receives high to very high use and day use may be a significant portion of the visitation. Evidence of other users within the area is high and campsites may be present. Fire rings at campsites may be present where campfires are permitted. System trails are present and their difficulty level generally ranges from Easiest to More Difficult. Stock users may stay overnight. Visitors will generally not experience a high level of solitude, risk, or challenge. Rustic signs and structures may be present. There will be a high frequency of contact with management personnel. This is a semi-primitive and the least pristine WRS class.

CLASS II

An area that is characterized by an unmodified natural environment. The area generally receives moderate to high use and day use may be a minor portion of the visitation. Evidence of other users within the area is moderate and campsites may be present. Fire rings at campsites may be present where campfires are permitted. System trails are present and their difficulty level generally ranges from More Difficult to Most Difficult. Stock users infrequently stay overnight. Visitors will generally have a moderate level of solitude, risk, and challenge. Rustic signs and structures may be present. There will be a moderate frequency of contact with management personnel. This is a semi-primitive WRS class.

CLASS III

An area that is characterized by an unmodified natural environment. The area generally receives low to moderate use and day use may be a minor portion of the visitation. Evidence of other users within the area is low to moderate and campsites without fire rings exist but are not noticeable from other campsites. System trails are not present. Stock users infrequently stay overnight. Visitors will generally have a high level of solitude, risk, and challenge. There are no signs or structures. There will be a low frequency of contact with management personnel. This is a primitive WRS class.

CLASS IV (MOST PRISTINE)

An area that is characterized by an unmodified natural environment. The area generally receives very low to low use and there is generally no day use. Evidence of other users within the area is very low and campsites and fire rings do not exist. System trails are not present. Stock users do not visit this area. Visitors will have a high level of solitude, risk, and challenge. There are no signs or structures. There will be a very low frequency of contact with management personnel. This is the most pristine WRS class.

Wildfire - Any wildland fire that is not a prescribed fire (see also *Prescribed Fire*). (2)

Wildlife and Fish User Day (WFUD) - Twelve visitor hours which may be aggregated continuously, intermittently, or simultaneously by one or more persons.

Windthrow - See *Blowdown.*

Withdrawal - A legislative or administrative order removing specific land areas from availability for certain uses.

Wood fiber production - The growing, tending, harvesting, and regeneration of harvestable trees.

Woody material - Organic materials necessary for stream channel stability and maintenance of watershed condition. It includes large logs and root wads.

Working circle (WC) - The primary unit of forest management, with well-defined boundaries, usually based on topography, large enough to furnish a sustained yield of forest products sufficient to support dependent communities or industries. (6)

Working group - A term used for planning purposes to identify and group the major commercial tree species harvested from the Forest. These classifications are based on the vegetative potential of a site and not necessarily the actual vegetative occupancy of the site. Working groups are further stratified by productivity potential.

X, Y, Z

Xeric - A dry soil moisture regime. Some moisture is present but does not occur at optimum levels for plant growth. Irrigation or summer fallow is often necessary for crop production. (3)

Yarding - Hauling timber from the stump to a collection point. (2)

Yield tables - Tables that estimate the level of outputs that would result from implementing a particular activity. Usually referred to in conjunction with FORPLAN input or output. Yield tables can be developed for timber volumes, range production, soil and water outputs, and other resources.

Zone of influence - The geographic area whose social, economic and/or environmental condition is significantly affected by changes in Forest resource production or management.

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