Long-Term Soil Productivity

Soil is a basic nonrenewable resource. The demands for sustained timber production create a need for maintaining long-term soil productivity. The ability of soils to remain productive depends largely on the management practices that are allowed. Future management will likely include shorter rotations of timber, the use of mechanical timber harvesting equipment and more complete utilization of woody residues The effect of repeated activities, over a long period of time, has the greatest potential of lowering forest soil productivity. The maintenance or enhancement of the soil resource is a primary goal of management

The components of long-term soil productivity have been identified as the preservation of·

1. Surface litter and topsoil layers;
2 Soil organic matter and its replacement;
3 Soil organisms and biological systems; and
4. Soil porosity, structure, drainage and aeration.

The goal is to maintain or enhance soil productivity This directs the Forest Soil Program to measure, quantify and evaluate the effects of management activities on the natural capacity of soils to heal after disturbances The Forest-Wide standard/ guidelines for soils as well as FSM 2521 R6 supplement No.50, June 1987 provide a basis from which to measure these changes.

Compaction

Soil compaction is an increase in the soils bulk density and a decrease in its porosity, resulting from the application of mechanical forces such as weight and vibration. It usually reduces the productivity of the land (Helms, 1978; Froehlich, 1972 and 1979; Meurisse, 1978). Air and water movement into and within the soil affect biological activity, and ultimately nutrient availability necessary for vigorous plant growth. Changing soil properties through human activities that induce compaction, puddling, erosion, displacement and mass movement (Boyer, 1981) will lower the sites ability to produce. In particular, soil compaction on many sites has led to decreased water infiltration, accelerated erosion of topsoils, damage to soil biological systems and reduced seedling growth (Cochran and Brock, 1985).

Detrimental compaction in volcanic ash and pumice soils is an increase in soil bulk density of 20 percent or more over the undisturbed level. In other soils, an increase in soil bulk density of 15 percent or more over the undisturbed level, a macropore space reduction of 50 percent or more, and/or a reduction below the 15 percent level as measured by an air permeameter.

Displacement

Soil displacement is the horizontal movement of soil from one place to another, triggered by mechanical force such as a tractor blade Regional standards define soil displacement as detrimental when more than 50 percent of the topsoil or humus-enriched A1 and/or AC horizons is removed from an area of 100 square feet or more which is at least 5 feet in width

Burning

Soils are considered to be severely burned when the top layer of mineral soil has been significantly changed in color, usually to red, and the next one-half inch blackened from organic matter charring by heat conducted through the top layer.

Erosion

Surface erosion is the detachment and transport of individual soil particles by wind, water or gravity. Surface erosion occurs as the loss of soil is a fairly uniform layer across the land surface or in many small rills.

In summary, the prevention of soil damages before they occur is better than trying to rebuild productive capacity. In the past, the Forest tried soil moisture as a critera to control ground skidding equipment. In certain situations it is very effective, but may have limited success because of naturally varying soil moisture levels within a sale area. The current emphasis is toward a "fixed ground skidding" network designed to concentrate the machine disturbance within allowable levels. Where lands exceed tolerable levels of soil damage, reclamation measures are warranted. These include tillage of compacted soils, back blading of mounds or berms, fertilization, or spreading of biologically rich organic materials to rebuild the organic matter levels

Water

Streams

The Deschutes is a remarkably forgiving Forest, slopes are gentle and soils are very porous[1]. While there are localized road erosion problems, there are very few documented instances of accelerated surface erosion or stream sedimentation and cummulative effects are not of significance[2] Problems do occur under severe conditions such as rain on frozen ground or rapid snowmelt. The Forest is actively treating road network drainage problems which cause the greatest amount of erosion and sedimentation[3]. These problems occur on a small percentage of the Forest and are not common on a Forest-wide basis. Best management practices, which include proper road location and design and streamside management prescriptions, are utilized to protect against accelerated erosion or sediment problems.

Streamflow on the Forest generally originates from deep-seated springs. As such, streamflow is very stable and is not subject to frequent flooding[4]. Other than under severe conditions, such as rain-on-snow, streams on this Forest are rarely high enough to overtop their banks. Channel stability, evaluated in terms of bank slope, vegetative cover, cutting, deposition, and debris, is "good" or "fair" with some zones of "excellent"[5]. Streams flowing through permanent range, which has been grazed over the last several decades, are in good shape and exhibit little of the traditional problems associated with cattle grazing[6] (loss of cover, channel widening, loss of banks) Stream temperatures are cold, outflow from spring vents is characteristically between 40 and 45 degrees Fahrenheit and downstream temperatures rarely exceed 70 degrees[7]. Best management practices are used to maintain streamside vegetation and channel stability whenever a management activity is proposed along a stream or lake.

[1]Larsen, Daniel M Soil Resource Inventory, Deschutes National Forest, Pacific Northwest Region, 1976

[2]Hughes, Dallas Letter (2500) documenting service trip October 9, 1984 Regional Office, Pacific Northwest Region

[3]McCammon, Bruce. Hydrologic Investigation of the Effects of Timber Harvesting and Road Construction within Watersheds Tributary to the Metolius River Deschutes National Forest, Pacific Northwest Region, 1984

[4]McCammon, Bruce Prediction of Flood Magnitude and Frequency on the Deschutes National Forest (a) and Streamflow Summary of the Deschutes National Forest (b) Deschutes National Forest, Pacific Northwest Region, 1979

[5]Satterthwaite, Thomas Unpublished Field Evaluations of Channel Stability Deschutes National Forest, Pacific Northwest Region, 1979

[6]Hughes, Dallas Letter (2540) dated September 10, 1982 Regional Office, Pacific Northwest Region

[7]McCammon, Bruce Numerous Technical Reports and Summaries on Water Quality Monitoring, Deschutes National Forest, Pacific Northwest Region, 1978-1985

A good example of this is the Metolius River, which rises from a series of spring vents near Black Butte. The Metolius is one of the largest spring-driven streams in the United States. Such streams are not subject to the wide fluctuation of flow commonly found in the western U.S. Flooding occurs only under extreme circumstances, such as rapid snow melt on frozen ground.

Another consequence of the very stable flows are generally well armored banks which are in good condition. Riparian vegetation is also in good condition throughout most of the Forest and serves to protect the streambanks from occasional over-bank flow

There is one exception to the very stable flows, well armored streambanks and excellent riparian zone conditions. Approximately 35 percent of the streambank along the Upper Deschutes from Wickiup Reservoir to Benham Falls in an unstable, highly eroding condition

This condition is caused by the release schedule of local irrigation districts. The normal historical flow for the Upper Deschutes near Wickiup Reservoir was almost 1,500 cubic feet per second (cfs). Currently irrigation districts hold all but 20 cfs in Crane Prairie and Wickiup Reservoirs during the winter and early spring (November through April) and then release over 2,000 cfs during the irrigation season.

Frost action on the high pumice streambanks during the winter, when flow is very low, causes piping and disintegration Past efforts to mitigate this degradation have met with little success

Short of very expensive mechanical measures, specialists who have studied the situation believe the only remedy is to return the stream to a more even year-around flow.

There are more than 732 miles of stream on the Forest. There are four stream classifications based on the beneficial uses and the potential for affecting downstream watercourses. Class 1 streams are important as fish habitat, recreational areas and for domestic, municipal water supply, or irrigation Class 2 streams are moderately important to fish and water quantity. Class 3 streams are perennial streams that do not meet Class 1 and 2 criteria.

Class 4 streams are intermittent or empheremal. The miles of stream by class are.

Class	Miles
1	161
2	181
3	164
4	226

The surface water yield on the Forest during a normal water year is approximately 2.26 million acre feet (based on water year 1978). Much of this water is immediately used as it leaves the Forest boundary for irrigation, domestic domestic water supply, and to generate hydropower. Nearly all the water leaving the Forest receives some beneficial use by humans prior to reaching the Columbia River.

Lakes

The Forest has some of the most strikingly scenic water bodies on the West Coast Lakes are glacial, volcanic, and man-made in origin Some have surface inflow but no surface outflow (Davis, Sparks) Others have no inflow but considerable surface outflow (Little Lava, the source of the Deschutes River).
There are a total of 304 lakes on the Forest, many of which are small glacially formed lakes in Wildernesses near the Cascade crest. There are three major irrigation reservoirs on the Forest: Wickiup, Crane Prairie, and Crescent Lake. They provide a total storage of about 341,000 acre feet used to irrigate lands north and east of Bend and as far north as Madras.

Two lakes (Paulina and East) lie within the caldera of Newberry volcano. While there is no surface inflow into these lakes, one stream does flow out of Paulina Lake. This is a unique hydrologic regime, isolated and tied to an area of significant geothermal energy potential.

Ground Water

The Forest ground water reservoir is highly variable, but very large in general. In areas near Ft. Rock and LaPine the water table is only 20 to 30 feet

deep In other areas, wells several hundred feet deep must be drilled to reach water.

The overall flow direction of ground water appears to be north and east, with a few exceptions where the chain of cones running north to south from Broken Top to Round Mountain cut off this flow pattern and cause the water to flow South and around Round Mountain before swinging North-east.

Information permitting predictions about ground water levels, flow patterns, and ground water quality is generally lacking. An undetermined amount of groundwater is believed to be lost to underground aquifers (possibly lava conduits), but the water reappears as springs along the lower Deschutes River (Bend to Lake Billy Chinook).

Water Quality

The water quality of streams, lakes and ground water on the Forest has been monitored for several years by the Forest Service, the Oregon Department of Environmental Quality, and the Oregon Department of Fish and Wildlife. With few exceptions, water quality is considered excellent. Surface water is characteristically very cold (40-44 degrees Fahrenheit) due to ground water inflow. Low in chemical concentrations, this surface water is suitable for all the identified beneficial uses in the Deschutes River Basin.

There have been a few violations of water quality standards in and near the Forest Most are associated with agricultural activities on or along the streams which flow through mixed ownership lands Some areas of documented water quality violations are:

Violations of water temperature standards because of the diversion of large amounts of water for irrigation

Temperature violations when water has been stored in shallow reservoirs and then released during the irrigation season.

Turbidity violation when large quantities of water are stored during the winter in reservoirs, then released at high volumes during the irrigation season This usually occurs during the late spring and early summer season

Major degradation to the streambanks and turbidity violations when there is extensive grazing on mixed ownership lands during the spring runoff season.

Turbidity violation when poorly designed skid trails in emphermeral drainages concentrate water

Most of these violations are short term but occur annually. Some are under the jurisdiction of the Forest Service, which initiates restoration activities. Others are beyond the ability of the Forest to deal with under present water and property rights laws Most of these short duration, annual problems are occurring in drainages which possess streams designated as Wild, Scenic or Recreational under either federal or State law.

In compliance with Section 208 of Public Law 92-500, the State of Oregon evaluated the State Forest Practices Act and its ability to act as a set of Best Management Practices (BMP's) The State evaluated the Forest Service Manual requirements, contract language, and Code of Federal Regulations to test if they operate under State policies and requirements and met the intent of Section 208 of Public Law 92-500, which the Forest did. The Forest Service is charged with meeting the substantive and procedural requirements of the State water quality laws and regulations which are contained in River Basin Water Quality Plans The Forest uses BMP direction to guide every day activities such that water quality laws are complied with and sources (or potential sources) of pollution are avoided.

Implementation of the State Water Quality Management Plan on lands administered by the U S Department of Agriculture--Forest Service (USDA Forest Service) is described in a Memorandum of Understanding (MOU) between the Oregon Department of Environmental Quality (DEQ) and USDA Forest Service (2/79), and "Attachment A" referred to in the MOU (Implementation Plan for Water Quality Planning on National Forest lands in the Pacific Northwest 1978). This MOU and plan provide the basis for the interagency agreement, whereby the Governor of the State designates the Forest Service as the implementing agency for non-point

source pollution control on lands under its jurisdiction This agreement has been updated with a Memorandum of Agreement (MOA) 1990, between the DEQ and USDA Forest Service, pursuant to Section 319 of the Clean Water Act.

The 1979 agreement provides for annual meetings between Region 6 and the DEQ to evaluate the program and progress being made and provides the basis for recertification by the Governor. Available monitoring information is reviewed, revisions, or additions to the best management practices are addressed, progress on problem identification and treatment is provided, and reports are written and submitted by the State to the Environmental Protection Agency (EPA).

In compliance with Section 319 of the Clean Water Act, DEQ has issued the "Oregon Clean Water Strategy" to provide a strategic management plan for the prevention and correction of non-point source water quality problems The Forest would work with the DEQ to resolve the water quality status of waters on the Forest.

Historical Cumulative Effects

Cumulative effect happens when a number of different activities occur in a watershed Each activity may make a minor contribution to the degradation of the resource but cumulatively the impacts can be significant. Two potential areas of cumulative effect have been investigated on the Forest:

Increases in streamflows associated with management activities, causing degradation to the stream channels, and corresponding reduction in water quality.

Small contributions of sediment from many sources or activities resulting in degradation of water quality.

A Forest hydrologist studied these two potential impacts in the Metolius Basin in 1984. The final report identifies no known or observable cummulative effects occuring within the basin. This was due to the resilient nature of the soils, stream bank stability, the health of riparian vegetation and runoff characteristics in the watershed (spring flow driven).

An identified problem was road drainage water which required some changes in road design and application of best management practices during road/skid trail construction and maintenance. In the professional judgement of a number of watershed specialists, adverse cummulative effects have not occurred elsewhere on the Forest and the potential for future cummulative effects is small. The accuracy of this estimate will be determined by monitoring.

Floodplains and Wetlands

Inventories show that there are approximately 18,800 acres of wetlands/riparian zones on the Forest and 29,700 acres of floodplains. Many floodplain acres are wetlands so there is overlap in these figures. Wetlands/riparian zones occur along major streams, rivers and lake shores. Others occur in isolated meadows and are associated with springs and seeps.

There was early recognition of the need to maintain healthy riparian vegetation and stable streambanks on the Forest. The condition of these wetlands/ riparian zones and floodplains is good, with very little degradation. This is attributable to the highly stable flows, dominated by spring driven stream systems and flow regimes. The extremely high stability of the soils and their capability to maintain high infiltration rates and capacities after disturbance contributes to stable conditions

Municipal Watersheds

The Forest contains two municipal watersheds, the City of Bend in the Bridge Creek Watershed and the City of Sisters in the Pole Creek Watershed. The former operates under a 1926 formal agreement between the Bend and the secretary of Agriculture Management within the watershed has been custodial with all actions being subservient to maintaining the highest quality of water possible. There is no existing formal agreement with the City of Sisters. The Sisters water department has expressed satisfaction with the Forest's management of the watershed, which has maintained a high quality of water for the City's uses.

Water Uses

Surface water is a focal point for at least 50 percent of recreation on the Forest. This includes boating, fishing, hiking, and camping. Water originating on the Forest is also used for irrigation, domestic water supply, and power generation. The largest diversion of water from the Forest is for irrigation. About 864,000 acre feet are used to irrigate 160,000 acres between Bend and Madras annually. Runoff from the Forest is used to generate power in Bend, and at Round Butte, Pelton, the Dalles, and Bonneville Dams

The Deschutes River Basin above Bend was withdrawn from further water rights appropriation by the State Engineer in 1969. This withdrawal means that applications for surface water use in the upper basin are not accepted by the State except in certain situations. The Deschutes National Forest currently has several water rights for use of water, and is filing on those uses for which the State will accept applications. The present consumptive use of the Forest is approximately 59,000 acre feet Future consumptive needs are expected to be less than 5% additional where non-consumptive needs may far exceed this amount. Where it is not possible to obtain a surface water right, other sources are being considered (e.g. groundwater, purchase of water). It appears that the greatest potential for increasing water availability from the Forest is through increased transmission efficiency of irrigation canals and ditches. Currently, between 45-60 percent of water conveyed is lost.

Fish

The Deschutes National Forest has approximately 300 miles of fish bearing streams, of which 160 miles have sufficient fish populations and habitat to support a decent fishery. Two major rivers drain Forest lands, the Deschutes and Metolius. These rivers are known for quality fishing both historically and, in some reaches, today. Approximately 136 lakes contain sport fish. Nine are known for fine fishing and are of regional importance Prior to construction Round Butte Dam on the lower Deschutes River, anadromous fish (steelhead and salmon) traveled up the Metolius River and Squaw Creek. Currently there are no anadromous fish runs on the Forest.

Fishing is one of the most important recreational activities on the Forest The Oregon Department of Fish and Wildlife estimates that there were 348,100 angler days of recreation activity associated with fishing in 1987. Much is associated with the large lakes and reservoirs and the Deschutes and Metolius Rivers. Fishermen spend an estimated $7.7 million annually to pursue the activity on the Forest and about 322,700 fish are harvested annually

Fish species are distributed within the 300 miles of fishbearing streams as shown in Figure 3-2. The percentages may not represent the actual biomass but rather indicate the amount of habitat occupied or seasonally used by fish species. The native resident fish on the Forest streams are the redband rainbow trout, bull trout and whitefish. All other game fish have been introduced. Non-game fish include sculpins and dace. The Metolius River and portions of the Deschutes River are well known for quality fishing. The Metolius River has been designated as special management stream where wild trout must be released.

Figure 3-2 Miles of Fishbearing Streams

Species	Percent of Total Miles
Rainbow	70
Brown	62
Brook	55
Whitefish	46
Kokanee	18
Bull Trout	17
Coho	3

The quality of fishing is excellent for wild rainbow, brown and bull trout. These fish are closely associated with undercut banks and subsurface cover This habitat was impaired in the 1940's when the Metolius was cleared of large woody material to facilitate log rafting. Restoration of instream cover has been underway for the last few years.

The quality of fishing is fair to good on the Deschutes. Habitat degradation has occured from Wickiup Reservoir to Benham Falls. Reservoir regulation, low winter flows, frost action, ice heaving on many low banks, removal of large woody material, and sediment deposition within the key overwintering pool habitat has resulted in a major decline in habitat quality.

Smaller streams which provide quality fishing experiences on the Forest include Squaw Creek, Little Deschutes River, Big Marsh Creek, Crescent Creek and all the tributaries of the Metolius River. They provide diverse opportunities to angle for rainbow, brown, and brook trout and white fish.

Overall, inventory data indicate most fish habitat is in good or better condition. Nearly half the miles of streams on the Forest have been surveyed and the remainder is expected to be surveyed in the next three years. The three streams with the worst habitat quality are deficient in large woody material, instream flows (irrigation storage and diversions) and severe bank erosion.

Lake fisheries may be stratified by grouping lakes into those which are accessible by car and those which are not. Figure 3-3 shows the species of fish which can be found in both.

Figure 3-3 Location of Fishbearing Lakes (in percent)

Species	Car Access	Backcountry Lakes
Atlantic salmon	9	0
Brook trout	59	70
Brown trout	19	0
Coho	9	0
Cutthroat	13	7
Bull trout	6	0
Golden trout	0	4
Kokanee	28	0
Lake trout	13	0
Rainbow trout	72	19
Whitefish	25	0

The nine lakes which have regional importance are Crane Prairie, Davis, O'Dell, Crescent, Wickiup, Suttle, East and Paulina, and Billy Chinook. All provide top quality fishing and are heavily fished Recently, Hosmer Lake has provided a very important and unique fishery. It is stocked with Atlantic Salmon and a catch and release flyfishing policy has been establish for the species. Campgrounds and parking adjacent to the lake are commonly full when salmon are hitting flies. The popularity of this high quality fishing experience is expected to increase.

Davis and Crane Prairie are known for rainbow trout, Big Cultus and O'Dell are known for their lake trout and Crescent, O'Dell, Wickiup, Crane Prairie, Suttle, Billy Chinook, Paulina and East Lake for kokanee. There has been an illegal introduction of large mouth bass in Crane Prairie in the past few years and the population of this species is exploding Bass of two pounds and better are reasonably common.

Numerous fish habitat restoration and improvement projects have been undertaken on the Forest. The funding for these projects has been steadily increasing as cost sharing with local chapters of state and national fishing groups becomes more common. Flyfishing groups have provided money and volunteer time This program will become increasingly important in improving access, fish habitat and the enjoyment of fishing on the Deschutes National Forest.

Wildlife

The Forest provides habitat for a wide variety of vertebrate wildlife species, including at least 16 species of reptiles, 8 species of amphibians, 84 species of mammals, and 243 species of birds.

All reptile and amphibian species are yearlong residents, as are most of the mammal species Some of the predatory mammals (e g. coyote and cougar) and hoofed mammals (e.g deer, elk, and pronghorn) move to lower elevations or off-Forest to winter. Most bird species migrate to southern latitudes to winter.

Management Indicator Species

Certain wildlife species have been identified and selected as management indicator species (MIS) because their populations are believed to be influenced by forest management activities. They were chosen because they. (1) are designated as Proposed, Endangered, Threatened, or Sensitive on Federal or Oregon state lists, or; (2) have special habitat needs that may be influenced significantly by plannned management activities, or; (3) are popular for hunting or trapping, or; (4) are nongame species of special interest, or; (5) indicate the effects of management for other species within major biological communities.

Management indicator species selected for the Forest are·

Peregrine falcon
Northern bald eagle
Northern spotted owl
Northern goshawk
Three-toed woodpecker
Pine marten
Osprey
Woodpeckers
Elk
Mule deer

Proposed, Endangered, Threatened, and Sensitive Species

There are 33 Proposed, Endangered, Threatened, and Sensitive (PETS) species known or suspected to occur on the Deschutes National Forest. Of these, 3 have been listed, or are proposed for listing, by the USDI Fish and Wildlife Service. They are the American peregrine falcon (Endangered), northern bald eagle (Threatened), and northern spotted owl (Proposed).

In addition to the above species, the Regional Forester has also designated as Sensitive 3 *invertebrates, 3 birds, 3 mammals, and 19 plants* (FSM 2670, R-6 Interim Directive No. 6, dated August 15, 1989). These are, respectively:

Alsea micro caddisfly
Cascades apatanian caddisfly
Klamath limnephilan caddisfly
American white pelican 1/
Ferruginous hawk
Western sage grouse 1/
Greater sandhill crane
Long-billed curlew
Preble's shrew 1/
Pacific western big-eared bat
Pygmy rabbit 2/
California wolverine
Agoseris elata
Allium campanulatum
Arnica viscosa
Artemisia ludoviciana spp. *estesii*
Aster gormanii
Astragalus peckii
Botrychium pumicola
Calochortus longebarbatus var *longebarbatus*
Campanula scabrella
Castilleja chlorotica
Cysmopterus bipinnatus
Draba aureola
Gentiana newberryi
Hieracium bolanderi
Lobelia dortmanna
Lycopodium annotinum
Mimulus jepsonii
Ophioglossum vulgatum
Penstemon peckii

[1]Labeled incorrectly as *not* being documented or suspected on the Forest.

[2]Labeled incorrectly for this Forest because the species is not Sensitive in the state of Oregon

American Peregrine Falcon

The American peregrine falcon is known to have nested on the Forest in only one location. That site has been unoccupied for the last several years. Suitable cliff nesting sites are rare on the Forest. Infrequent sightings have been, and continue to be, reported for locations along the Cascade Mountains crest and Deschutes River, and are thought to be unmated individuals

Northern Bald Eagle

Within the state of Oregon, 186 bald eagle nesting territories have been identified (through year 1989). Of the 36 nesting territories known within the Pacific Bald Eagle Recovery Plan's High Cascades

Recovery Zone (USDI Fish and Wildlife Service, 1986), 24 (67%) are located on Deschutes National Forest land. Twenty-two of the 24 have been active in recent years, and many are located within the Deschutes River drainage.

Certain river or lake locations on the Forest are extremely important as feeding sites during the reproductive, fall, and winter periods Although individualistic in behavior, most bald eagles are sensitive to human disturbance during these time periods. Over-mature Ponderosa pine or mixed-conifer forest is preferentially selected by eagles for nesting or winter-roosting habitat

Northern Spotted Owl

The northern spotted owl is found in mixed conifer forests along the Cascade Mountain Range from the extreme northern to southern boundaries of the Forest. No owls have been found, or are suspected to occur, east of Highway 97. Six (6) reproducing pairs, 12 apparently non-reproducing pairs, and 16 apparently-single owls have been confirmed within the Forest during extensive owl surveys between 1985 and 1989.

The Final SEIS for an amendment to the Pacific Northwest Regional Guide (USDA, 1988) provides a general description of suitable spotted owl habitat. Specifically, the Deschutes National Forest's spotted owl habitat occurs predominantly in the mixed conifer timber working group with old growth Douglas fir, Shasta red fir, and white fir trees Generally, the mountain hemlock community is too high in elevation for successful nesting habitat. (See Appendix I - Management Requirements for full description.)

The Forest's Spotted Owl Habitat Area (SOHA) network is composed of 14 SOHA's "During the period of 1985-1989 3 SOHAs are known to have had reproducing pairs, 7 have had apparently non-reproducing pairs, 3 have apparently single individuals, and 1 (Princess Creek SOHA) has no spotted owls confirmed at all." Three SOHA's are located on land reserved from scheduled timber harvest (e g. Wilderness or Oregon Cascades Recreation Area).

Sensitive Species

Little is known about the distribution or habitat needs of the 3 Sensitive caddisfly species The American white pelican, rare on the Forest with Davis Lake being the only known occurence, is not thought to nest here Neither is the ferruginous hawk, an occupant of dry grasslands or juniper woodlands on the eastern edge of the Forest. The western sage grouse is found in very low numbers in the sagebrush shrublands near Pine Mountain.

Ten (10) nesting pairs of greater sandhill cranes are known to nest in moist or wet meadows at 5 locations on the Bend and Crescent Ranger Districts. The long-billed curlew is known from only one fall sighting at Wickiup Reservoir several years ago Grassy areas near streams and ponds east of the Cascade Mountains are suspected habitat for the Preble's shrew, but the species has not been documented on the Forest

The Pacific western big-eared bat, a cave dweller for winter hibernation and reproduction, is known to occupy 8 caves primarily on the Fort Rock Ranger District. At least 250 summering and 110 wintering individuals have been observed. The species, like many other bats, is easily disturbed by human intrusion during these sensitive periods.

Never abundant because of its' large home range, the California wolverine has been infrequently observed in alpine areas along the Cascade Mountain crest from one end of the Forest to the other.

There are 19 Sensitive plants known or suspected to occur on the Forest. Sensitive plants discussed below are ordered from least to most common based upon local and world abundance.

Scientific/ Common Name	Known Forest Populations	Habitat Description
Botrychium pumicola Pumice grape-fern	6	Nonforest, and openings within subalpine mixed conifer forest, above 6,000 feet elevation
Castilleja chlorotica Green-tinged paintbrush	4	Nonforest, and openings within Ponderosa pine forest, above 5,000 feet elevation.
Astragalus peckii Peck's milk-vetch	3	Nonforest, and openings within juniper woodlands or lodgepole pine forest, at 3,000-3,600 feet elevation.
Artemisia ludoviciana ssp *estesii* Estes' artemisia	0	Nonforested river floodplains at 2,000-5,200 feet elevation
Penstemon peckii Peck's penstemon	14	Ponderosa pine or larch forest, and drymeadows, at 2,600-4,400 feet elevation.
Aster gormanii Gorman's aster	0	Nonforest, and forest openings, at 4,000-6,200 feet elevation.
Calochortus longebarbatus var. *longebarbatus* Long-bearded mariposa lily	0	Nonforest, and openings within pine forest, at 1,800-3,600 feet elevation.
Lobelia dortmanna Water lobelia	0	In shallow water at margins of lakes, ponds, and rivers, or in standing water of bogs and wet meadows, at about 2,700 feet elevation.
Ophioglossum vulgatum Adder's tongue	0	Associated with perennial aquatic ecosystems (e g. among low shrubs in moist to wet meadows).
Agoseris elata Tall agoseris	2	Dry edges of ecotone between moist meadow, lake, or stream and Ponderosa pine (or rarely lodgepole pine) forest, at 3,000-4,800 feet elevation.
Gentiana newberryi Newberry's gentian		3Meadows or mesic grassy ecotone adjacent to lakes and streams at 4,700-8,700 feet elevation.

Calamagrostis breweri Brewer's reedgrass	0	Moist or dry alpine and subalpine meadows, open slopes, streambanks, and lake margins at 4,600-6,000 feet elevation.
Arnica viscosa Shasta arnica	1	Nonforest, and openings in subalpine mixed conifer forest, at 6,500-9,200 feet elevation.
Cymopteris nivalis Snowline cymopteris	0	Scablands and other open places, including rocky ridges and talus slopes, at 4,900-9,500 feet elevation.
Mimulus jepsonii Jepson's monkeyflower	4	Nonforest, and lodgepole pine, Ponderosa pine, or rarely mixed conifer forest, at 4,400-7,300 feet elevation
Hieracium bolanderi Bolander hawkweed	1	Mixed conifer forest, and nonforest, at 1,100-8,700 feet elevation.
Lycopodium annotinum Stiff clubmoss	1	Along the margins of streams, lakes, ponds, wet meadows, or bogs where shrubs and trees of mixed coniferous forest meet, at 3,000-6,000 feet elevation.
Draba aureola Golden alpine draba	9	Nonforest at 7,500-10,300 feet elevation
Campanula scabrella Rough harebell	0	Nonforest at 7,000-9,000 feet elevation.

Special Habitat Species

Woodpeckers

The composite snag needs of woodpeckers as a group are presumed to represent all wildlife species which use cavities for nesting or denning On the Deschutes National Forest, 10 species of woodpeckers excavate cavities used by 33 other species of hole-nesters incapable of excavating their own nest-site. All of the woodpeckers, and many of the secondary hole-nesters, consume forest insects, thereby having a valuable suppressive influence on destructive forest insect pests.

It is widely thought that the absence of suitable nest-sites is the usual limiting factor for cavity-nesting birds. Also, a direct relationship is assumed between the number of snags and the number of snag-dependent wildlife in a forest. To measure habitat capability for woodpeckers, an index can be used based on the percent of maximum woodpecker population expected when snag habitat ceases to be the limiting factor of a population (Thomas et al, 1979). This level is a function of the amount of forest area containing snags and the number of snags present.

Regional Management Requirements (MR's) for cavity excavators are set at 20 percent of their maximum population (marginally viable, and not a functioning part of the ecosystem). Regional policy (FSM 2630.3, R-6 Supplement 45, August 1987) establishes management of dead and defective tree habitat for woodpecker populations in excess of 40 percent of their potential population capacity (probably viable, and starting to be functional in

the ecosystem) on commercial forest lands Forty percent of potential population capacity requires 90 snags of suitable size and height per 100 acres in Ponderosa pine or mixed conifer forests, and 72 snags per 100 acres in lodgepole pine forest.

High population viability and influence within the ecosystem is thought to occur at 60 percent or greater of maximum woodpecker population. Sixty percent of potential population capacity requires 135 snags of suitable size and height per 100 acres in Ponderosa pine or mixed conifer forests, and 108 snags per 100 acres in lodgepole pine forest.

Because snags come and go over the life of a forest stand, careful planning is necessary to assure that snags of appropriate species, size, and density are available at all times. Long individual-tree or stand rotation, retention, and possibly induced mortality, of suitable live trees, and retention of existing snags are methods to produce snags

Snags at levels estimated to average at least 80 percent of maximum woodpecker capacity exist in the natural stands of Wilderness and other places unavailable for timber harvest. In managed Ponderosa pine stands, existing snags are estimated to average between 20 and 40 percent of maximum woodpecker capacity because of extensive salvaging until the last 10 years Mixed conifer and lodgepole pine forests are estimated to average between 50 and 70 percent, and 80 and 100 percent (due to extensive mountain pine beetle-caused tree mortality), respectively.

Hunted or Trapped Species

Mule Deer

Mule deer populations in the Forest are divided into four herd management units by the Oregon Department of Fish and Wildlife. These are the Metolius, Upper Deschutes, Paulina, and Fort Rock Units

The winter range for each of these herd units includes land-ownerships other than the Deschutes National Forest, so the number of deer wintering on Forest land each year depends on weather conditions. The Oregon Department of Fish and Wildlife estimates current winter-range populations to be approximately 25,000 animals Deer hunting on the Forest has drawn an average of about 29,700 hunters who harvest 7,400 deer in 157,600 hunter-days of recreation

Extensive tree mortality caused by the mountain pine beetle epidemic in Ponderosa pine and lodgepole pine stands, together with resulting timber harvest to salvage or invigorate infected stands, have diminished forested cover Increased human access from an expanding recreation demand, and private land development in winter range, are additional dilemas for management.

Rocky Mountain Elk

An expanding Forest elk population estimated to presently total 1,000 summering animals is scattered in small herds from one end of the Forest to the other. The largest concentrations are found in the upper Deschutes River and Little Deschutes River drainages, where riparian areas adjacent to forested uplands provide an ideal mosaic of succulent forage and cover

Although most summering elk move to winter ranges west of the Cascade Divide, an inexact number winter along Cultus River, the lower Deschutes River from Slough Camp to the Inn of the Seventh Mountain, and the lower Metolius River.

As with mule deer habitat, extensive tree mortality caused by the mountain pine beetle epidemic in lodgepole pine stands, together with resulting timber harvest to salvage or invigorate infected stands, have diminished forested cover. Increased human access from an expanding recreation demand, and private land development in winter range, are additional dilemas for management.

Waterfowl

Twenty-nine (29) game species of waterfowl, including ducks, coots, geese, and swans, are found within the Forest. The larger lakes and reservoirs provide summer nesting or migrational stop-over habitat, with Crane Prairie Reservoir, Wickiup Reservoir, and Davis Lake being especially productive. The estimated summer population for the Forest is estimated to currently number about

2,600 pairs. Relatively few waterfowl remain to overwinter, as most water bodies ice over. Waterfowl that do remain are often prey for wintering bald eagles.

Although some habitat improvements, primarily nesting structures, have been accomplished, substantial opportunities remain at such locations as Wickiup Reservoir and Big Marsh.

Special Interest Species

Osprey

Osprey are distributed across the Forest, but are most abundant in the Deschutes River drainage. Crane Prairie and Wickiup Reservoirs are population centers, with Crane Prairie alone showing record highs of 305 individuals in 1978 and 105 occupied nests in 1979

Since 1979, however, the Crane Prairie population has shown a steady decline to a low of 26 individuals and 8 occupied nests in 1982, apparently due to a combination of factors including nest-tree toppling, water quality for hunting visibility, and possibly even chemical residues obtained from wintering areas south of the United States. It is suspected that birds displaced from the reservoirs are occupying habitat along the Deschutes River below Wickiup, and Fall River. The current Forest population is estimated at about 125 pairs.

Biological Community Barometer Species

Northern Goshawk

The northern goshawk was selected as a Management Requirement (MR) species for the mature and old growth Ponderosa pine forest community, although it also inhabits mixed-conifer and lodgepole pine forest communities It nests in relatively dense old-growth forest stands from one end of the Forest to the other, but because of a large home range of up to 36 square miles it is not found in great numbers

Pine Marten

The pine marten was selected as a Management Requirement (MR) species for the mature and old growth mixed conifer forest community, although it inhabits lodgepole pine and mountain hemlock forest communities as well. Generally widespread over the Forest, the pine marten is less common east of Highway 97 and north of Highway 31. The pine marten apparently prefers dense, multi-layered forest with a canopy-cover of at least 60 percent (as low as 40 percent will be used), and lots of large woody debris for prey habitat and entry points below crusted snow cover. Large openings, either natural or man-made, are avoided.

Three-toed Woodpecker

The three-toed woodpecker was chosen to represent most other species found in the mature and old growth lodgepole pine forest type Recent local research indicates an apparent preference for ecotones with Engelmann spruce or mountain hemlock forest types Available sighting records indicate the species may be most prevalent on the Bend and Crescent Ranger Districts

Other Wildlife or Habitat (Not Designated as MIS)

Hunted Species

Wild turkeys were introduced, and have since been supplemented, into the Forest on the north end of the Sisters Ranger District about 30 years ago They have expanded their range and are now found in huntable numbers as far south as Bend.

Two species of forest grouse are known on the Forest. Blue grouse are widespread, though in relatively low numbers, throughout the Forest and in almost all forested or shrubby habitats. Ruffed grouse are also widespread in the Forest, but their habitat is generally limited to riparian woodland and a few isolated upland shrubfields.

Mountain quail occur on dry shrublands of the Sisters Ranger District. California quail are scarce, found only near farmland on the eastern edge of the Sisters and Bend Ranger Districts. The common

snipe is abundant in riparian areas around the Forest. The mourning dove is likewise very widespread and common in drier upland sites.

The western gray squirrel is common in the Ponderosa pine forests of the Metolius River corridor, and less frequent from there south to the Lava Butte area. Black bear are widely distributed within the Forest and across vegetation types. Occasionally, bears in Newberry Crater and along the Metolius River become a public nuisance by scavenging in campgrounds there. Cougars have been sighted most often on the Sisters Ranger District, but a large home range limits their natural density to very low.

Pronghorns are found in small numbers along the southeastern edge of the Forest Black-tailed deer summer along the Cascade Crest, interbreed with mule deer on the east slope, and winter west of the Divide. Very isolated sightings of white-tailed deer have been reported on the Sisters Ranger District

Trapped Species

Mink, beaver, river otter, and raccoon are widely distributed across the Forest near surface water. The coyote, and two weasel species, the long-tailed weasel and the ermine, are common everywhere. Bobcat and badger are similarly widespread, but low in density. Red fox have been infrequently observed on the Sisters Ranger District.

Riparian Species

In addition to species described under the Management Indicator Species section above, there are several other wildlife species associated with riparian areas. The great blue heron is found across the Forest in riparian areas with surface water, but only 2 nesting colony locations totaling approximately 40-50 nesting pairs are known. Smaller wading birds like the American bittern, and shorebirds like the Wilson's phalarope and spotted sandpiper, are relatively common in riparian areas with a significant amount of surface water The sora is less common amd more secretive. All depend on riparian vegetation for concealment.

Songbirds like the marsh wren of cattail or bulrush marshes, and the yellow and Wilson's warblers of shrubby or forested riparian areas, are abundant and widespread.

Amphibians such as the widely distributed long-toed salamander, and the less-common spotted frog of higher elevations, are closely associated with riparian surface water. A few mammals, the northern water shrew and muskrat, for example, are similarly found near surface water

Cliff, Cave, and Talus Species

Cliff-nesting inhabitants of the Forest include the cliff swallow and common raven, both species abundant and widely distributed

Wildlife not already mentioned as closely-associated with caves include 2 bat species, the small-footed myotis and big-brown bat The distribution of these two species is not well documented on the Forest, however most known cave systems are lava-tubes located on the Fort Rock or Bend Ranger Districts. Cave-dwelling bats are vulnerable to human disturbance, especially during the rearing of young and in winter hibernation, because relocation to an alternative site with equivalent thermal environment may be impossible.

Talus species include the pika and yellow-bellied marmot, both of which are found Forest-wide

Edge Species

The great gray owl is uncommon within the Forest, sparingly documented in lodgepole pine forest bordering riparian areas between Lapine and Wickiup Reservoir. The Hammond's flycatcher is usually found at the edge of forest and opening The widespread and abundant mountain bluebird, and uncommon western bluebird, similarly inhabit the border of grassland and forest, although a tree cavity for nesting, rather than forest habitat, is the forest's only contribution

Woody-Debris Species

Woody ground debris is important habitat for several animals Widely distributed but in low numbers because of a large home-range, the black bear forages for larva of wood-boring insects in rotting logs. The chickaree, golden-mantled ground squirrel, and yellowpine chipmunk are all

widespread and abundant throughout the Forest where woody debris provides denning and food-storage sites

Dense-Forest Species

The sharp-shinned hawk and the Cooper's hawk are two accipiter hawk species that apparently prefer dense, young-forest stands of mixed conifer or Ponderosa pine for nesting Sharp-shinned hawks prefer even-aged stands of 40-60 year-old trees with a canopy-cover of 65 percent or greater. The Cooper's hawk will use a slightly more open stand of pole-sized or second-growth trees (50-80 years old; average height of 30 feet) with a 60 percent or greater canopy-cover

There are numerous other wildlife species on the Forest. Figure 3-4 presents a general description of habitat for all species based on existing plant and animal community diversity.

Figure 3-4 Habitat Based On Plant and Animal Community Diversity

Habitat Characteristic	% of Forest by Habitat Characteristic	Number of Wildlife Species	No. of Vulnerable Species
Coniferous Forest			
Stage I (Grass-forb)	8	55	0
Stage II (Shrub)	8	88	1
Stage III (Saplings)	11	68	0
Stage IV (Immature)	8	82	0
Stage V (Mature)	18	109	8
Stage VI (Old Growth)	31	94	8
Juniper	1[1]	71	0
Meadows	1[1]	65	3
Brush Dominated	2	74	2
Riparian	1[1]	128	17
Alpine	9	21	1
Rock and Talus	3	17	1

[1]Less than 1 percent.

Wilderness

The Forest Service began administering some of National Forest System lands to preserve their primitive character as early as 1930. Congress formalized the Wilderness concept in 1964 with the passage of the Wilderness Act (Public Law 88-577). The Oregon Wilderness Act of 1984 added 59,265 acres of roadless areas to three existing Wildernesses on the Forest. It also created the 6,859 acre Mt Thielsen Wilderness from the Windigo-Thielsen roadless area.

Special management techniques are employed to preserve and protect designated lands. The Wilderness Recreation Opportunity Spectrum (WROS) creates several zones within Wilderness which require different management. In addition to recreation, air quality, soils, water and vegetation are taken into account. The most recent development in wilderness management is the Limits of Acceptable Change (LAC) System. Quantitative standards are established for the amount of change which can occur in a given area. Actions required to prevent further change are taken and the results monitored. This requires Wilderness managers to

establish desired conditions and maintain or achieve them

Wilderness Descriptions

Portions of five different Wildernesses are managed as part of the Deschutes National Forest A description of each follows.

Diamond Peak Wilderness

This Wilderness, initially 36,357 acres in size, was established February 5, 1957. It was enlarged to 52,337 acres in 1984 by the Oregon Wilderness Act Boundaries of the Deschutes National Forest portion are near Windigo Pass to the south, Crescent and Odell Lakes to the east, Diamond Peak on the west and Fengra Pass to the north

Diamond Peak, an extinct volcano, stands 8,744 feet high. Its current rugged appearance is the result of glaciation during the last Ice Age. The Wilderness contains 125 miles of trails including 14 miles of the Pacific Crest National Scenic Trail. There are numerous lakes, many of which are stocked with brook or rainbow trout. A wide variety of wildlife, evergreens and alpine flowers are encountered by hikers during the July to early October recreation season

Mt. Jefferson Wilderness

One of the first Primitive Areas in the Pacific Northwest, 52,200 acres in the Mt. Jefferson area were set aside in 1930. It was enlarged to 85,033 acres in 1933 and became an official wilderness in 1968 with 99,600 acres. The Oregon Wilderness Act of 1984 increased its size to 111,177 acres

Current boundaries for the Deschutes portion are just south of Long and Square Lakes to the south, Jefferson County Line on the west, the confluence of Cabot and Jefferson Creeks to the east and Goat Peak on the north.

Lewis and Clark named 10,497 foot Mt. Jefferson, the second highest peak in Oregon, on March 30, 1806 after President Thomas Jefferson. This rugged alpine area also contains another volcanic peak prominant on the Cascade skyline, 7,841 foot Three-Fingered Jack. Both have proven challenging to experienced mountain climbers

There are more than 150 lakes, approximately 60 containing brook or rainbow trout, within the area. Numerous hiking trails, 194 total miles, including 36 miles of the Pacific Crest Trail, run through this Wilderness

A wide variety of wildlife inhabits the area This Wilderness is well known for its Forests interspersed with small scenic meadows and especially, its impressive display of a variety of wildflowers

Mt. Thielsen Wilderness

This Wilderness encompasses 55,100 acres that are located directly north of Crater Lake along the Crest of the Cascades. It contains a wide variety of landforms, ranging from essentially mountain desert to lush canyon meadows and high peaks Elevations range from 4,300 feet to 9,182 foot Mt. Thielsen. There are 78 miles of trails including several miles of the Pacific Crest Trail. The area contains fewer lakes than Wilderness areas to the North. Two popular camping lakes are Lucile and Maidu.

Mt. Washington Wilderness

The Oregon Wilderness Act of 1984 enlarged this Wilderness to 52,516 acres The Deschutes boundaries include the Forest boundary including Mt. Washington and Belknap Crater on the West, Mackenzie Pass to the south, just south of Hortense Lake to the north and Dugout Butte to the east.

Forty miles of hiking trails, including 17 miles of the Pacific Crest Trail, wind through this Wilderness. About half of the 28 lakes are stocked with brook and rainbow trout. The area is filled with volcanic formations such as extinct volcanoes, cinder cones and lava fields Black-tailed and Mule deer roam this Wilderness along with several smaller mammals and several bird species. Volcanic wildflowers are scattered through the lava fields and alpine wildflowers grow along the lakeshores

Three Sisters Wilderness

Originally dedicated as a 191,000 acre primitive area in 1937, the Three Sisters Wilderness area now encompasses 283,402 acres. Some major boundary points for the Deschutes are from a couple of miles north of Black Crater to the north, near road 4601-370 to the southeast of Three-Creek Lake, Irish-Taylor Lakes to the south and the Cascade Crest or Deschutes County Line to the west.

Hikers and horseback riders can choose from approximately 433 miles of trails in this Wilderness This includes over 42 miles of the Pacific Crest Trail. Trailheads are located on all sides of this Wilderness, in both the Deschutes and Willamette National Forests

The dominant figures are the Three Sisters and Broken Top Mountain which exemplify the changes glaciers and time can bring to a volcano. The oldest of the four peaks, North Sister and Broken Top have both been severely eroded by glaciers. These two peaks form a sharp contrast to South Sister, the youngest of the four, which, because of light erosion, still retains its original conical shape. All four of these peaks are popular with mountain climbers

Over 100 lakes, many formed by receding glaciers, dot the Wilderness Many of these lakes are annually stocked with brook and rainbow trout.

In the summer months, black-tailed deer, mule deer, and Roosevelt elk roam the area. Smaller mammals are present year-round include pine marten, mink, badgers, squirrels, snow-shoe hares, yellow-bellied marmots, and pika Many birds, including the Clark's nutcracker, gray jay, hairy woodpecker, and dark-eyed junco are common.

Nearly 200,000 acres of this Wilderness consist of forests and woodlands. On the west side, in the lower elevations you will find stands of Douglas fir At higher elevations, on both sides of the Cascade Crest, stands of mountain hemlock and lodgepole pine are common. Alpine meadows contain a wide array of wildflowers during the short growing season

Figure 3-5 Acres in Wilderness (Acres are from Publication 383, Land areas of The National Forest System as of 9/30/88)

Wilderness Area	Acres
Mt. Jefferson	32,734
Mt. Washington	13,563
Three Sisters	92,706
Diamond Peak	32,964
Mt. Thielsen	5,911
Total	**177,878**

Research Natural Areas

There are two designated Research Natural Areas (RNAs) on the Forest The Metolius RNA is located within the Sisters Ranger District and contains 1,318 acres. It is occupied by the following plant communities: Ponderosa/bitterbrush/fescue, bitterbrush/needlegrass on volcanic ash, manzanita/snowbrush/needlegrass on volcanic ash, Ponderosa/snowbrush/chinquapin, and snowberry/pinegrass.

The 1,357 acre Pringle Falls RNA is located within the Experimental Forest on the Bend Ranger District. It is occupied by Ponderosa pine/ bitterbrush and lodgepole pine/bitterbrush communities.

During 1980, a survey was conducted to review the 11 proposed RNA's designated in the 1978 Forest Management Plan It was determined that seven meet the Regional needs and requirements for RNAs. Figure 3-6 describes these candidates. For more detailed information see Appendix E.

Figure 3-6 Potential Research Natural Area Descriptions

Name	Acres	District	Meets Regional Need For:
Little Cache Mtn.	660	Sisters	Lakes at moderate elevation surrounded by mixed conifer forests
Cultus River	300	Bend	Large, upwelling cold spring.
Katsuk Butte	990	Bend	High elevation, undisturbed entirely forested cinder cone
Many Lakes	1,075	Bend	Typical bog areas, sub-alpine permanent ponds, alpine lakes and ponds and high elevation lodgepole pine communities.
Torrey-Charlton	500	Bend	Mountain hemlock plant community.
Mokst Butte	890[2]	Ft Rock	Entirely forested cinder cone with white fir and a recent lava flow
Wechee Butte	425	Ft Rock	Undisturbed entirely forested cinder cone with varying topography.

[2]500 of these acres lie within the Lava Cast Forest Special Interest Area

Transportation System (Roads)

Forest roads are classified as either arterial, collector, or local. The arterial roads (293 miles) are the highest standard routes connecting with state highways and county roads They are designed and maintained to provide for significant levels of commercial hauling and recreation visitor traffic. The typical arterial is a two-lane road with either asphalt pavement or rock surfacing with dust palliatives. The collector roads (1,356 miles) branch off the arterials and access large areas of the Forest. The combined arterial and collector road system provides general access for all Forest activities and, because of the significantly higher standard than most local roads, represents the greatest percentage of the total investment.

The local road system provides access for developed and dispersed recreation, fire protection and timber management activities. The local roads to the developed recreation sites (about 350 miles) are generally at a standard equivalent to the arterial and collector roads. Other local roads (about 6500 miles) serve as primary access to timber management activities and are typically unsurfaced, single-lane, with intermittent use.

Each road is constructed and maintained to meet the access requirements for a specific land area. The road to a developed, high-use campground, for example, requires a higher level of service than a road to a woodcutting area. Some roads are closed to protect wildlife, reduce erosion, or for a variety of other purposes.

Roads are designed using standards based on the types of vehicles (e.g., log trucks, motorhomes, passenger cars) that will use the road, the traffic volumes for each type, the economy of the investment, and environmental concerns. The road standard establishes the allowable traffic capacity and is based on user safety and the structural components of the pavement base and surfacing If the capacity is exceeded, the road must be either reconstructed to higher standard or have traffic restrictions implemented to maintain an acceptable operating condition. Restrictions, such as no timber hauling on weekends and holidays, will generally increase the cost of commercial operations. Restrictions may also be placed on recreation traffic that could have a negative effect on public travel and access on the Forest.

The Highway Safety Act has established nationwide standards for the design, operation, and maintenance of all highways, roads, and streets. These same standards apply on Forest roads which invite passenger cars for recreational travel. The construction and maintenance costs for these roads are several times higher than for roads which do not comply with the Act.

Currently, about 80 percent of the Forest road system is managed for high clearance vehicles (roads excluded from the Act). It is assumed that people traveling on these roads are familiar with the hazards such as rocks, fallen trees, and minor ditches. Unusual hazards, such as washouts, are corrected or marked.

Geothermal development will have a significant effect on the road system for specific areas. During the development phase some roads will require widening or re-alignment to accommodate large drill equipment. After development, some use will continue for the support of daily operations Some visitor traffic is expected but the amount is unknown. At this time the cost for improving and maintaining the road system to meet geothermal development needs is borne by the individual energy companies. Because this activity is new to the Region, it is unknown how road improvement projects supporting geothermal development will compete for funding in the Region-wide Forest Road Program, however geothermal energy is a valuable Forest resource that could generate significant revenue to both the counties and the Government. Road maintenance will remain the resonsibility of the companies commensurate with their use

Part of the road system was constructed jointly with timber companies for the purpose of economy (Cost Share Program) For example, one road is built to serve both private and federal lands for timber management activities, rather than building and maintaining two parallel roads. The expense for construction and maintenance is shared commensurate with use. In addition, the Forest road system is occasionally used for hauling timber from private lands authorized by a Forest Service permit. These private commercial users add to the traffic levels.

The companies associated with the Cost Share Program have easement rights to use certain roads, subject to maintenance obligations. Other commercial users are permitted to use the Forest road system at the discretion of the Forest Service.

Cultural Resources

Cultural resources are the remains of sites, structures, or objects used by humans in the past. They may be historic, prehistoric, archaeological, or architectural in nature. The values of cultural resources lie in the story they tell about former ways of life, human adaptation to the environment, past use of the natural resources, and human behavior in general. These values may be aesthetic, historical, scientific, interpretive, or utilitarian.

The Deschutes National Forest contains a rich legacy in its archaeological sites. Human history in Central Oregon extends back to the waning of the last great continental ice sheet when the Fort Rock Basin was covered by a great pluvial lake. Ancient peoples hunted the now extinct mammoth and sought cover in the numerous rock shelters from the cooler, moister climate. The most famous archaeological site from this time period is Fort Rock Cave, excavated and studied by Dr. Luther Cressman in the 1930's and several times since Although Fort Rock Cave is not on Forest Service land, it is within the general physiological boundaries of the Forest and represents the potential for sites of this antiquity on the Forest.

By 7000 years ago, the ancient lakes had dried up, becoming the arid, dusty playas common to southeastern Oregon today Water and food resources were less abundant Human populations were forced to migrate seasonally in small groups to pursue the game and root crops. This period of time also marks the beginning of a period of volcanism in Central Oregon which most assuredly affected the movement of native populations. The cultural change is reflected in the archaeological record. More recent deposits in the dry caves show that people were only there seasonally, possibly using the shelters as temporary hunting camps.

By far the most common archaeological sites from this period of time are the large, open-air lithic scatters which are defined as concentrations of chipped stone debris or "waste flakes" resulting from the manufacture of stone tools. These sites rarely indicate year-round habitation, revealing instead, short stays for a specific purpose such

as hunting or materials gathering (obsidian quarries).

The most notable volcanic event during this period was the eruption of Mount Mazama approximately 6,700 years ago. That eruption spread a thick mantle of ash across Central Oregon, devastating much of the landscape A number of small, local eruptions also occurred, such as the 6,160 year old eruption of Lava Butte and more recent volcanic activity in Newberry Crater.

This volcanic activity affects the archaeology of this region in a variety of ways. Many valuable prehistoric sites are buried under several feet of ash and pumice. When scientific excavations reveal these buried sites, however, the ash layers serve as invaluable time markers. Additionally, many of the eruptions produced massive obsidian flows which were extensively used by prehistoric people as material sources for manufacturing stone tools

The effects of volcanic activity on the prehistoric Indians who lived in this region are not well known, though it appears that the region was not extensively re-occupied until the ash had settled and vegetation was re-established The effect of this volcanism remains a crucial, unresolved archaeological problem.

Most archaeologists believe that beginning about 3,000 to 2,000 years ago, an ethnic identity can be placed on many of the archaeological sites throughout the Great Basin, including Central Oregon. According to this widely accepted theory, which is based primarily on linguistic rather than archaeological evidence, small groups of Indians ancestral to the historically-known Northern Paiute and related peoples, all sharing the same Numic language, migrated northward through the Great Basin and Great Plains Carrying the bow and arrow as opposed to the more ancient "atlatl" or spearthrower, these adept desert foragers either joined or replaced the indigenous prehistoric people living in the Great Basin. Why and how this migration took place is not known and remains a point of controversy among archaeologists and scholars. In any case, these groups apparently evolved in place into the historically known Indian groups that we know today--the Paiute, Mono, Paviotso, and other tribal groups scattered through the American West.

The EuroAmerican settlement of the west brought to an end an ancient lifeway that had its origins during the last Ice Age. By the 1840's, EuroAmericans on the Oregon Trail through Oregon (and elsewhere) destroyed much of the habitat occupied by the Northern Paiute and other groups. Livestock competed for human food--seeds, roots, and grasses Game populations were slaughtered.

The wagon trains of white settlers brought disease, alcohol, and conflict to Indian groups trying to protect their ancient homelands and ways of life. Both Indian and White depredations were common. By the late 1870's most Indians were established on reservations after a series of short-lived Indian "wars" in southeastern Oregon

Reservation life has been a difficult adjustment for American Indians who must continue to struggle to find a balance between 20th century life and preservation of tribal culture and traditions. Preservation of the evidence of their past takes on a more urgent note when viewed in the context of this struggle.

The Forest's cultural resource program has as its primary goal the protection of this resource for purposes of cultural preservation, research, and interpretive services. The program is integrated into multiple resource planning and management with two primary directions. The first is to find and document cultural sites so that their values can be fully considered in land management decisions. The second is to manage and protect these sites to preserve areas of cultural significance to living Tribes, to provide useful information for scientific and historical research, to provide public education, and to engender an appreciation for the resource and a respect for the culture it represents.

Illegal collecting and artifact theft is a major concern in Central Oregon. This fragile, non-renewable resource is disappearing at an alarming rate at the hands not only of recreational collectors, but of commercial excavators and artifact traffickers. During the last four years, two individuals have been convicted of felony violations of the Archaeological Resources Protection Act. The problem is serious and has become a focus for law enforcement and cultural resource managers in the efforts to preserve the resource.

The Forest implements laws and regulations pertaining to historic preservation in consultation with the State Historic Preservation Office and the

Advisory Council on Historic Preservation. These agencies are consulted in managing cultural sites which qualify for the National Register of Historic Places Recognized American Indian Tribes are also consulted regarding Forest Service activities that potentially affect sacred and sensitive sites and areas on the Forest.

More than 1,000 prehistoric and historic sites have been identified on the Forest. Prehistoric Indian sites are predominantly open-air campsites or lithic scatters. Caves and rockshelter habitation sites are also common, but most have been seriously damaged by illegal collectors. Pictograph and petroglyph sites are not abundant, but are present They too have been seriously damaged by collectors. Other prehistoric sites, such as rock alignments and tool caches are rare, while pithouses and large village sites are nonexistent or have yet to be found.

Historical sites include traces of early white immigrant trails and military wagon roads, trappers' and homesteaders' cabins, the remains of early railroad logging camps and structures, and Depression-era Forest Service administrative and recreation buildings.

All four Ranger Districts contain some of the cultural resource described above, but their distribution is not even due to the Forest's environmental diversity. Located along the foothills of the Cascade Mountains, the Bend, Crescent, and Sisters Ranger Districts contain fewer prehistoric sites than the Fort Rock District Sites are abundant at Fort Rock due to the availability of obsidian and the district's central position between the Deschutes River and the Fort Rock valley. Historic Civilian Conservation Corp and Depression-era sites are evenly distributed across all Districts, but the Fort Rock and Bend Districts contain most of the historic railroad logging sites.

Sources Used

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Vegetation

Mountain hemlock, alpine, and subalpine plant communities occur in the high elevation and high precipitation zones of the Forest. Mixed conifer and Ponderosa pine communities are common to the middle elevation and precipitation zones. Sagebrush, juniper, and sparse Ponderosa pine communities occur on the semiarid, lower elevations along the eastern edge of the Forest. Lodgepole pine occurs over a wide range of site conditions and elevations.

Mt. Mazama pumice deposits, decreasing in particle size and depth north and east from Crater Lake, influence the variety and productivity of plant communities. Productivity tends to decrease as the pumice layer becomes deeper. Fifty-five naturally occurring ecoclasses have been mapped over the Forest (excluding Wilderness). Forty-one are forested communities and 14 are nonforested.

There are no threatened and endangered plant species on the Forest. Plants classified as sensitive are listed below.

Agoseris elata
Allium campanulatum
Arnica viscosa
Artemisia ludoviciana ssp estesii
Aster gormanii
Astragalus peckii
Botrychium pumicola
Castilleja chlorotica
Calochortus longebarbatus var. longebarbatus
Campanula scabrella
Draba aureola
Gentiana newberryi
Hieracium bolanderi
Lobelia dortmanna
Lycopodium annotinum
Mimulus jepsonii
Ophioglossum vulgatum

Penstemon peckii

Old Growth

Overview

Biologically and politically, many people have more interest in old growth than in other successional stages. Old growth stands are a substantial portion of the forested acres on the Deschutes National Forest. Figure 2-77 identifies the acreage available by species. Old growth was harvested in conjunction with adjacent mature stands during the last 50 years. Other small amounts of old growth have 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 Definition

Old growth stands can be defined by age, by stand condition, by diameter, by ecological characteristics, by a combination of some or all of these factors, or by other factors (USDA Forest Service 1981b) In the past, the definition used was often a function of the proposed use for the trees. Recently, old growth definitions have focused on the structural components of the stand Several of the structural components are of key importance in an old growth stand. These are: individual, live, dead, down logs in streams, and multi-storied canopy of mixed species These structural features are unique to an old growth forest ecosystem, setting it apart from young growth and, especially from managed stands Most ofthe distinctive compositional and functional features of old growth forests can be related to these structural features. These structural components make possible much of the uniqueness of the old growth forest in terms of flora and fauna (composition) and the way in which energy and nutrients are cycled (function).

While structural components are essential for the scientific definition, the general public is concerned with the existence of big trees. Substantial portions of the Forest are considered old growth by our publics, however, few acres meet the scientific definition.

The old growth mixed conifer in both the Region 6 definition as well as publication 447 do not represent all the conditions in mixed conifer on the Forest. The definitions used on the Deschutes National Forest are the Region 6 definitions. These are:

Ponderosa pine stands:

Contain 10 mature to overmature trees per acre with trees 21 inches or larger in overstory.

Ponderosa pine represents 75% of the overstory canopy level

Broken top trees are present.

Pine bark is furrowed and ranges from orange to yellow.

Overstory canopy is usually less than 50%

Snags are present.

Down woody material, with large logs, is present.

Mixed Conifer:

There is a mixture of species (Ponderosa pine, lodgepole pine, Douglas fir, white fir, western spruce, shasta fir, and cedar).

Contains shade tolerant and shade intolerant trees.

There are at least 15 trees per acre.

There are two or more snags per acre.

Three or more tons of down woody debris, including large logs, are present.

Broken top trees are present.

Lodgepole Pine·

Includes 12 or more trees per acre that are 6 d.b.h. inches or larger.

There are three snags per acre.

Three tons of down woody material, including logs, are present.

Lodgepole represents 60 percent of the overstory canopy.

Individual trees have round to flat topped crowns.

Mountain Hemlock:

15 or more trees per acre that are 21 inches d.b.h. or larger.

Two or more snags per acre are present.

Three tons of down woody material, including more than three logs per acre are present.

Broken top trees are present

There are current efforts within the Forest Service to address the definitions to be more representative of specific areas of Region 6

The 1985 forest inventory did not identify old growth. The stratification was done in such a manner that extraction of information regarding old growth cannot be done Therefore, the acreage which is identified in this Plan is estimated acreage. The Forest utilized the forest inventory, stand exams and personal judgements of Forest personnel to arrive at old growth acreage.

Current Situation

Old growth stands are scattered throughout the Forest and in all species working groups. Estimated acreage is 50,200 acres in Ponderosa pine, 64,400 in lodgepole pine, 146,000 in mixed conifer and 79,600 in mountain hemlock and 7,900 in acreage considered unsuitable. These are stands which meet the Region 6 scientific definition (see figures 2-76 and 2-77) Its important to note that while there are 348,100 acres of old growth which meet the Region 6 definition, there are additional acres which our publics have identified as old growth. These stands are mostly Ponderosa pine and have 2-3 large trees in the overstory with the rest in various sizes.

In examining the old growth issue, the Forest looked at several things, which include:

Landscape Ecology: The objective is to provide for bio-diversity, research needs, long-term site productivity and setting aside a representation of landscape ecology. The unit of measure is the number of areas of old growth set aside by working group by province. The minimum level was three areas by province. For this purpose all management allocations were considered.

Wildlife: The objective is to meet the needs for wildlife species that are associated or closely associated with old growth ecosystems. In this regard, other management allocations were also considered. The unit of measure is the number and type of areas set aside which would maintain and enhance needs of indicator species.

Social: The objective is to address the social issue of esthetics, politics, and spiritual needs. Other considerations were:

Protection of key visual corridors,

Blocks of old growth set aside (the unit of measure is the number and size);

The percentages of the General Forest allocation prescribed for uneven-aged management; and

Uneven-age management target tree size (the unit of measure is the percentage of acres prescribed to retain the larger tree character).

Historical Trends

Old growth timber stands in the Cascades typically were maintained or rejuvenated through natural fire occurrance. The average age of the mature old growth trees are typically about 250-300 years in Ponderosa pine, mixed conifer, and hemlock. Old growth lodgepole pine is usually 80-110 years old. Historically, Ponderosa pine old growth did not have the structure as called for in the Region 6 definition Stands were typically open with little undergrowth. Since the early 1900's the stand structure of all the species working groups has changed because of the exclusion of fire and management activities

Future Trends

The amount of old growth will continue to decrease if present management activities continue. It is anticipated that stands 100-150 years old will become old growth in the next 50-80 years and

it's estimated the ingrowth will occur at 2% per year. Ponderosa pine and mixed conifer where Ponderosa pine is a significant component will need to be manipulated to maintain as old growth. Lodgepole pine also will be replaced either through fire or insects and disease. Typically, lodgepole will not live longer than 100 years in it's natural state Timber stands in management allocations with no programmed harvest will continue to develop old growth characteristics and are likely to remain so for the next 50-100 years Harvest or other disturbance will cause the old growth stands to be replaced by younger stands

Under existing plans, a good portion of the old growth occuring outside of reserved lands or lands featuring big trees would be harvested in the next 5 decades. Chapter 2 and 4 have additional estimates of future amount and condition of old growth (see figures 2-76 and 2-77)

Resource Relationships

Large organic debris from old growth forests has a major influence on the physical characteristics of the small stream (Class IV) systems Large accumulations of woody debris result in complex aquatic environments of riffles, pools, runs, glides and side channels. The debris adds stability to stream channels and reduces the rate of downstream flow

In Class III streams large woody debris is common and may cover from less than 25% up to 50% of the channel area The canopy in the undisturbed state provides continuous shading Energy of water flowing in the channel is continually dissipated by woody material and vwegetation, reducing erosion and leading to depositon of organic and inorganic material. As streams get larger, there is less direct influence of old growth.

Harvesting of old growth stands has been of major importance to the timber industry in the Pacific Northwest for several decades. The high value of the old growth and especially old growth Ponderosa pine makes it feasible for hauling of this material for long distances. Demand for this material will increase.

Recreation users of the Forest enjoy old growth stands of trees for many different reasons. The old trees are aesthetically pleasing and provide a living connection with the past and a visual reference to the natural successional processes of the forest environment. From a social perspective, many people feel that the massive, towering trees in some old growth stands have a cathedral quality and are spiritually uplifting and inspirational. These stands provide a feeling of solitude and escape from the evidence of human presence. Old growth stands are also important as a gene pool, conserving the diversity of characteristics which insures the survival of the species against attacks by insects and disease. These stands are also valuable for conducting research on the undisturbed organisms and processes of the forest ecosystem

Old growth provides wildlife habitat to many animal species. This is especially important to the wildlife indicator species as well as to birds such as the bald eagle and osprey.

Timber

The economy of Central Oregon is less dependent on timber products than has been the case in the past, but this sector of the economy is still by far the dominent provider of well payed jobs in the area

Approximately 1.15 million acres, 71 percent, of the Forest are classified as "tentatively suitable forest land," that is, land that is available for timber production. The remaining 29 percent is not suitable or is non-forest land, i.e., water, rock, sagebrush flats, or land occupied by noncommercial tree species (juniper or aspen). In terms of standing volume, the predominant tree species is Ponderosa pine Lodgepole pine, Douglas-fir, white fir, Shasta red fir and mountain hemlock also contribute substantially to the Forest's standing timber volume.

Figures 3-8 and 3-9 show estimates of various types of land class acreages, timber type acreages, and standing timber volumes by species groups The "mixed conifer" category in Figure 3-9 includes stands which are a mixture of Douglas-fir, and/or true firs, and usually also contain some lodgepole pine, Ponderosa pine, and mountain hemlock.

Figure 3-8 also shows acres within the Forest boundary by ownership and indicates how many are forested and non-forested and how many are

suitable for timber harvesting There are 1,868,400 acres of land within the Forest boundary Of these, 1,620,900 are National Forest land. After water bodies and non-forested acres are subtracted, 1,430,000 acres of forested lands remained.

Approximately 279,100 acres of forest land were withdrawn from the timber base because: (1) they have been designated Wilderness, Research Natural Areas, Experimental Forest, or Oregon Cascade Recreation Area; (2) they have been developed for non-forest uses, primarily roads; or (3) regeneration of timber stands and timber growth is considered difficult and uncertain. A total of 1,150,900 acres of tentatively suitable forested lands remains available for scheduled timber harvesting. This compares with the 1,272,000 acres available under the current Timber Management Plan.

Throughout these documents, tree diameters indicate the size of a tree 4 and one half feet from the ground on the uphill side, diameter at breast height

Figure 3-8 Determination of Lands Tentatively Suitable for Timber Production (M Acres)

Classification	Acres
1 Non-Forest Land (includes water)	190 9
2. Forest Land	1430 0
3 Forest land withdrawn from timber production	176.3
4. Forest land not capable of producing crops of industrial wood (dedicated roads)	10 2
5. Forest land physically unsuitable	
--irreversible damage likely to occur	0.0
--not restockable within 5 years	92 6
6. Forest land--inadequate information[1]	0.0
7. Unsuitable forest land (items 3, 4, 5, and 6)	481.1
8 Tentatively suitable forest land (item 2 minus items 3, 4, 5, and 6)	1150.9
9 Total National Forest Land (item 1 and 2)	1620 9

[1]Lands for which current information is inadequate to project responses to timber management Usually applies to low site lands.

In terms of volume, the predominant commercial tree species is Ponderosa pine Other commercially important species include lodgepole pine, Douglas-fir, white fir, grand fir, and Shasta red fir. The volume of mountain hemlock is also significant

The Forest annually sells 190 MMBF under the 1978 Land Management Plan. Acres of available timber are shown by species group in Figure 3-9.

Figure 3-9 Tentatively Suitable Timber Inventory, By Species Group

Working Group	Condition Class	Acres (M)[1]	Volumes[2] MMCF	MMBF
Ponderosa Pine.	Underproductive	21 4	0.1	0 6
	Seedlings & Saplings	113 8	0.0	0.0
	Poles	74 8	100.0	502 7
	Immature Small Saw	43.5	58.7	308.7
	Mature Small Saw	5.5	11.0	64.1
	Large Sawlogs	9.6	19 1	110.0
	Multi-Story w/o S & S	14 2	32.0	183 4
	Multi-Story w/ S & S	170 2	344 4	1988.9
	Subtotal	**453.0**	**565.3**	**3158.4**
Lodgepole Pine:	Underproductive	36.7	28 1	138.1
	Seedlings & Saplings	104.1	0.0	0.0
	Poles	122.5	149.6	761.5
	Immature Small Saw	22 0	38.0	193.3
	Mature Small Saw	35 1	52.0	269.6
	Multi-Story w/o S & S	5.7	9 7	51 9
	Multi-Story w/ S & S	65.8	121 2	654.4
	Subtotal	**391.9**	**398.6**	**2068.8**
Mixed Conifer:	Underproductive	11 5	0.0	0 0
	Seedlings & Saplings	23 8	0.0	0 0
	Poles	29 6	96.0	515 0
	Immature Small Saw	26.5	87.3	457 3
	Mature Small Saw	14.0	53 9	292.4
	Large Sawlogs	9.7	40 6	237.5
	Multi-Story w/o S & S	4.4	20 2	120.2
	Multi-Story w/ S & S	121 2	430 0	2435.0
	Subtotal	**240.7**	**728.0**	**4057.4**
Mountain Hemlock	Underproductive	1.9	0.0	0 0
	Seedlings & Saplings	4 4	0 0	0.0
	Multi-Story w/ S & S	59.0	369.0	2125 7
	Subtotal	**65.3**	**369.0**	**2125.7**
Total		**1150.9**	**2060.9**	**11,410.3**

[1]*As of January, 1989*

[2]Gross Volumes based on a utilization standard of 9 inches dbh to a 6 inch top dbh to a 4 inch top diameter utilization standard was used These volumes are from the 1985 inventory projected to 1989, and represent live trees only

History of Timber Harvesting

Between 1910 and 1945 about 15 to 20 percent of "pure" Ponderosa pine stands now occupying the Forest were owned and harvested by private timber companies. Most were single-storied stands of mature and overmature (300 years and older) Ponderosa pine trees averaging 32 to 36 inches in diameter and 90 to 100 feet in height There was little or no brush or small trees beneath.

This was the classic, parklike Ponderosa pine forest recorded in old photographs Everything merchantable was harvested except for the two or three trees per acre which were required to be left as seed sources The poorest quality trees were often left but, surprisingly, they often regenerated into healthy stands of young Ponderosa pine relatively quickly.

By World War II, when private timber lands had been largely cut over and demand for lumber increased sharply, the Forest began to augment the supply of logs needed for local milling operations

In the 1940s and 1950s, timber sales were located where desired species were most accessible and where roads would reach previously inaccessible stands Priority for harvest was given to a large number of recently dead, dying, and about-to-die trees

By the early 1960s, most stands of large sawtimber were accessible by a system of main roads Cutting practices shifted from emphasis on salvage and sanitation to control of dwarf mistletoe infestations in Ponderosa pine and Douglas-fir stands. This created the first truly managed stands By the late 1960s and early 1970s, an attempt to control depredation by the the mountain pine beetle had begun, accelerating the creation of managed stands.

During the 1970s there was a significant change in timber management on the Forest It was brought about by three concurrent developments. (1) the increased demand for, and the timber industry's ability to utilize, smaller trees; (2) the bark beetle epidemic; and (3) new expertise available for forest management Previously, timber management was carried out by foresters and technicians equipped with aerial photographs, compasses, ribbon, paint guns, and Biltmore sticks

By the end of the decade, timber management projects were the result of hours of joint planning by teams which often involved silviculturists, geneticists, wildlife specialists, soils scientists, hydrologists, economists, archaeologists, and landscape architects.

The result has been the development of management prescriptions which are more sophisticated, scientifically based, and better designed to obtain multiple use objectives. An example of the benefits of this development is the increased survival rate of planted trees (50 to 70 percent in 1960 and 85 to 90 percent in 1980)

By the end of the 1970s, advances in logging and milling techniques and equipment enabled the profitable use of timber 8 or 9 inches in diameter. In 1960 the smallest lodgepole pine tree the Forest could market was 12 inches In the succeeding 20 years, the merchantable size steadily decreased to 8 inches.
The recession of the early 1980s sharply reduced demand for timber products. The market for chip materials has fluctuated, while demand for post and pole material and fuelwood continued to be strong. Increased demand for smaller trees enabled the Forest to begin serious management of its vast stands of lodgepole pine.

This development coincided with a rapid increase, to epidemic proportions, of mountain pine beetle activity on the Forest. By 1960, most lodgepole pine stands were declining in vigor, a condition which contributed to beetle populations. Forest managers responded with these measures. (1) trees killed by beetles were salvaged before they became commercially worthless; (2) new stands were quickly regenerated to replace beetle kill, and (3) adverse effects of the infestation on scenery, wildlife habitat, recreation, and other resources were reduced See the *Deschutes National Forest Environmental Assessment for Lodgepole Pine Management*, 1981, for a detailed description of the integrated pest management program.

Since the early 1960s, when the Forest started managing lodgepole pine in earnest, approximately 120,000 acres have been treated. In 1985, the

entire Forest was inventoried and lodgepole pine plots were revisisted in the spring of 1988. At that time, approximately 60 percent of all lodgepole trees larger than 6 inches d b.h. in untreated stands had been killed by the mountain pine beetle In the larger diameter classes, mortality approached 90 percent.

By 1986, live lodgepole trees had become scarce and the beetles began attacking adjacent mature and immature Ponderosa pine Emphasis of the treatment program was shifted to these stands the following year. These developments are described in the *Deschutes National Forest Bark Beetle Infestation in Ponderosa and Lodgepole Pine Environmental Assessment*, 1987. By 1988, the infestation appeared to have peaked in lodgepole and mixed lodgepole and Ponderosa pine stands Emphasis was then given to stands of second growth Ponderosa pine, which are expected to be thinned by 1992.

For timber supply potentials, refer to Figure 2-50 in Chapter 2. The market area is expanding and demand is undergoing change. There is a strong demand for Ponderosa pine and mixed conifer. Demand for lodgepole pine has been cyclic and, in the absence of new markets, this is likely to continue.

Supply and Demand

Regional Timber Supply and Projections

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 situation for long-term (50 years) and do not necessarily recognize current short-term regional fluctuations A summary of those projected RPA trends (year 2030) for timber supplies follows.

Softwoods

Total projected softwood roundwood harvests would rise 24% 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 timber 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. (RPA, 1984)

In contrast, the other major source of softwood timber harvest is the South, which is projected to rise from about 4.1 billion cubic feet in 1980 to 7 3 billion in 2030 However, most recent forecasts are now showing a downward modification in the rate of economic supply This may indicate that the South could be expected to be shifting to a slower rate of increase above present levels, until the year 2030. Much of the current expansion in the South with softwoods as well as hardwoods, is due to the fact that its wood products production has become more diversified as compared 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 unfulfilled housing demand, the future will depend primarily on the 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 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. (Haynes and Adams, 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. This needs to be recognized in terms of a shifting of industry within the region and also in the shifting emphasis on the types of wood products produced, as well as the ability of the subregion to supply the various kinds of wood needed.

With a new vision for the future and a concerted effort by the wood products industry to broaden the economic base, bringing about the transition which enables the Pacific Northwest to regain much of the previous strength of one of its larger revenue-generating basic industries--will still take time.

A broader vision of the future that includes developing a flexible regional basis for stabilizing wood supplies and applies to forward looking perspective on wood fiber management will also 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 working of a different market system and provide more products in the form demanded. (Campbell, et.al , 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 now being supplied by the South and Canada. However, the situation with Canada can be expected to change as there are indications that the economic supply may begin dropping off within 6 years or at least by 15 years. The projected change indicates a potential drop in supply capability of 30% to 50% from the current relatively high levels The South should be able to maintain or show a slow increase in harvest because of its remaining inventory and some substitution of hardwoods. However, both the economic and physical supply of softwoods from that area may begin to show a decline by 2030.

At about the same time this drop in supply capability begins to occur for the other sources, 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)

See List of References for sources used in preparing this documentation

Uneven-age Timber Management

The most important change between the Draft Environmental Impact Statement and this FEIS is a decision to emphasize uneven-age timber management in Ponderosa pine stands on the Forest

In the 1950's and 60's, clearcutting on the Forest was confined primarily to the control of dwarf mistletoe Even-age management, however, had been extensively used west of the mountains since World War II and the housing boom which followed. In the 1970's, it also became dominant on the eastside. Approximately 8,000 acres were clearcut on this Forest annually.

The re-evaluation of this policy was occasioned by an outpouring of opinion following the publica-

tion of the Draft EIS in 1986. A recession in the timber products industry convinced many observers that the future of the Central Oregon may be tied more closely to recreation and tourism than timber products.

More than 60 percent of Respondents to the DEIS opposed clearcutting. This included, for different reasons, both timber industry representatives and environmentalists. The former sought a harvest method which would produce a greater number of large Ponderosa pine trees. Biological diversity for wildlife and scenic quality were the objectives of the latter.

Responding to this unmistakable demand, Forest silviculturalists developed a strategy containing these elements:

1. Maintain or develop at least three distinct canopy layers, which include yellow-barked old growth

2. At each entry, harvest as a priority the highest risk, poorest quality trees, leaving behind a better quality, lower risk stand

3 Achieve overall stocking level control in all tree sizes at each harvest entry.

4. Open ground for the establishment of new seedlings after each harvest entry, favoring natural regeneration where possible.

5 Work with the existing stand structure to maintain occupancy by trees at stocking levels appropriate to the site and harvest interval

Recent Timber Program - Revenues, Expenses, and Other Program Information

The demand for timber from the Deschutes National Forest is influenced by regional, national, and international markets for wood products Stumpage prices received for timber sold through the competitive bidding process reflect the species being sold and the strength of the markets for products which can be manufactured from each species.

Ponderosa pine high bid values have ranged from $300 to $600 in the 1987-1989 period. Lodgepole pine high bid values have ranged from $50 to $100 in 1988 and 1989 Much of the lodgepole pine volume is dead and offered and sold for pulpwood Demand and value for pulpwood increases when lumber and plywood production curtails because of the shortages of byproduct production associated with lumber and plywood. The pulpwood market soared to all time highs in 1989. The fluctuation in prices for any one species over time is heavily influenced by the strength of the building and paper industries. This, in turn, is affected by the level of interest rates and other factors. The differences in stumpage prices between species reflect the retail prices which can be received for products made from them and the cost of production. None of these variables can be controlled at the Forest level

The following timber program information, revenue and expense table and employment and income table provides an overview of the timber management program for FY 1987 and 1988

FY 1987 Deschutes National Forest Timber Sale Program

Timber harvesting saw a healthy year which was prompted by a good lumber market. The Forest's harvest volume exceeded its sell volume by about eight percent It is believed that the harvest level would have been slightly higher, but the August-October fire shutdowns curtailed logging production somewhat Of the timber harvested in FY 1987 on the Forest (almost 226 million board feet):

1 75% was sawtimber, principally Ponderosa pine.

2 15% was dead lodgepole pine used principally for pulp and paper production, and

3. 10% was mainly dead lodgepole pine removed under Personal Use Firewood Permits

4. About 2/3 of the volume harvested was mortality salvage (dead and dying lodgepole pine and Ponderosa pine attacked by mountain pine beetle).

Most of the Forest's timber revenues (about 99 percent) were generated from sawlog harvesting Timber volume sold on the Forest in FY 1987 was 201 million board feet of which 75 percent was sawtimber, principally Ponderosa pine. An additional 45 million board feet was offered but not sold, or sold and was later cancelled.

Additional facts and figures about the FY 1987 timber program:

- 9,372 acres of deforested timberland were regenerated;
- 11,517 acres recieved timber stand improvement treatments;
- 126 9 miles of road were constructed reconstructed by the timber sale program

FY 1988, Deschutes National Forest Timber Sale Program

Commercial timber sale harvesting declined almost twelve percent below the Forest's FY 1987 level. Two reasons for this decline were that the summer of FY 1988 had slightly more fire precaution "downtime" than in FY 1987, and the local DAW Forest Products' three month strike curtailed log delivery to its idle mills Of the commercial timber harvested in FY 1988 (about 154 million board feet):

1. 85 percent was sawtimber, principally Ponderosa pine;

2. 15 percent was dead lodgepole pine used principally for pulp and paper production.

Additionally, about 12 million board feet (mainly dead lodgepole pine) was removed under personal-use firewood permits

Commercial timber sale volume sold in FY 1988 was about 180 million board feet About 72 percent was sawtimber, principally Ponderosa pine. Additional facts and figures about the FY 1988 timber program:

- 10,468 acres were reforested;
- 15,368 acres received timber stand improvement treatments;
- 107.5 miles of road were constructed or reconstructed for the timber sale program.

Revenues and Expenses

Figure 3-10 Revenues, Expenses and Gains in the Timber Program (M$)

	FY 1987	FY 1988
Timber Revenues	30,259	26,438
Expenses	9,030	10,457
Pmt to State	7,049	5,584
Net Gain	14,180	10,397

Generally, it is not appropriate accounting to compare the receipts in any particular year directly to the costs for that year This is because costs have little or no relationship to the receipts for a specific year. Timber revenues are received at the time of harvest. Harvest can range from one to five years after the date the sale was sold. Costs, on the other hand, are incurred in preparation for future timber sales, administering current ongoing sales, or as investments in future stands. Nonetheless, a comparison of annual receipts to cost does provide a way of portraying their general relationship.

Employment and Income

Figure 3-11 shows the employment and income that was generated by the Forest's timber sales program in the recent past. The Draft Forest Plan identified Deschutes, Jefferson, and Klamath Counties as the primary area influenced by the timber program on the Deschutes National Forest. Additionally, Lake County shares in a small proportion of the 25 percent fund paid to states. For purposes of modeling economic impacts, Deschutes County was used as a surrogate for the full zone of influence Employment and income effects were estimated based on the total volume harvested exclusive of personal-use permits. The value of federal income taxes was estimated as 15 percent of the total income to communities.

Figure 3-11 Employment and Income Generated by the Forest Timber Sale Program

	FY 1987	FY 1988
Total Jobs	1,365	1,245
Total Income(M$)	$40,312	$38,00
Value of Federal Income Taxes Paid(M$)	$6,047	$5,700

Forest Health

In the past, control of forest pests consisted primarily of salvaging dead and dying trees, and direct suppression projects developed after pest populations had reached damaging levels (often *broad scale epidemics*). Now the emphasis is changing to viewing pests effects in the context of the integrated land management process and a wide variety of specific resource management objectives Vegetative management is increasingly being regarded as an opportunity to proactively develop stands which are highly resistant to *damaging attacks by forest pests* As *prescriptions* and the process of choosing a preferred resource management alternative becomes more sophisticated and scientifically founded, analysis tools and levels of expertise have increased. The use of growth and yield models which incorporate the effects of pests are used with increasing frequency *as a tools to compare management options.* Pest management specialists are often providing input as an integral part of the decision-making and planning process

This change is encouraging but much more needs to be done Many stands exist which will not provide *the desired goods and services because of the* impacts of pests Models presently available do not incorporate the effects of all the important pest agents on the forest In addition, scientific information is lacking on the effectiveness of many of the more complex silvicultural treatments now being implemented to mitigate the undesirable effects of forest pests.

History

Insects and diseases have had, and are presently having, a significant effect on the structure, species composition and condition of the forest ecosystem of the Deschutes National Forest. Three groups of pathogens are impacting the Forest the most: Dwarf Mistletoes, Root Diseases and Stem Decays. There are 2 groups of insects of major importance, Defoliators and Bark Beetles.

Although these pests are native to the forest ecosystems of Central Oregon, pest populations are unnaturally high, in many cases, because of the fire suppression and harvesting practices of the past 50 years which have put the forests in a state of increased susceptibility

Fire is an integral part of the ecosystem of Central Oregon. Frequent fires played an important role in maintenance of seral species like pine and larch and replacement of decadent and/or diseased trees with young vigorous trees. Fire exclusion over the last 75 years has resulted in a shift in floristic composition, density and structure from park-like stands dominated by Ponderosa pine or western larch toward dense, multi-aged stands of shade tolerant species, primarily the true firs or Douglas-fir (Figure 3-12). Unfortunately, stands of *this structure and species composition are more* susceptible than the earlier stands to a number of pest problems including: root disease, stem decays and extensive defoliation by Western Spruce Budworm

Fire is perhaps the key agent which controls the delicate equilibrium between dwarf mistletoe and it's host in the natural ecosystem. Because heavy mistletoe infection leads to accumulation of dead trees, witches' brooms and, resinous stems and branches and other fuels, the low intensity fires common in Central Oregon would often flare up and consume most of the trees in localized infection centers In addition, heavy witches brooming provides concentrated fuel for "torching" and destruction of infected trees, where normal tree crowns are too open to carry fire up the tree. Thus, mistletoe was periodically removed from the stands with usually subsequently regenerated to an uninfected stand of trees. Unfortunately, with fire suppression and the disruption of this cycle, dwarf mistletoe levels and associated damage has greatly increased. Because dwarf mistletoe

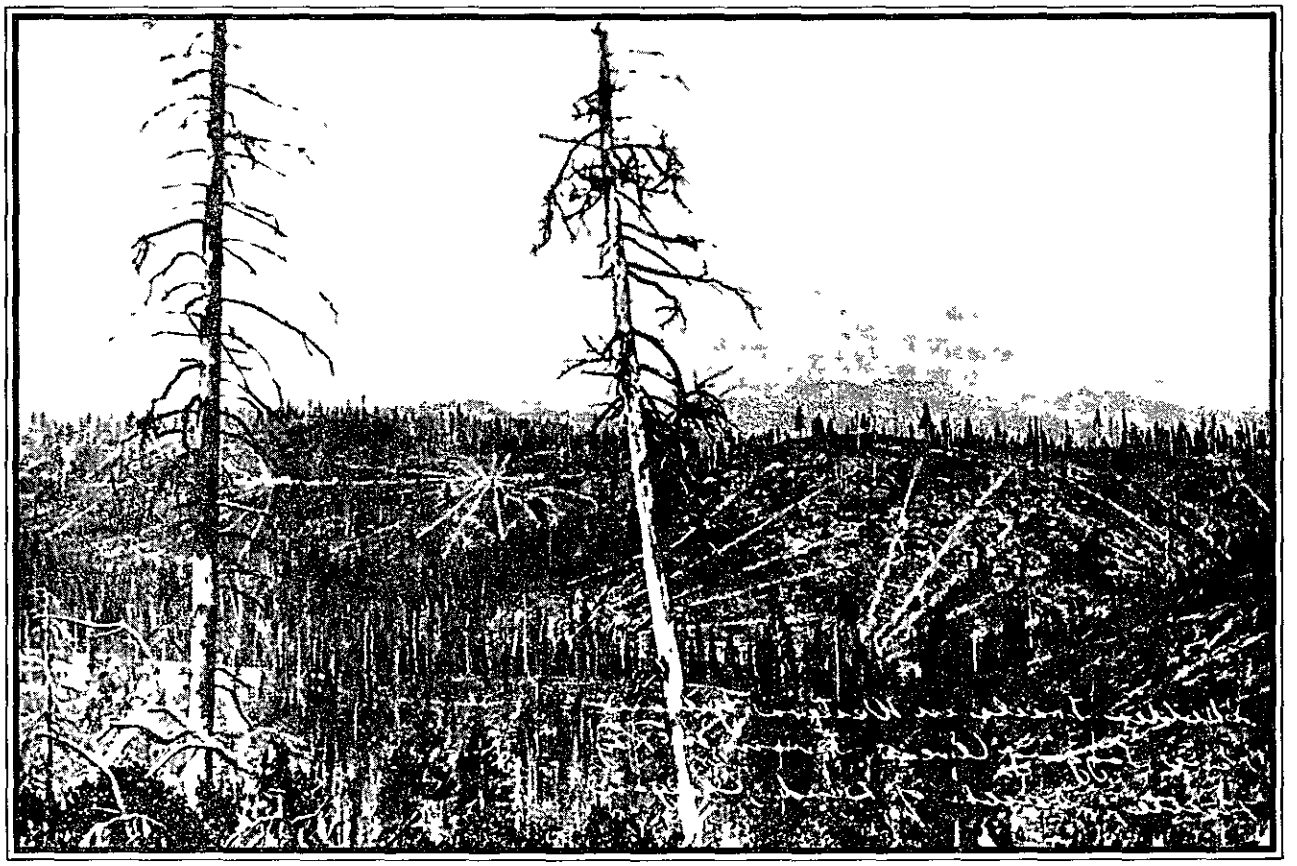
also spreads more quickly through uneven-aged stands than it does through even-aged stands, fire suppression has also indirectly contributed to the spread of dwarf mistletoe by favoring a more multi-aged stand conditions

Selection logging practices (especially in the 1950's and 1960's) have also hastened the rate of replacement of seral species by shade tolerant species Trees "selected" for harvest were the large high value trees; mainly pine and larch. Thus, the more disease resistant species of a stand were removed by the harvests and the more susceptible remained. In addition, residual trees were often damaged during the harvests These damaged trees together with freshly cut stumps provided entrance courts for root diseases and stem decays and these problems have increased greatly For example, in mixed conifer stands that have been selectively logged the amount of cull volume, as a result of decay is, on average, 3 times higher than in even-aged mixed conifer stands. Stressful growing conditions caused by overstocking, soil compaction and disturbance resulted in trees succumbing to pests (most notably bark beetles and root diseases) they might have been able to resist had they been vigorous

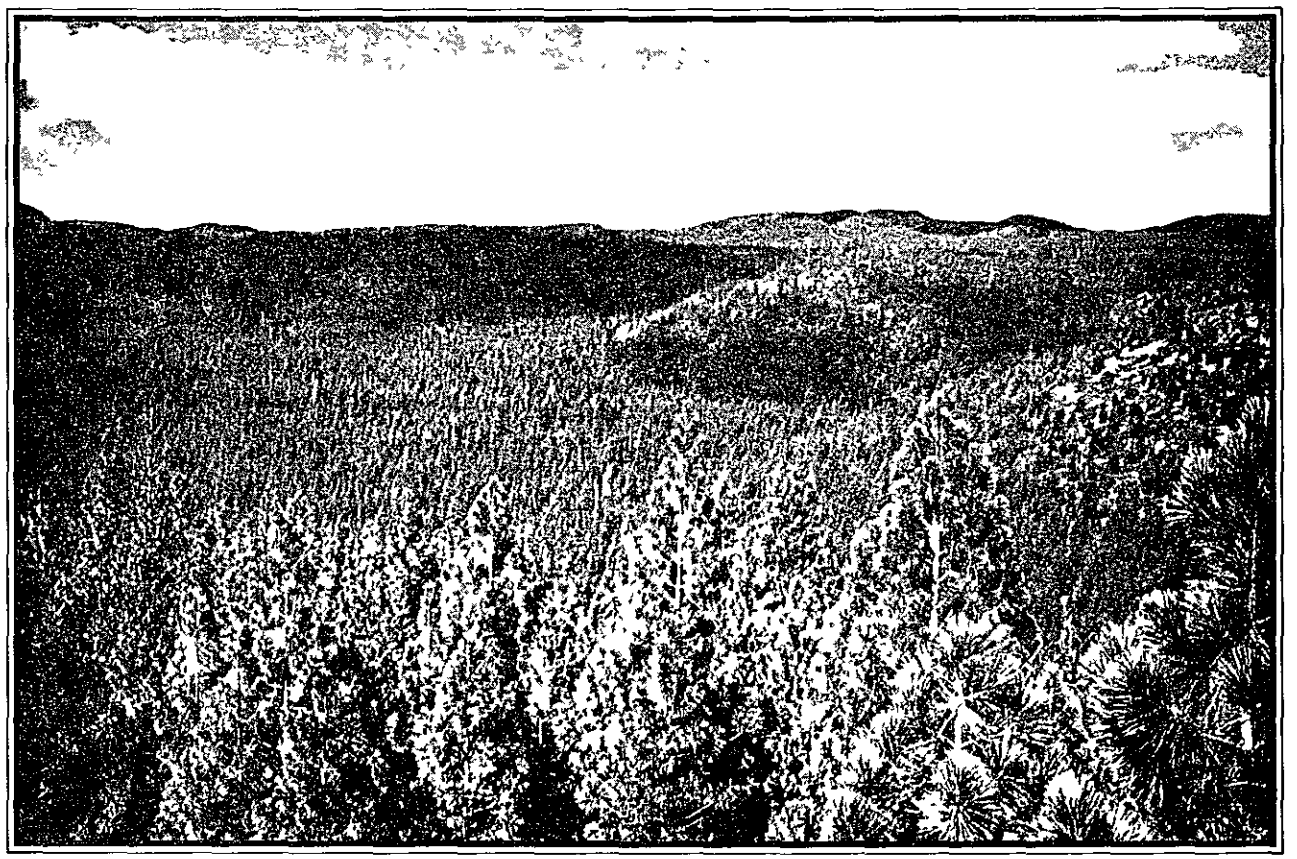
In the recent past 20 years approximately 246 1 M acres on the Forest have been subjected to regeneration cuts. These cuts are most often incomplete clearcuts where small amounts of advance regeneration and overstory trees are scattered through the treatment area Often the residual overstory trees have dwarf mistletoe The mistletoe has subsequently spread from these trees into the reproduction, threatening it's success.

In many cases, past harvesting practices have also resulted in a large-scale loss of horizontal diversity Where this has happened the risk of severe insect epidemics is greatly increased The best example of this are the large acreages (110,000 acres) of Ponderosa pine clearcut and regenerated early in the century. This area is now composed of relatively uniform stands of 60-80 year old overstocked Ponderosa pine which is presently of an age which is susceptible to large-scale bark beetle attack (Figure 3-12).

Figure 3-12 Fire supression and tree selection practices have changed the structure of many even-aged ponderosa pine stands on the Forest to multipage stands with understories dominated by white fir.



Wide-scale clearcutting in the early part of the century has resulted in large areas of the Forest where horizontal diversity is low If left untreated, these stands would be highly susceptible to a mountain pine beetle attack The photo on the top was taken on McKay Butte in 1929, the photo on the bottom was taken on the same spot in 1975



Present Condition

The following paragraphs will briefly outline the occurrence, estimated levels of impact (if known) and characteristics of each of the 5 major pest types.

Dwarf mistletoe: Dwarf mistletoe is widely distributed on the Deschutes National Forest. According to the 1985 Vegetative Resource Survey, dwarf mistletoe occurs at some level of severity on an estimated 54% of the total acres covered by the inventory. Breaking this out by type, dwarf mistletoe occurs on an estimated 34% of the inventoried acres of Ponderosa pine type; 73% of the Mixed Conifer type and 66% of the lodgepole pine type. Figure 3-13 further breaks down mistletoe occurrence in each of these major types down into groups based on frequency and severity. Dwarf mistletoe is also been observed to occur frequently in a significant number of the plantations on the Forest (not part of the Forest Inventory). The dwarf mistletoes are among the most damaging forest diseases in the Pacific Northwest. They damage their host by reducing growth, lowering wood quality and killing or predisposing it to attack from other pests. Most of the conifer species of the West are parasitized by dwarf mistletoes. Although losses from dwarf mistletoe are not as visible as those caused by insects, the cumulative losses of growth and mortality are considerable over the life of the Forest.

Figure 3-13 Dwarf Mistletoe Incidence and Severity Levels by Type on the Deschutes National Forest

			Dwarf Mistletoe Intensity[3]			
Forest Type	**DM(-)[1]**	**DM(+)[2]**	**Light**	**Moderate**	**Mod-Heavy**	**Heavy**
Ponderosa Pine	65	34	26	5	2	1
Lodgepole Pine	34	66	50	15	1	0
Mixed Conifer	27	73	59	11	3	0
Totals	**46[4]**	**54[5]**	**42**	**10**	**2**	**0+**

[1]Estimated percent of total acres of forest type where trees are dwarf mistletoe free
[2]Estimated percent of total acres of forest type where trees have some level of dwarf mistletoe infection.
[3]Dwarf mistletoe infection severity level based on the Hawksworth 6 class rating system(DMR). Light 0 < stand DMR < 1, Moderate= 1 < stand DMR < 2, Mod-Heavy=2 < stand DMR < 3, Heavy=3 < stand DMR
[4]Estimated percent of total acres of forest where trees are dwarf mistletoe free
[5]Estimated percent of total acres of forest where trees have some level of dwarf mistletoe infection.

At present, however, the magnitude of growth loss and mortality due to mistletoe on the Forest, although undoubtedly considerable, has not been documented. Quantifying the impact of mistletoe is difficult because it's effect is subtle, apparent only over a relatively long period and governed by a complex array of factors some of which include:

The effect of dwarf mistletoe depends on what age trees became infected; trees infected relatively late in the rotation experiencing a negligible to no effect in contrast to trees which are infected early and may never reach a merchantable size.

The rate of height growth on the tree versus the ability of the mistletoe to spread within the tree will greatly affect the impact of mistletoe.

The ability of mistletoe to infect other trees in the stand varies considerably with stand structure, density, species composition and management activities

Because of this high level of complexity, a growth and yield model which can account for the effects of dwarf mistletoe, is almost essential for projecting the magnitude of volume loss At the present time, however, growth models for Central Oregon do not have this capacity. In the Southwest where these models are available, however, projected impacts (at about the same level of mistletoe occurrence in similar stand types) have been considerable, comprising approximately 14% of the annual increment.

Root and stem rots: Root diseases are widely distributed throughout the mixed conifer type. Forest-wide it has been estimated that approximately 10% of the total acres of mixed conifer type experiences some reduction in growth and yield attributable to root disease (more detail on how this estimate was derived is found in the Appendix under procedures for using the root rot model). On the Sisters RD, district personnel have estimated that 97,649 acres, or over 80%, of the mixed conifer type is impacted to some degree by root disease. One specific survey of a 2,500 acre mixed-conifer stand on the district showed 19% of all trees over 5 inches (representing 22 percent of the merchantable board foot volume) were killed by root disease over a 20 year period.

Two major root diseases are responsible of most of the problems on the Forest: Armillaria root disease (*Armillaria ostoyae* and Annosus root disease (*Heterobasidion annosum*) Laminated root disease (*Phellinus weirii*) is not as common but still significant Black stain root (*Ceratocystis wageneri*) disease has been found in the past in a few isolated situations but it's occurrence has increased recently and now it is scattered throughout the Suttle Lake and Cache Mountain areas.

Root rots impact trees in a number of ways. They can cause mortality because the tree roots are entirely killed so the tree can no longer transport water and nutrients, or, roots are so rotted that they no longer support the tree which dies when it topples over Infection by root disease also stresses the tree to the point where it is more susceptible to mortality by some other agents such as bark beetles or windthrow. Often, a root-diseased tree is actually killed by bark beetles or drought. Concern about root diseases is increasing as the number of unsuccessful efforts to regenerate harvested stands increase and stands previously regenerated become understocked.

Stem decays and butt rots are scattered throughout all forest types. Estimated live merchantable volume that is is cull as a result of decays by type are 3%(even-aged stands) to 5%(uneven-aged stands) for Ponderosa pine type, 7% for lodgepole type, and 4%(even-aged stands) to 14%(uneven-aged stands) for the mixed conifer type. On Ponderosa pine, *Inonotus cinerascens* and velvet top" fungus (*Polyporus schweinitzii*) are the most common butt; red rot (*Polyporus anceps*) and red ring rot (*Phellinus pini*) are the most prevelent cause of stem decay. On Douglas-fir and lodgepine, "velvet top" fungus is the primary cause of bole rot and red ring rot the primary cause of stem decay. On the true firs, indian paint fungus (*Echinodontium tinctorium*)is the most common cause of stem decay. Various butt rots are also present throughout the type.

Stem decays affect the quality and amount of sound wood in the tree Extensive decay also results in a loss or reduction in the structural integrity of the tree Consequently the tree becomes more susceptible to breakage.

Defoliating insects: Most prominent among the defoliating insects is the western spruce budworm This insect, which may reach outbreak levels in large contiguous areas of multi-aged mixed conifer type, can cause extensive tree mortality and top-kill, and will produce growth loss in trees less heavily defoliated. In past years risk has increased dramatically and large outbreaks have occurred in Eastern Oregon but have been restricted to small outbreaks on the Forest At present risk is not significantly increasing and may in fact be decreasing as management practices are being designed to remove the susceptible mixed conifer component from the stands

Bark beetles. Two groups of potentially damaging bark beetles occur in the forests of Central Oregon These are the engraver beetles (*Ips* spp and *Scolytus* spp) which attack Ponderosa pine and true firs, respectively; and the *Dendroctonus* beetles which feed on all the prominent species of pine The engravers are usually confined to the tops of their host trees, but may kill entire trees if they are stressed by drought and/or root disease *Dendroctonus* beetles including the mountain

pine beetle (*D. ponderosae*) and the western pine beetle (*D. brevicomis*) can kill pines outright and do not require that host trees be moisture-stressed. All of these beetles are most active where host trees grow under crowded, highly competitive conditions. Stocking level is the single most important variable in determining the risk of a stand to bark beetle infestation. Where stands are overstocked, tree mortality can be severe, but when trees are free to grow, bark beetle impacts are minimal

On the Deschutes National Forest the most serious of these bark beetles is the mountain pine beetle which has devastated large areas of lodgepole pine in recent years, killing an estimated 65 million trees (2.9 MMMBF). In terms of impact on the environment, surveys have showed that most lodgepole pine stands have experienced 50 to 65 percent mortality with some stands going higher. The largest trees were preferred by the beetle and in most stands nearly every tree larger than 9 inches in diameter was killed. Now that its preferred food source has been nearly depleted, the mountain pine beetle poses a serious threat to young Ponderosa pine stands throughout the Forest. Approximately 110,000 acres of these young stands have reached a susceptible condition (60-80 years old and heavily stocked) and will eventually be damaged by the mountain pine beetle if they are not treated. In some areas on the Forest, mountain pine beetle attacks are already occurring in these types of stands.

To lessen the risk in these stands, the Forest has initiated a thinning program which will reduce stocking, while accomadating other resource objectives including wildlife hiding cover. This will enhance growth of residual trees and impart a high level of resistance to bark beetles

See List of References for sources used by Planning Team members in preparing this and other technical documentation.

Fire

Before 1900, fire was a natural aspect of the Forest eco-system. It was more frequent in areas occupied by the more flammable pine species. These fires, occurring at five to 25 year intervals on lower elevations, were often of low intensity. They removed accumulations of forest litter and light brush.

Many years of effective fire suppression efforts have caused unnatural accumulations of needle litter, dead limbs, and dead trees which can lead to destructive, high intensity wildfires. Serious outbreaks of mountain pine beetle infestations added additional fuels

Fires have been moderately frequent. Over the last two decades, 1,986 wildfires were ignited and 1,550 were man-caused. An average of 978 acres burned each year.

Except for fires associated with housing developments near the Forest, the number of man-caused fires have remained fairly stable in the area for some time. This class of fire constitutes a serious threat to life and private property and is a number one concern.

Air Quality

Air quality in Deschutes, Klamath, and Jefferson Counties is considered to be good. Monitoring sites for measuring air quality variables are few. Population densities and the prevailing climate rarely allow concentrations of particulates or chemicals.

There are, however, some notable exceptions to this usual condition. Local inversions can concentrate smoke in populated areas during the winter. These inversions usually break down in the afternoon and allow the smoke to dissipate. Smoke from agricultural burning near Madras or in the Willamette Valley occasionally drifts into the area for short periods of time

The effect of wildfires on or off the Forest is usually short term, although it can persist longer during extreme fire seasons Another source of smoke is from prescribed burning on National Forests and privately owned lands

Dust particles from the pumice soils are commonly considered air pollution. Most of this dust comes from vehicles on unsurfaced roads and from winds blowing through unvegetated areas The Environ-

mental Protection agency's *Environmental Quality Profile for Oregon*, 1979, describes air quality standard violations due to "fugitive dust" in Deschutes and Klamath Counties.

As the result of a voluntary agreement with the State, prescribed burning on the Forest does not occur from July 4 to September 5 This is intended to protect air quality during the peak recreational season.

Pollution sources outside Forest boundaries are regulated by the Prevention of Significant Deterioration provisions in the Clean Air Act. Special measures are taken to maintain air quality in wildernesses.

Rangelands and Forage

The Forest rangelands support a variety of wildlife, recreation, and commercial livestock resources (18 commercial cattle allotments and 16 commercial sheep allotments) which exist on 741,000 acres (46 percent) of National Forest land Of this total, approximately 522,000 acres are useable rangelands. The total carrying capacity of the usable range is estimated at 35,000 AUMs (animal unit months).

Roughly 98 percent of the Forest's rangeland is dominated by a tree shrub overstory, the remaining 2 percent are meadows. Annual forage associated with the tree and shrub communities is dry bunch grass, primarily Idaho fescue, needlegrasses, or various species of sedges. Annual forage production on the dry bunch grass range varies from 50 to 450 pounds per acre annually.

Most of the rangelands are in fair to good condition with a stable upward trend. Some isolated areas exist within allotments where conditions are poor due to past overgrazing

Demand for livestock grazing has been consistent in the cattle industry; most of the cattle allotments are used each year. Demand for sheep allotments has not been as strong. Over the last ten years no more than four of the sheep allotments have been grazed each year

The commercial livestock capacity of the Forest is estimated to be 60,000 AUMs. This capacity could not be achieved without substantial investments for improvements in water availability, forage quality, and allotment management

There are no known wild horses or burros on the Forest

Energy

Geothermal Energy Resources

This is one of the few National Forests in the nation which has high geothermal potential. The development of geothermal energy for electricity would have major economic implications for the area and would be attended by serious environmental concerns. Because of this, a general description of the phenomenon is considered appropriate.

In certain areas of the world, heat from the earth's interior can be found close enough to the surface to be extracted economically Drill holes that tap hot, valuable fluids are usually less than 10,000 feet deep.

A major global zone of geothermal potential is a ring of volcanoes surrounding the Pacific Ocean, the "Ring of Fire " The Forest is part of this great ring and geothermal indications abound. In parts of Central Oregon, geologically young volcanism and hot springs suggest sources of heat; faults suggest corridors along which hot fluids may rise; and steam has been found in Newberry Crater at a depth of only 1,200 feet. Newberry Crater, designated a Known Geothermal Resource Area (KGRA), and other areas on the Deschutes National Forest are thought to be among the best prospects for geothermal exploration in the continental United States

Geothermal energy is used directly to heat buildings and green houses, dry lumber, and pasturize milk. It is also used to produce electricity The largest development in the world, located at The Geysers about 70 miles north of San Francisco, produces roughly twice the amount of electricity as the Trojan Nuclear Plant or Bonneville Dam (both near Portland). Each produces about 1,100

megawatts or enough electricity to supply the electric needs of a city of a million people.

Geothermal energy can be economically competitive with coal, nuclear energy, and possibly hydropower for the production of electricity. Fewer environmental problems are associated with it.

A geothermal development for the production of electricity usually consists of a power plant supplied with steam or hot water from several nearby wells. Power plants typically produce from 10 to 135 megawatts of electricity with each well contributing 2 to 8 megawatts.

Roads, well pads, pipelines, a cooling tower, and a transmission line are required. A 50 megawatt power plant and cooling tower may occupy 3 to 5 acres Each well pad may be 1/2 to 4 acres in size. Pipelines, generally placed above ground for ease of maintenance, may require the width of a primitive road. Altogether, a 50 megawatt development may affect 20 to 50 acres of land.

Direct Uses of Geothermal Energy

Direct use of geothermal hot water on the Forest has been limited to Newberry Crater. No natural warm or hot water is known outside of the Crater. Water from hot springs (175 degrees F) along the southeast shore of East Lake provided hot baths in a primitive resort from about 1912 to 1930. Today, a hand-pumped water well in Little Crater Campground provides visitors with 95 degree F water. Low volume direct use of hot water, if developed, would probably be confined to Newberry Crater.

Other direct use may develop from deep exploration and test wells drilled elsewhere on the Forest. Such wells may be drilled with the intention of discovering high temperature fluids suitable for generating electricity. Hot water could be pumped from these wells through pipelines to points of use. Chemically acceptable hot waste water from electric generating facilities could be carried in pipelines to population centers.

Phases of Geothermal Energy Development for Electricity

Exploration

Targeted geothermal areas are explored to locate and define the extent of reservoirs of steam or hot water and to determine the economic feasibility of development In the Cascades most targeted areas exhibit no direct surface manifestations such as hot springs.

Exploration may include aerial and surface surveys Airplanes are used to make magnetic, photographic, and visual geologic surveys and to sense changes in surface temperatures.

Exploration using existing roads and trails and requiring little land disturbance are "casual activities." They include:

Reconnaissance of surface features and natural phenomena without land disturbance,

Geologic mapping;

Geophysical surveys of resistivity, microseismicity, ground noise, magnetism, and gravity; and

Geochemical surveys of air, water, vegetation, and soil.

Activities requiring minor land disturbance include shallow and intermediate well drilling Equipment often consists of a truck-mounted core drilling rig with tanks for water and drilling mud. Road construction and clearing are seldom necessary. Several temperature gradient holes have already been drilled in clearings along existing roads and on old logging landings. Sites drilled on Forest have shown the need to drill deeper than 2,000 feet in order to reach below a deep and extensive body of cold ground water.

Development of a large geothermal field involves clearing and grading for access roads, well drilling pads, and pipelines. It is not necessary to clear corridors wide enough to prevent trees from falling across the pipeline.

Powerplant, Pipeline, and Powerline Construction

Construction of facilities for generation and transmission of power follows a thorough examination of all environmental impacts, including an

analysis of all available information on the geothermal reservoir and fluids

Power generation and transmission facilities are constructed in stages consistent with the capacity of the geothermal reservoir.

Power plants at The Geysers range in size from 10 to 135 megawatts Typical sizes constructed in the past few years are 55, 80 and 110 megawatt power plants. A 55 megawatt plant is housed in a building 140 feet long, 34 feet wide, and 30 feet high. The cooling tower consists of three units each measuring 36 feet by 66 feet and placed side by side. This plant requires a 7 acre area. A 135 megawatt plant consists of a turbine building 173 feet long, 83 feet wide, and 66 feet high. The cooling towers occupy an area 360 feet long by 75 feet wide by 65 feet high.

Restoration

Site restoration is a part of the geothermal operation that begins with the completion of the first well and continues through the life of the field. Wells, power plants, and other installations are removed as the geothermal resource is exhausted Thus, restoration may be underway in one part of the field while development is in progress in another. Complete restoration includes removal of all installations such as pipelines, buildings, generators, and power transmission towers and lines. Wells are sealed, and roads, well pads, and other clearings are regraded and revegetated.

Present Knowledge of Geothermal Potential

A geothermal resource may exist if vertical channels in the ground allow large amounts of rain or melted snow to travel deeply to a heat source of hot or molten rock. The heated water or steam rises along other vertical channels to a large holding area or reservoir which, if penetrated by drilling, yields hot water or steam If this system leaks to the surface, it can produce hot springs, fumeroles, mudpots, and geysers Such is the case at Yellowstone National Park Once heated, the water becomes gas-charged and mineralized to widely varying degrees

All conditions mentioned above are thought to exist in several areas on the Forest. Volcanic events occur here on a time scale of hundreds to thousands of years, which suggests that hot or molten rocks lie within 5 miles of the surface in these areas. Vertical fractures along which water can travel are clearly evident at the surface in a few areas but generally are obscured by young lava flows. Water is abundant The young volcanic rocks are highly fractured and permeable so that leaks from geothermal reservoirs spread out under the ground instead of rising to the surface to make hot springs. The only exception is hot springs and warm ground water in Newberry Crater.

Several geologic and geophysical surveys have been made recently by public agencies and private companies. Several holes have been drilled up to depths of 3,000 to 5,500 feet deep. Holes to 4,000 feet are planned. Except for holes drilled by public agencies in Newberry Crater, all other significant drilling has been performed by private companies Information from these companies is generally not available. So far, the only clear evidence of high geothermal potential is from Newberry Crater. A hole drilled to 3,058 feet by the U. S. Geological Survey in 1981 revealed a temperature at the bottom of 509 degrees F (265 degrees C) and yielded steam at the surface during a 20-hour flow test.

All public information related to geothermal potential on Forest is either inconclusive or encouraging. Exploration is in its infancy and will move forward only after substantial intermediate to deep drilling.

Areas of Geothermal Potential

There are four areas which have the greatest geothermal potential on the Forest All are formed by geologically young volcanic rocks The rest of Forest appears to have at least a moderate potential.

Newberry Volcano

Newberry Volcano is a large, broad composite volcano that covers about 500 square miles. Much of its great bulk consists of ash, pumice, and tuff, which are all products of explosive eruptions. These materials erupted primarily from Newberry Crater, a caldera. Lava and cinders have erupted from fissures on the north and south flanks burying great expanses of ash, pumice and tuff. The entire

volcano is probably less than 700,000 years old The most recent eruption occurred within the caldera 1,300 years ago. Areas closest to the caldera probably have higher geothermal potential than those on lower elevations.

Bearwallow Butte/Melvin Butte Area

This area is part of a prominent highland, the Bend Highland, that extends eastward from the Three Sisters Rocks (andesite, dacite, and rhyolite) indicate a favorable environment for geothermal reservoirs. Hot or molten masses of rock may lie within 5 miles of the surface. They could rise to the surface explosively or build volcanic domes much like the recent dome at Mount St. Helens. Bearwallow Butte is a dome similar to the one in the crater of Mount St Helens. Several sheets of pumice, ash, and tuff in the Bend to Sisters area erupted violently from this highland. Most or all of these eruptions occurred less than 400,000 years ago.

Mount Bachelor/Dry Butte Area

About 12 cubic miles of lava and cinders erupted 15,000 or so years ago to form a 16-mile-long chain of volcanoes from Mount Bachelor to Dry Butte (near Lookout Mountain). The geologic youth of this volcanic chain suggests the presence of geothermal reservoirs.

Sparks Lake/South Sister Area

Obsidian domes and lava erupted in this area about 2,000 years ago. Cinders and lava erupted under a glacier about 15,000 years ago to form Katsuk Butte These and other events suggest sources of heat for geothermal reservoirs.

Estimate of Geothermal Potential on Deschutes National Forest

Estimates of potential for all areas in the Cascades of Oregon range from 2,500 to 402,000 megawatts Most investigators believe that the central Cascades of Oregon have proportionally higher potential than other areas in the Cascades.

Estimates of geothermal potential at Newberry Volcano range from a few to 13,000 megawatts. A study by the Bonneville Power Administration produced a 1,600 megawatt estimate. Estimates at other areas thought to be favorable have not been made.

Indications to date suggest modest to large geothermal resources on the Forest. Until more information is obtained from drill holes and geothermal reservoirs, however, estimates will continue to range widely.

This discussion was based on an extensive collection of technical reports and geothermal surveys which is available at the Forest Supervisor's Office

Status of Leasing and the Decisions Made to Date

The Forest began receiving geothermal lease applications in 1974 Initial applications were for Newberry Crater and the rest of Newberry Volcano. The first leases were issued in 1982 By early 1985, a total of 463 lease applications had been filed on the Forest. In response, separate Environmental Assessments were completed for the Fort Rock and the Sisters Ranger Districts in 1982. The Bend and Crescent Ranger Districts were combined and a third Environmental Assessment completed in 1984 According to the terms of these Environmental Assessments, 177 leases were issued by the Bureau of Land Management. Figure 3-14 shows the status of geothermal leasing on the Forest.

Figure 3-14 Status of Geothermal Leasing

Status[1]	Number	Acreage
Pending Applications	116	206,000[2]
Leases Issued	177	353,000
Apps Rejected or Withdrawn	170	
Total	**463**	

[1]As of the First Quarter of calendar year 1985
[2]This acreage includes the acreage of overlapping applications.

Treatment of Wilderness and the Oregon Cascades Recreation Area

There have been no geothermal leases in the Newberry Crater KGRA (31,000 acres), the Oregon Cascades Recreation Area (42,600 acres) or several small tracts which lie outside but adjacent to Wilderness (9,600 acres). The latter are a product of differences between the previous Environmental Assessment boundaries and boundaries created by the Oregon Wilderness Act (leasing is not permitted in Wilderness). The Oregon Cascades Recreation Area prohibits leasing after 1989.

Classification System

In order to understand the geothermal resource potential, a resource inventory is needed. Geothermal resources cannot be identified with the same degree of certainty as many surface resources For this reason, a broad classification system was used to rate the geological potential The classification system uses four classes and rates the resource potential as high, medium, low, and unknown. Figure 3-15 shows estimated potential in areas that have been leased to date and in portions of the Forest that remain unleased.

Figure 3-15 Geothermal Resource Potential Classification in Acres

Area Status	Low Potent.	Medium Potent.	High Potent.	Unknown Potent.	Total
Leased	13,100	269,800	71,800	0	354,700
Unleased	410,000	654,800	200,900	0	1,265,700
Unleased, excluding Wilderness & OCRA	410,000	504,500	126,100	0	1,040,600
Total:					
Including Wilderness	423,100	924,600	272,700	0	1,620,400
Excluding Wilderness	*423,100*	*774,300*	*197,900*	*0*	1,395,300

Oil and Gas

There have been a few applications for oil and natural gas leases. One has been issued. According to U.S. Geological Survey maps, most oil and gas potential lies east of the Forest on neighboring Bureau of Land Management and Ochoco National Forest lands. Both of these agencies have received applications over the past few years and have issued a large number of leases.

Hydropower

Currently there are no commercial hydropower facilities on the Forest. The North Pacific Division of the Corps of Engineers released a report entitled "Summary of Northwest Hydroelectric Power Potential" in 1976. The large-scale power generating potential of the Deschutes and Metolius Rivers was found to be economically infeasible. Since 1980, however, seven applications for low-head hydropower production on streams flowing through the Forest were filed with the Federal Energy Regulatory Commission. These applications and their status are shown in Figure 3-16.

Figure 3-16 Hydropower Applications on the Deschutes National Forest

	App. No.	Proposed Capacity	Status
Deschutes River @ Pringle Falls[1]	6573-000	---	Water rights denied by State.
Wickiup Dam Retrofit	3560-001	7.0 MW	Applied for license 1982.
Columbia Southern Canal	6473	3 0 MW	Preliminary study permit issued.
Crane Prairie Dam	3446-001,4171	3 5 MW	Dropped
Lava Diversion (Benham Falls)	5205	16 0 MW	Applied for license 1984.
Arnold Irrigation[1]	7306	3.8 MW	Exemption
Squaw Creek	7903	3 5 MW	Preliminary permit issued.

[1]Amount of the project on the National Forest may be minor

Of the pending applications, all but the Lava Diversion and the Squaw Creek project use existing irrigation facilities. The Lava Diversion would require construction of a new facility

Firewood

A major source of energy on the Forest is fuelwood for home heating.

Fuelwood supply is probably at an all-time high as a result of the mountain pine beetle epidemic in the mature lodgepole pine forests. By 1984, approximately 230,000 acres were infested resulting in an abundance of fuelwood. Fuelwood is also available as a result of the wood residues left from timber harvesting and other timber stand treatments.

Although this resource is removed in small increments, the total volume is substantial A conservative estimate is that 26,000 cords of personal use firewood and 10,000 cords of commercial firewood were removed from the Deschutes National Forest in fiscal year 1988.

This equates to approximately 16 MMBF, or about 8 percent of the annual chargeable timber cut from the Forest. According to these estimates the average permittee removed about 1.5 MBF, equivalent to about three to four cords. Revenues to the Forest from personal use firewood permit sales were approximately $105,000 in 1988.

There has been a slow decline in personal use of firewood in the past few years This is attributable to· (1) longer distances which collectors must travel as sources close to town are depleted, (2) increasing energy efficiency of new homes; (3) harvest of lodgepole pine in the Forest's normal sale program; (4) greater efficiency in new model stoves and the increasing popularity of stoves burning pellets.

If firewood consumption levels off, 25 percent of the current mature lodgepole pine inventory will be removed as firewood over the next 10 years.

Recreation

Forest Setting

For people devoted to outdoor recreation, the Deschutes National Forest is one of Pacific Northwest's premier attractions. Bounded by the Crest of the Cascades on the west and the high desert on the east, the Forest offers recreational opportunities which are extraordinary in both number, variety, and quality They include primitive recreation in alpine Wildernesses, skiing in both natural settings and at the Northwest's most popular developed ski area, and some of the best fishing on the West Coast

The Forest's climate and location attract people from all the major population centers in the Northwest It provides a dry climate for recreation desired by people living in the rain belt west of the Cascades. The short driving times, two to four hours from Eugene, Salem, or Portland, and seven to eight hours from Seattle, make the Forest very accessible both on weekends and for longer vacations.

These circumstances have made the Deschutes one of the first National Forests in the region to receive heavy recreational visitation. Most Forests in the region were not extensively roaded until the 1950s, confining recreation to those hearty enough to explore the woods on foot. The dense understory of timberland west of the Cascades further reduced access, limiting visitors to early trail systems.

This Forest has been much more congenial. Many railroad grades left by early logging activity became roads and open forest stands on flatland or gentle slopes provided easy access to large portions of the Forest.

Much of the earliest visitation was by people residing east of the Cascades Ranchers from Sherman County constructed vacation homes along the Metolius River in the early years of the century (hence Camp Sherman)

While fishing was nationally renowned on much of the Forest, fish were blocked by Paulina Falls and both Paulina Lake and landlocked East Lake were fishless. Fish stocking, however, began very early in Newberry crater In 1912 some 60,000 rainbow trout fry were released in East Lake Conservation also has a long history on the Forest.

The Crane Prairie reservoir was closed to fishing from 1925 to 1949 to foster the propagation of trout After World War II the Forest hosted many national conventions of scouting and other outdoor associations

In 1986, the Forest ranked third among the 19 National Forests in the Pacific Northwest Region and 25th among 125 Forests nationally in total recreation During 1987, 2,600,000 recreation visitor days were recorded. (This measure represents a 12 hours visit on the Forest It could be one person staying 12 hours or 12 people staying an hour.)

Recreation during 1987 is recorded by activity type in Figure 3-17

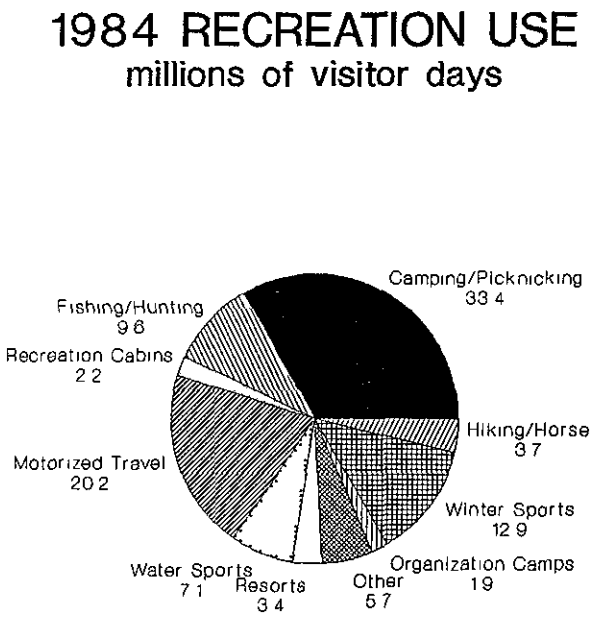
Figure 3-17 Recreation Use by Activity (1987 Figures)[1]

Activity	Use MVD's[2]	Percent Use
Camping/Picnicking	882 2	33 4
Motorized Travel	532 9	20 2
Winter Sports	339 5	12 8
Water Sports	187 0	7 1
Fishing and Hunting	253.7	9.6
Resorts	90.3	3 4
Organization Camps	50 7	1 9
Recreation Cabin Use	57.0	2 2
Hiking/Horse Riding	97.9	3 7
Other	151.0	5.7
Total	**2642.2**	**100.0**

[1]1987 RIM Report Number 2300-1

[2]The above figures include 80 6 MVD use on 182,506 acres of Wilderness

Figure 3-18 1984 Recreation Use (MVRD)



Developed Recreation

Nearly half of the total recreation on the Deschutes National Forest is associated with developed recreation sites. Most of it occurs in one of the Forests 101 campgrounds Fifty campgrounds receive standard maintenance and a fee is charged There is a lower level of maintenance at the remaining 51 campgrounds, which often do not have drinking water but no fees are charged. Fee campgrounds are becoming increasingly popular. The average occupancy rate in 1988 was 45 percent This is for a 130 to 150 day season that generally starts with the opening of fishing season in mid-April and ends in mid to late September

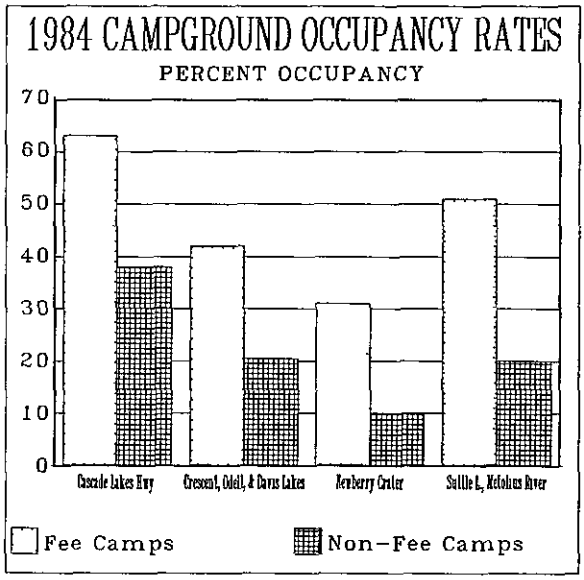
Campgrounds are considered "well managed" when they operate at 20 to 40 percent of capacity (occupancy may exceed 100 percent on weekends and holidays and be very low in the early and late season). Occupancy which is significantly above 40 percent for the season tends to destroy vegetation

In addition to Forest Service campgrounds, there are eight private recreation vehicle parks on the edge of the Forest Two of these are large membership campgrounds Four of the resorts on the Forest also have recreation vehicle parks.

Figure 3-19 shows that fee campgrounds are currently used above their design capacity and that non-fee campgrounds fall within the desirable use range.

Figure 3-19 Campground Occupancy Rates.

(Figure XXXXVIII pg 152 DEIS bar graph 1984 Campground Occ. Rates)



The condition of facilities within developed recreation sites can influence patterns of use. Poor facilities discourage campers while heavy use can degrade facilities The "maintenance only" column of Figure 3-20 indicates the number of developed sites in good condition which require only normal maintenance. The second column indicates developed recreation sites in need of rehabilitation The last column indicates sites in such poor condition that they need to be replaced Boat sites and non-fee campgrounds occur most frequently in this last category

Additional fee camping sites are needed to meet existing and future demand. There are several ways this demand could be met They include:

Expanding existing fee campgrounds,

Building new campgrounds,

Upgrading reduced service level campgrounds to fee campgrounds,

Expanding recreation vehicle parks at resorts on the Forest,

Adding recreation vehicle parks at other resorts,

Converting some resorts entirely to recreation vehicle parks,
encouraging new campgrounds off the Forest,

Permitting new campgrounds on the Forest to be built with private funds

Figure 3-20 Condition of Developed Sites[1]

Site Kind	# Sites	PAOT[2]	Maint. Only	Needs Rehab.[3]	Needs Replacing[3]
Observation	14	643	8	3	3
Boating	51	2,619	20	12	19
Swimming	8	810	7	0	1
Trailheads	24	1,146	22	0	2
Campgrounds					
Fee	49	6,350	34	6	9
Non Fee	53	2,885	15	14	24
Picnic Grounds	27	900	16	6	5
Winter Sports	14	1,163	14	0	0
Interpretive	9	914	2	5	2
TOTAL	**249**	**17,430**	**138**	**46**	**65**

[1]1988 RIM Facility Condition Report Number 2300-6
[2]PAOT = People at one Time Capacity
[3]Site Condition of Major Facilities

Visitor information centers and other interpretive service facilities are another major component of the developed recreation program The largest is the Lava Lands Visitor Information Center, which is located at the base of Lava Butte about 10 miles south of Bend The dynamics of volcanic forces which shaped Central Oregon are exhibited and explained at the Center. Travel information and background on a variety of other points of interest in the area is provided. Interpretive trails near the Center explore the rugged lava flow and surrounding forest lands.

A short 1.5 mile drive leads from the Center to the top of Lava Butte, a classic breached cinder cone. At the summit, the Lava Butte Observatory offers further interpretation of Central Oregon geology as well as a panoramic view of the Cascade Mountain Range and Deschutes Plateau.

Closely associated with Lava Lands is Lava River Cave, one mile to the south This mile-long lava tube is the longest in Oregon

Lava Lands, Lava Butte and Lava River Cave receive a combined total of about 250,000 visitors annually. The season of operation generally runs from May through October

The Scandinavian origin of many early loggers and mill workers in the Bend area led to early development of skiing as winter recreation. A

group calling itself the Skyliners organized a winter sports area along the McKenzie Highway east of Sisters in 1928. A location closer to Bend was sought and the Skyliners located at Swede Hill on upper Tumalo Creek. A ski jump and lodge were constructed.

The low elevation of this site, however, was a problem Frequently there was not enough snow for a complete season of skiing In 1957, fire destroyed three buildings and much equipment.

James A. Egan, then supervisor of the Forest, led a group of local citizens to the foot of Bachelor Butte in February of 1958 and a local institution, the Mt. Bachelor Ski Area, was born The ski resort, locally financed, was open for business the next year and attracted an estimated 10,000 people

Currently, the Mt Bachelor Ski Area is visited by more than a half-million people annually, making it the most popular ski resort in the Northwest and one of the largest in the country. Skiing starts in November and continues through July The summit lift continues to operate through Labor Day for sightseers The area has nine chairlifts that provide over 3,000 vertical feet of skiing for alpine skiers. The area also offers more than 25 kilometers of nordic skiing.

The area has an approved Master Plan which allows for increasing capacity from the current 12,000 skiers at one time to 26,000. (*Mt Bachelor Recreation Area Proposed Master Plan*, March 1, 1980.) The plan is committed to maintaining the "Mt. Bachelor experience," which is generally low density skiing in a natural environment.

Mt. Bachelor is a major contributor to the tourism economy of Bend and Deschutes County (see below).

Other Developed Sites

The only National Park in the state is located at Crater Lake, about 100 miles south of the Forest The Park has limited camping facilities so many visitors to Crater Lake avail themselves of campgrounds on nearby National Forests including the Deschutes National Forest Oregon has only a few State Parks east of the Cascades. They are small, highly developed campgrounds like Cove Palisades State Park on Lake Billy Chinook, just north of the Forest Others, adjacent to the Forest on the Deschutes River, are the LaPine Recreation Area south of LaPine and Tumalo State Park north of Bend.

The Bureau of Land Management, the other major Federal landowner in eastern Oregon, emphasizes dispersed recreation and has only a few developed sites. Deschutes County does not provide any recreation sites. The Bend Metro Park and Recreation District has recreation facilities that are oriented to the urban population of Bend

Several major resorts are located within the Forest boundary and include Sunriver, the Inn of the Seventh Mountain, and Black Butte Ranch. These resorts offer their guests a wide variety of recreation experiences, many of which take place on the Forest

Many smaller resorts and a few private campgrounds are also available on the Forest Some of these campgrounds cater to overnight visitors traveling through the area Others, particularly the membership campgrounds, provide facilities for guests who may spend an entire vacation in the area These campground users also spend much of their time participating in a variety of recreation activities on the Forest.

Another attraction for recreationists is the High Desert Museum, an extensive collection of natural science exhibits which is located south of Bend near Highway 97

Dispersed Recreation

Dispersed recreation occurs outside of developed recreation areas. Camping in Wilderness and unroaded areas is the primary form The extensive road system on the Forest has created many dispersed sites along lakes and streams accessible to fishermen who prefer not to camp in developed campgrounds The same roads have also opened up many areas for hunter camps Dispersed recreation will be addressed in two categories, recreation which occurs in wilderness and recreation which occurs outside of wilderness.

Wilderness Recreation

An ongoing Limits of Acceptable Change inventory of non-maintained campsites and recreation areas determines the use patterns and condition of dispersed recreation areas. The inventory revealed that as of 1988 resource and social impacts did not meet wilderness management standards on 60% of the campsites and many of the trails in three wildernesses, Mt Jefferson, Mt. Washington and Three Sisters. Use is at or exceeding capacity in most of the popular areas in these three Wildernesses Repeated efforts to rehabilitate a number of the sites have been unsuccessful due to use Trends indicate that day use is increasing and overnight camping is becoming less popular Because the Mt. Jefferson, Mt Washington and Three Sisters Wilderness are in close proximity to a growing urban area, use would continue to increase if not limited by management.

The Forest portion of the Mt Thielsen Wilderness was in very good condition as of 1988

Use is steadily increasing in the Deschutes portion of the Diamond Peak Wilderness and will need to be monitored closely. Individual areas are experiencing some unacceptable impacts.

Non-Wilderness Recreation

An ongoing survey indicates that many of the dispersed sites, especially popular ones adjacent to bodies of water, are in a heavily and severely impacted condition Impacts include deterioration of riparian vegetation, excessive roads and vehicle tracks, and excessive areas of compacted and exposed soil Management of dispersed sites will require increased management emphasis

Many of the activities commonly associated with dispersed recreation have the potential to be in conflict with other management objectives for the same area.

Origin of Visitors

Figure 3-21 shows the origins of visitors to the State. (Oregon Travel and Tourism, D Runyon Associates, 1989) Because the dominant mode of travel to the State is by automobile the western states will continue to provide most of the non-resident recreational visitors.

Figure 3-21 Origin of Visitors to Oregon

Foreign	8 0
California	30 0
Washington	12 5
Texas	4.0
Arizona	3.4
Florida	3 4

Other surveys suggest other rankings of out-of-state visitors. It can be stated however that California and Washington are Central Oregons major out-of-state markets

State	CORA In-Room-Survey	Mt. Bachelor
Oregon	46 14	55.1
Wash	34 89	19 7
Calif	13 75	16.6

This data is summarized in a special report to the Forest Service by the Central Oregon Recreation Association, "Blended Visitor Industry Research Findings," September 25, 1989

Wilderness use is similar to campground use but a significantly higher percentage (92 percent) of Wilderness users are from Oregon See Figure 3-22.

Figure 3-22 Table - Origin of Visitors to Wilderness Areas[1]

Influence Area	Portland Metro	Salem/ North Willam Valley	Eugene/ Spring-field	Central Oregon	All Other OR	Calif State	Wash. State	Other USA & For-eign	Total
Wilder-ness	% Total	% Total	% Total	% Total	% Total	% Total	% Total	% Total	% Total
Mt. Jefferson	24.2	42 8	9.4	6.6	11 0	1 8	1.3	3.0	100
Mt Washing-ton	13 8	19.9	42 0	7 9	6.9	3.6	1.4	4 5	100
Three Sisters	14.2	14 2	33 5	15.9	13 9	3 0	2 0	3.3	100
Diamond Peak	6.3	6 8	65.1	1 8	9 5	4.1	1.0	5.4	100
All	18 0	26.1	25 5	10.9	11.9	2 6	1 6	3 4	100

[1]Analysis of Wilderness Permits 1978 (Does not include data for Mt Thielsen Wilderness which was created in 1984)

Seventy to 80 percent of the visitors to the Forest are Oregonians. They come from three distinct areas· Portland-Metropolitan area, the Willamette Valley, and Central Oregon. Most of the other visitors are from California and Washington. This and the total number of recreation visitor days registered each year establish the regional significance of the Forest. It is a preferred destination for people seeking recreation from all over the West Coast

The previously referenced studies compiled in 1989 also suggest a number of factors which will influence visitation and recreation opportunities on the Forest in the future.

Word-of-mouth advertising and positive previous recreation trips here will continue to be the major factors bringing people to the area. Other promotional efforts will be especially important to attracting new visitors to the area.

Currently, Central Oregon recreation facilities meet or exceed visitor expectations. Facility maintenance, cleanup, policing and the quality of personal services (Forest Service personnel host skills) provided will continue to be extremely important.

Roadless Areas

The Oregon Wilderness Act of 1984 added 59,265 acres of roadless areas to three existing Wildernesses. It also created the 6,859 acre Mt. Thielsen Wilderness from the Windigo-Thielsen roadless area on the Deschutes. The Oregon Cascade Recreation Area (OCRA) was also created from 37,891 acres of roadless land and 4,765 additional acres.

The remaining acres of each Roadless Area are listed in Figure 3-23.

FIGURE 3-23 Table - Remaining Roadless Area Acres

RARE II Number	Roadless Area	Net RARE II Acres	New Inventoried Acres	Reason for Change
6198	Mt Jefferson	2,700	2,608	Reflects areas which have been roaded since 1979
6191	Metolius Breaks	10,900	10,907	Adjustments made as a result of some roads and acquiring private land that was unroaded
6103	Mt Washington	7,300	0	Was included in the Mt Washington Wilderness in 1984 with only small slivers of unroaded lands left.
6192	Three Sisters	36,800	8,315	Majority was included in the Three Sisters Wilderness in 1984 A long narrow strip of unroaded land remains
6195	West-South Bachelor	32,500	30,945	Reduction due to developments at Mt Bachelor Ski Area and excluding some roads
6193	Bearwallows	8,100	7,337	Reduced to exclude some roads and an electronic site at Bearwallow Butte
6194	Bend Watershed	16,200	14,250	Reduced as a result of roads constructed during the Bridge Creek fire and post fire salavage logging and rehabilitation
6106	Waldo	9,700	4,992	Reduced as much of the area was included in the Three Sisters Wilderness in 1984
6107	Charlton	9,280	7,243	Reduced because of some new road construction and logging
6196	North Paulina	22,450	21,622	Reduced because of some new roads
6197	South Paulina	10,200	9,915	Reduced to exclude some roads and a power line
6108	Maiden Peak	29,420	27,008	Reduced because of new roads and timber sales
6111	Odell	14,150	0	Included in Wilderness in 1984
6109	Cowhorn	22,450	0	Included in Oregon Cascade Recreation Area in 1984
6132	Windigo-Thielsen	22,300	0	Included in Wilderness and Oregon Cascade Recreation
Total	**254,450**	**145,142**	**Area in 1984.**	

Oregon Cascade Recreation Area (OCRA)

The Oregon Wilderness Act of 1984 created the 157,000 acre Oregon Cascade Recreation Area (OCRA). It is located on four National Forests including 42,656 acres of the Deschutes. Other portions of the OCRA are in the Winema, Willamette and Umpqua National Forests. The law instructs managers to conserve and protect the area in a substantially undeveloped condition while providing public access for recreation, including motorized vehicles.

There is an interesting diversity of landforms in the OCRA, ranging from towering peaks and high desert to lush canyon meadows. Rivers with headwaters inside the OCRA include the North Umpqua, Klamath, Deschutes, and Willamette. Many lakes, ponds, rivers, and smaller streams are inviting attractions to day visitors and longer term campers.

The roadless character of much of the area provides watershed protection, wildlife habitat, scenic beauty, and recreation. The popular Pacific Crest National Scenic Trail passes through the area It is accessed by a number of secondary trails, many of which originate at heavily used and developed recreation complexes such as Diamond, Crescent, and Odell Lakes.

Two of the seven zones included in the OCRA are on the Deschutes National Forest. A description of each follows.

Zone 1 - Summit Lake/Crescent Lake

This zone is bounded by the Cascade Crest, Diamond Peak Wilderness, the Crescent Lake area, and the Windigo Pass road. Elevations range from 7,664 feet at Cowhorn Mountain to approximately 5,000 feet near Crescent Lake. Most of the zone has a relatively gentle topography, although it is steep and rugged near Cowhorn Mountain and along the Cascades. There are numerous small pothole lakes and a dozen of about 10 acres in size.

Summit Lake is situated on the west edge of the zone The small campground at Summit Lake receives about 1,000 visitor days use during the July to October season. Mosquitoes are the most significant deterrent to visitors.

Most activity in the zone occurs around Crescent Lake. It includes resort customers, day hikers, campers, equestrians, summer home owners, and Boy Scouts from Camp Mukualla. Winter activities include snowmobiles, off-highway vehicles, and cross-country skiing

The goal of management in this zone will be to enhance fish and wildlife habitat and provide for undeveloped recreation.

Zone 4 - Little Deschutes/Big Marsh

This zone inludes the headwaters of the Big Marsh Creek, Big Marsh itself, the headwaters of Spruce, Rabbit, Basin, Hemlock, and Swamp Creeks, portion of the Little Deschutes River The northern boundary of this zone is 500 feet south of the Windigo Pass Road.

Elevations range from nearly 7,500 feet at the summit of Burn Butte to 4,960 feet on the Little Deschutes Topography is generally steep, with mountainous lands bisected by narrow stringers of riparian meadowland associated with Big Marsh Creek and the Little Deschutes River. Big Marsh is an unusual area, a relatively large wet meadow/ marsh at fairly high elevation.

Black bear, beaver, bald eagles, herons, Sandhill cranes, the spotted tree frog, and Pacific tree frog are among the 74 species of wildlife identified in Big Marsh.

The area will be managed to enhance this wildlife habitat, particularly waterfowl, dispersed recreation (hunting), and water quality Historically, the primary activities were deer, elk, and duck hunting and domestic livestock grazing. Prior to its acquisition by the Forest, Big Marsh had been partially drained to provide additional forage for domestic livestock In a major habitat rehabilitation project, water is being returned to the original meandering channel of Big Marsh Creek Livestock grazing has been discontinued.

The zone is lightly roaded, but some system roads do exist There are some culverts and bridges crossing streams along existing roads.

For more information about OCRA management, see the Oregon Cascades Recreation Area Plan available at the Deschutes National Forest Supervisor's Office in Bend, Oregon and Appendix 4 of the Forest Plan

Wild and Scenic Rivers

In semi-arid country, rivers are especially prized. The Wild and Scenic Rivers Act of 1968 declares: "certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be perserved in free-flowing condition for the benefit and enjoyment of present and future generations."

The three classifications are:

Wild: 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: Rivers or sections free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accesible in places by roads

Recreation: Rivers or sections 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.

Six rivers on the Deschutes National Forest (Figure 3-24) have been designated as National Wild and Scenic Rivers

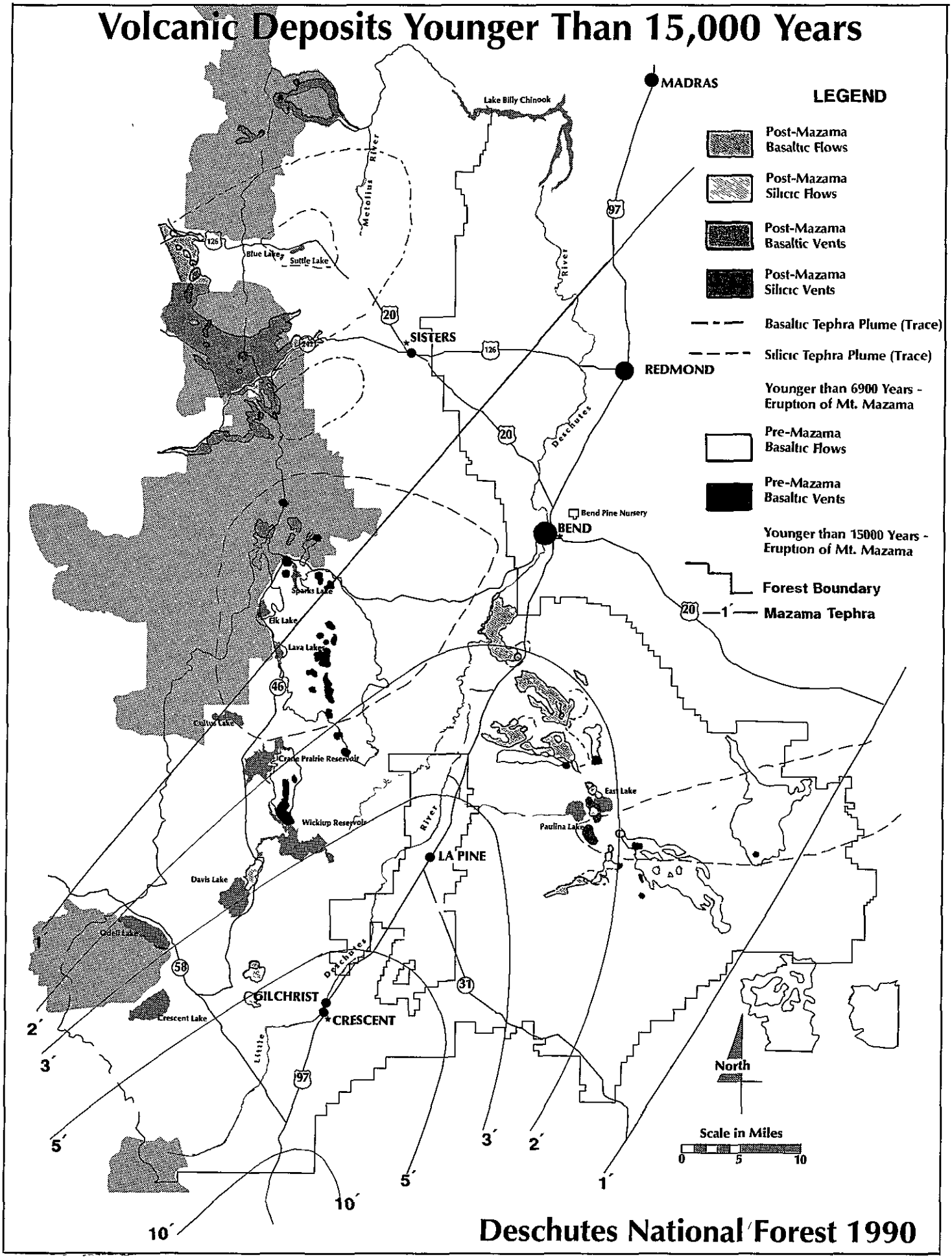

Volcanic Deposits Younger Than 15,000 Years
LEGEND
Post-Mazama Basaltic Flows
Post-Mazama Silicic Flows
Post-Mazama Basaltic Vents
Post-Mazama Silicic Vents
Basaltic Tephra Plume (Trace)
Silicic Tephra Plume (Trace)
Younger than 6900 Years - Eruption of Mt. Mazama
Pre-Mazama Basaltic Flows
Pre-Mazama Basaltic Vents
Younger than 15000 Years - Eruption of Mt. Mazama
Forest Boundary
Mazama Tephra
MADRAS
REDMOND
SISTERS
BEND
LA PINE
GILCHRIST
CRESCENT
Lake Billy Chinook
Metolius River
Deschutes River
Blue Lake
Suttle Lake
Sparks Lake
Elk Lake
Lava Lake
Cultus Lake
Crane Prairie Reservoir
Wickiup Reservoir
East Lake
Paulina Lake
Davis Lake
Odell Lake
Crescent Lake
Little Deschutes River
Bend Pine Nursery
North
Scale in Miles
0 5 10
Deschutes National Forest 1990

Figure 3-24

Figure 3-25 charts river classifications and number of miles considered

Table 4-12 Wild and Scenic Rivers

River	Termini	Classification	Mileage
Squaw Creek	Source to 3 Sisters Wilderness boundary and its tributaries	W	27 0
	Boundary of 3 Sisters Wilderness to Gaging Station 800 ft upstream from intake of McAllister Ditch	S	8 8
Big Marsh	NE/1/4 sec 15, T 26,R.6 to confluence w/Crescent Ck	R	15.0
Crescent Crk	SW/1/4 sec.11, T 24, R 6 to W sec line of sec.13, T 24 R.7	R	10.0
Deschutes	Wickiup Dam to N boundary of Sunriver at SW 1/4 of sec.20, T.19 R 11	R	40 4
	N. boundary of Sunriver at SW 1/4 of sec 20, T 19 R 11 to Lava Island Camp	S	11 0
	Lava Island Camp to Bend Urban Growth Boundary at SW corner of sec 13, T 18, R 11	R	3 0
Little Desch	Source in NW1/4 sec 15, T 26 R 6 1/2 to N. sec. line ofsec 12, T.26, R.7	R	12 0
Metolius	S Deschutes NF boundary to Bridge 99	R	11 5
	Bridge 99 to Lk Billy Chinook	S	17.1

W = Wild, S = Scenic, R = Recreational

Big Marsh Creek:

The 15 miles from its source between Cappy and Tolo Mountains to confluence with Crescent Creek were included in the system as a recreation river The stream flows through Big Marsh, which is the site of a major wetland restoration project

Big Marsh is a relatively flat, meandering stream and is notable for its fish and wildlife values. The marsh is a breeding ground for numerous birds and waterfowl, including sandhill cranes.

Crescent Creek:

A 10 mile segment from Crescent Lake to just east of the Crescent Creek Campground has been designated as a recreation river. This section of the river flows in a low gradient over wetlands of glacial outwash. It contains rainbow and brown trout and mountain whitefish and moderate water temperatures produce good fish growing conditions

The Deschutes River:

Three segments of this major waterway were added to the Wild and Scenic River System, two as recreation river areas, one as scenic.

The 40 mile reach from Wickiup Dam to the northern boundary of Sunriver was classified as a recreation river From there to Lava Island Camp, an 11-mile segment, was designated as a scenic river. A 3-mile section from Lava Island Camp to the Bend Urban Growth Boundary is now a recreation river.

The Deschutes River is a clean, chill, and frequently rapid stream which passes through an extremely diverse and complex variety of geologic features. They include recent and ancient lava flows, mud flows, pumice deposits, and glacial outwash plains.

Smooth and quite flowing in many sections, it fulminates when circumscribed by narrow canyon walls and is stripped into mist as it tumbles over numerous falls. While not precipitous, Benham Falls is a spectacular passage through a gorge along the south end of the Lava Butte lava flow

More than 130 species of birds have been identified in the area, which is frequented by deer and elk. The Deschutes is rated as a "blue ribbon" river for brown trout and good for rainbow trout and whitefish.

Little Deschutes River:

A 12-mile portion of this stream from its source near Cappy Mountain in the Windigo-Thielsen Wilderness to a private subdivision a mile and one half southeast of Mutton Chop Butte was designated as recreational.

It begins in a deep canyon inscribed with unusual glacial formations but the gradient quickly diminishes as it meanders over the valley floor The upper reaches sprovide elk and deer summer range and it is occupied by whitefish, brook, brown, and rainbow trout.

Most of the lower portion of the river, which is used as a pond at the Gilchrist saw mill, is in private ownership.

Metolius River:

Nearly the entire Metolius River has been classified, 11 5 miles as recreation and 17 miles as scenic.

The first reach begins just north of its source and ends at Bridge 99 From there to Lake Billy Chinook it is a scenic river.

Fed by a succession of deep springs, the Metolius is renown for this abrupt emergence from the earth and exceptional scenery. Initially it flows along the base of the Green Ridge Fault, an area of considerable geologic interest The lower portion passes through steep ridges until the valley opens up below Monty Campground.

There is striking contrast in vegetation in the lower portion of the river The west back is characterized by dense stands of old-growth conifers and a moist understory while the east side is dry, open country occupied by scattered Ponderosa pine trees.

Deer, beaver, otter, and ground squirrels are common in the upper segment and there is a bald eagle nest in the vicinity The Metolius is one of the most highly rated fly fishing streams in the West and contains rainbow, brown, and Dolly Varden trout and whitefish

Squaw Creek:

Approximately 15 and a half miles of Squaw Creek was included in the system. The 6.6-mile segment and the Soap and Park Creek tributaries from the source to the boundary of the Three Sisters Wilderness were classified as wild river The 8 8-mile portion from the boundary to the intake of McAllister Ditch is a designated scenic river. The Act included a provision permitting construction of a flood control structure if it is determined to be the only way to reduce the danger of flooding from Carver Lake

The upper reaches of Squaw Creek and its tributaries are of glacial origin and carry glacial flour. Stream channels are often braided and and contain loose unconsolidated material. There are numerous waterfalls.

Squaw Creek drains Carver Lake, 7,800 feet in elevation, which is impounded by large glacial moraines. A U.S Geological study in 1987 concluded that a possible failure in this natural dam poses a threat to the town of Sisters, 21 miles downstream

Access to the upper segment is by foot only. Several trails cross the area and hiking, horseback riding, mountain bicycle riding, and deer hunting are the primary forms of recreation. Because of

the steep gradient and numerous barriers, fishing in Squaw Creek is poor.

The following streams have been determined to be eligible for consideration as Wild and Scenic Rivers Complete stream descriptions and discussions of stream values can be found in Appendix D.

River	Termini	Classification	Mileage	Management Area
Paulina Creek	Source to Forest Bdry E. Line of Sec 29, T. 21S, R.11E	R	8.0	17
Deschutes River	Source in Little Lava Lake to Crane Prairie Reservoir	R	8.0	17
Browns Creek	Springs in Sec. 30, T.21S , R.8E to Wickiup Reservoir	R	2 0	17
Fall River	Source in Sec 10, T 21S., R.9E. to confluence with Deschutes River	R	11.2	17
Jack Creek River	Source in Sec. 1, T.13S , R.8E to confluence with Metolius	R	5 0	28

R = Recreational

Special Interest Areas

Figure 3-26 shows the three special interest areas are currently designated by the Regional Forester those that have potential for designation

Figure 3-26 Designated and Potential Special Interest Areas

Area	Type	Acres	Status
Lava Cast Forest	Geologic	3,982	Designated
Lava Butte	Geologic	7,269	Designated
Lavacicle Cave	Geologic	40	Designated
Katati Butte	Geologic	93	Potential
Big Hole	Geologic	741	Potential
Hole-in-the-Ground	Geologic	602	Potential
Newberry Crater	Geo /Archaeological	15,973	Potential
Castle Rocks	Geologic	232	Potential
Balancing Rocks	Geologic	42	Potential
Horn-of-the-Metolius	Scenic	1,528	Potential
Hosmer Lake	Biologic	93	Potential
Wake Butte	Geologic	602	Potential

Trails

The Forest has a large trail program designed to meet the needs of many different people. It is being planned to provide a wide range of opportunities, to accommodate a diversity of user types of a variety of difficulty levels There are approximately 1,300 miles of trail, 254 miles of which are in Wilderness Winter trails total 514 miles.

Figure 3-27 Miles of Trail by Type of User

Trails used by:	Bend	Crescent	Ft.Rock	Sisters	Total
Hikers	208	133	119	198	658
Pack & Saddle	150	132	80	155	517
Snowmobile	162	75	159	39	435
Nordic Skiing	99	37	34	55	225
Mountain Bike	106	*	*	60	166 *
ATV's	23	10	175	5	213
Motorbikes	*	*	175	*	175 *

* Indicates incomplete information

About 259.5 miles of trail are in Wilderness, 461.8 miles are winter trails, and 66 miles are part of the Pacific Crest National Scenic Trail.

Interest in the Forest's trail system has been growing steadily. Trail related comments on the draft Forest Plan were extensive and diverse. Strong interest was expressed for additional walking and hiking opportunities adjacent to resorts and campgrounds and close to Bend Strong interest was displayed for additional winter trails, particularly nordic trails away from motorized users. Strong interest was also expressed for mountain bicycle trails which were separate from heavily used hiking and horse trails. This concern was for the safety of hikers, horseback riders, and horses, as well as bicycle riders themselves.

The summer trail system outside of wilderness needs to be expanded significantly to enhance

recreational opportunities at destination and developed recreation sites, and to meet the needs of emerging and growing trail sports such as mountain biking. Mountain biking is currently the fastest growing summer trail sport.

Overall, maintenance of the trail system (winter and summer) and associated trailheads has been at a minimal acceptable level. As trail mileage and us increase the maintenance program will have to expand also.

User conflicts are increasing as use increases and as individual user groups push to expand systems for their individual interests.

OHV's also received a lot of comment, most of it negative Several respondents said OHV's should be prohibited in areas which are visually sensitive, those with a high level of recreation use, in wildlife habitat areas, riparian areas and special interest areas. Several said OHV's should be assigned a place of their own

Figure 3-28 indicates relative use levels by trails user type during the past five years

Figure 3-28 Deschutes National Forest Trail Use - 1983 through 1987 (Shown in Recreation Visitor Days)

Type of Use	1983	1984	1985	1986	1987	% Change
Hiking	47,800	60,600	51,300	67,000	56,700	+18 7%
Horseback	31,300	33,600	37,900	38,400	36,200	+15 7%
Snowmobiling	46,700	48,800	44,000	53,600	58,600	+25 5%
Nordic	37,500	42,300	28,700	36,400	78,100	+108.3%
Bicycle	3,700	3,700	4,100	4,800	5,100	+37.8%
Motorcycle	14,200	13,700	14,200	13,500	13,000	-8 5%
Total	**181,200**	**202,700**	**180,200**	**213,700**	**247,700**	**+36.7%**

The increase in cross country skiing, indicated above, is dramatic. There is a greater need for additional winter trails, particularly nordic trails, than for summer trails.

The use of mountain bicycles and all terrain vehicles (ATVs) is also increasing rapidly. There are opportunities to accommodate them but careful planning will be required to avoid conflicts with traditional trail users and other resource values.

Off Highway Vehicles (OHVs)

Much of the Forest is open to off highway vehicles in the summer and groomed snowmobile trails are accessible in the winter. Exceptions are Wildernesses, inventoried Roadless Areas, Research Natural Areas, the Experimental Forest, and areas closed to provide wildlife habitat. OHV's must be equipped with required equipment ("street legal") in order to operate in the Forest.

Presently, OHV use is dispersed throughout the Forest Most travel takes place on the existing Forest road system, primarily infrequently used logging roads Very few OHV trails exist on the Forest. Demand for additional OHV trails has been steadily increasing in the past few years As this use increases there will be increasing conflicts between motorized and non-motorized users

Off-highway vehicles have become much more numerous on the Forest since the recent advent of 3-wheel and 4-wheel all-terrain vehicles Summer OHV use falls into three categories; two wheeled vehicles (motorcycles), three and four wheel all-terrain vehicles (vehicle width generally less than 50 inches), and four-wheel drive vehicles with a vehicle width greater than 50 inches (jeeps,

pickups, etc.) The Forest is very suitable for these types of motorized activity because of its gentle and accessible terrain.

In the winter, the Forest has some of the best snowmobiling in the State. Some 346 miles of snowmobile trails are currently available; 261 miles are groomed. Many of these trails lead to open snowmobile play areas. There are about 50,000 visitor days registered annually by snowmobilers

The Forest also permits several motorcycle and 4-wheel drive vehicle races on the desert fringe each year. These races have up to 500 participants and several thousand spectators. Environmental damage is minimal and conditions are ideal for the racers. The demand for this type of event exceeds the Forest's ability to administer them, so the number of races has been limited to four each year

Future Demand

Most recreation visitors to the Forest are from Oregon but out-of-state visitors from California and Washington are also numerous. The population of Oregon is expected to increase approximately 2 percent annually, which is the basis for some long range recreation growth projections. Central Oregon tourist industry marketing efforts are expected to significantly increase recreation on the Forest Word-of-mouth advertising also will continue to draw visitors to the area Direct and indirect marketing will have a greater influence on recreation trends than population growth alone.

Recreation Special Uses

Private enterprise provides a number of recreational services on the Forest. Individuals and organizations operate under special-use permits issued by the Forest and remit a fee to the Government based on their revenues or type of land use. Permits are issued only to meet a demonstrated public need that can best be provided for by the private sector They are not issued simply to provide an economic opportunity for vendors

In 1984, 87 recreation special-use permits were issued for a variety of commercial operations. Permits were for one ski area, four organizational camps, 13 resorts, one store, 21 recreation events, and 27 outfitters and guides. The outfitter and guide permits include canoeing and rafting on the Deschutes River, horseback riding at various resorts, educational programs conducted by Central Oregon Community College, and Wilderness outfitters. Special events range from motorcycle races on the eastern fringe of the Forest to a Triathalon along the Cascade Lakes Highway.

Recreation Inventories

Recreation Opportunity Spectrum (ROS)

The various recreational settings on the Forest have been classified according to a Recreation Opportunity Spectrum (ROS).[2]

Classifications range from "primitive" to "urban", that is, undisturbed, natural settings where visitors have little or no contact with other humans to a highly modified, altered environments where contact between visitors is common In addition to the six categories in the national system, this Forest has identified two others, Roaded- Modified[3] and Semiprimitive Motorized Winter Only. Each ROS category is described below and the inventoried acres in each are shown in Figure 3-28.

[2]"Recreation Opportunity Planning Guidelines for Land and Resource Management Planning" (December 1979).

[3]Bacon, Warren R The Recreation Opportunity Spectrum - April 1982.

Primitive - These areas provide 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. On this Forest all of these areas are in Wildernesses.

Semiprimitive Nonmotorized - These are the same as "Primitive" areas except there may be very subtle alterations in the natural condition. They are in Wildernesses and roadless areas.

Semiprimitive Motorized, Winter Only - These areas are the same as "Semiprimitive Nonmotorized" except they are open to snowmobiles and all terrain vehicles in winter.

Semiprimitive Motorized - Isolation from the sights and sounds of other people is high to moderate in these areas Modifications to natural conditions may appear dominant when viewed from within the area but are less apparent from the lower standard roads passing through them

Roaded Natural - A moderate degree of isolation from the sights and sounds of humans is available in these areas, which are primarily natural appearing but accessible by passenger cars.

Roaded Modified - The experience is similar to that which can be had in Roaded Natural areas but modifications to these settings are quite apparent There are usually high standard roads in these areas, which commonly accommodate timber harvest.

Rural - These areas are often in the transition between the cities and the Forest They may include large well developed campgrounds, ski areas, and other facilities that serve large numbers of people.

Urban - Buildings and people dominate these areas. They are commonly city parks, large resorts, or winter sports complexes.

Figure 3-29 Acreages By Recreation Opportunity Spectrum Category

Category	Acres[1]	% Total Acres[1]	Acres[2]	% Total Acres[2]
Primitive	71,532	4	71,532	4
Semiprimitive, Nonmotorized	124,208	8	111,974	7
Semiprimitive, Motorized, Winter Only	144,830	9	0	0
Semiprimitive, Motorized	17,823	1	0	0
Roaded, Natural	223,735	14	0	0
Roaded, Modified	894,893	55	0	0
Rural	133,503	8	0	0
Urban	9,888	1	0	0
Total	**1,620,412**	**100**	**182,506**	**11**

Wilderness Resource Spectrum (WRS)

The three classifications for Wilderness settings are Pristine, Primitive, and Semiprimitive (Transition).

Pristine: These are large unmodified areas and they are managed to remain in this condition. Evidence of the influence of humans is as close to nil as circumstances permit. There are no system trails in these areas, which afford opportunities to extended and challenging cross country travel.

Primitive: These are essentially unmodified natural environments. Concentrated use by visitors is uncommon and signs of human intrusion are not

conspicuous Only structures which are essential for resource protection and safety are permitted and they are constructed of native or natural appearing materials. Measures are taken to disperse visitors. Trails are constructed and maintained at the most difficult standards (see FSH 2309 18, Trails Management Handbook

Semiprimitive (Transition): These are predominantly unmodified environments but there is a greater number of encounters between visitors, particularly in Transition areas. Evidence of human influence is common Facilities are limited to those needed for resource protection; they are not provided for the comfort or convenience of visitors. Only native or natural appearing materials are used. Opportunities for challenging exploration and solitude are moderate. Trails will be constructed and maintained to "more" and "most difficult" standards. Some small areas may be classified as Transition within the Semiprimitive Zone. These are typically small areas in Wilderness where day use may predominate and where social standards may be exceeded Management will be oriented towards making this a temporary condition

Scenic Quality

The Deschutes National Forest is nationally known for its high quality scenery that ranges from high elevation, snow-capped peaks to the forested flatlands of the high desert plateau Its dry environment, open timber stands and fairly gentle terrain contrasts with the rugged, densely forested, mountainous terrain found west of the Cascades.

Numerous high elevation lakes, streams and reservoirs, nestled between spectacular buttes and mountains, contribute to the scenic quality and diversity of the Forest. The varied vegetative environments are frequently used by the movie industry, who especially favor the golden barked Ponderosa pine stands. Numerous recreational support facilities are available for taking advantage of this scenic Forest.

Portions of the Forest appear as natural, unchanged landscapes, but the visual evidence of human activities exists, to varying degrees, on most lands outside of wilderness areas. Some of the activities are historic, the result of forest management practices, and other activities which occurred during the early years of the Forest. Others are more recent, such as road building, fires, timber harvesting and replanting.

Mountain pine beetles have killed lodgepole pines that once provided a dark green, dense forest canopy covering many of the visually sensitive landscapes seen from main travel routes and recreation use areas While this is a natural occurrence, some landscapes have been severely changed by this epidemic.

Even with these changed landscapes, many of the Forest landscapes viewed by the traveling and recreating public appear to be in a natural condition.

Two National Forest Scenic Byways have been recognized on the Deschutes National Forest for their outstanding landscapes. The Cascade Lakes and McKenzie Highways offer spectacular scenery, outstanding Cascade geology and rich cultural and historic resources.

Numerous Forest system roads also offer inspirational vistas, but many of the roads are not suitable to travel on in the average passenger car.

The slopes northeast of the Three Sisters and Tam MacArthur Rim are a significant component of the unique Cascade landscape, viewed from several important highways in the area. Postcards illustrating this magnificent view are a common souvenir item to Central Oregon tourists. These slopes are also important in providing high and sustainable levels of timber production. The Front Country Management Area was developed for this particular area to emphasize scenic quality while providing for timber production as primary management objectives

A visual inventory of the Deschutes National Forest was conducted based on three factors: 1) landscape variety; 2) viewer sensitivity (how many people see a landscape); and 3) viewer distance. Based upon these factors, measurable degrees of acceptable change from the natural landscape have been classified into the following Visual Quality Standards:

Preservation - Only changes introduced by ecological processes may occur in this category.

Management activities, except for very low visual impact recreation facilities, are prohibited.

Retention - Allows management activities that are not visually evident to the casual forest visitor.

Partial Retention - Permits management activities which are evident, but they must remain visually subordinate to the natural landscape.

Modification and Maximum Modification - Management activities in either of these classifications dominate the natural landscape, but the activities should be designed so that they appear natural when viewed as middleground and background.

In addition to the above classifications, there are two short-term management alternatives:

Rehabilitation - is used to restore landscapes containing undesirable visual conditions to make them visually acceptable

Enhancement - increases positive visual variety where little variety presently exists. Selective removal of vegetation to provide a scenic vista is one example of enhancement

Both of these alternatives are presently practiced in all inventoried visual classifications.

Figure 3-30 indicates the inventoried amount of Forest land within each category:

Figure 3-30 Amount of Land Allocated to Visual Quality Standards

Visual Quality Standard	Acres	% of Forest
Preservation	210,654	13
Retention	243,062	15
Partial Retention	550,940	34
Modification and Max. Modification	615,756	38
Totals	**1,620,412**	**100**

Economic and Social Environment

The Forest Influence Area is the geographic area where most of the Forest's products are first used and where public concern about management of the Forest is concentrated. While Forest management decisions may have economic consequences to people outside the area, the largest economic impacts are felt within the local economy A larger area, which includes communities in adjacent counties and the Willamette Valley, was used for the social analysis.

Population

In 1987, the Portland State University Center for Population and Research set the population of Deschutes County at 68,700. County officials, declaring that estimate too low, conducted another study but were able to establish a figure of only about 1,000 persons higher.

The incorporated cities in the Forest Influence Area (Deschutes County) are Bend (1987 population 18,700), Redmond (6,850), and Sisters (745). Concentrations of people in the unincorporated part of Deschutes County include the areas east and south of Bend and the communities of LaPine, Sunriver, Tumalo, and Cloverdale. The unincorporated part of the County had a total of 39,305 people. (General Social and Economic Characteristics, 1980 Census of Population, U S Department of Commerce, Bureau of the Census.)

The Crescent division of Klamath County has no incorporated cities. Communities there include Crescent, Gilchrist, and Chemult The Grandview division of Jefferson County also has no cities. Settlements in this division include Camp Sherman and Grandview

The last census study depicting social and economic characteristics was done in 1980 Deschutes County's population was 62,142. The labor force of persons 16 years and older was 29,031 with 25,788 people employed The median age in the County was 29.9 years. Female population totaled 31,101. The median income was $16,683 for households and $18,587 for families. Comparative information will be available after completion of the 1990 census.

The 1980 census showed that the majority of the population was white with other ethnic groups represented by Spanish, American Indian, Black and Asian people.

The majority of people are employed in services, retail trades, manufacturing and construction Major industries include timber, recreation and agriculture During an 11 year period (1975 through 1986), tourism related employment increased 138 percent, almost twice the increase for all other employment. Tourist related jobs totaled 4,030 in 1987. (Mr. Michael Mahan, Mid-Oregon Labor Force Economist, 1988)

Continued growth in Deschutes County is expected. Newcomers cite recreation opportunities, climate, and quality of the environment as reasons for moving to and living in Deschutes County.

Local Economy

The three most important basic industries in the Forest Influence Area are agriculture, wood products manufacturing, and recreation and tourism. (Butler, Jesse N ; Hewell, Denny; Sullivan, Michael C. Overall Economic Development Program for Central Oregon, for FY 1988-1989. Central Oregon Intergovernmental Council, 1984.)

Agriculture

While increasing slightly in absolute terms, agriculture within the Forest Influence Area has been diminishing in relative importance In Deschutes county, agricultural sales have increased from $9,210 in 1975 to County Extension service estimate of $34,960 in 1988. However, agricultural producers in Deschutes County are facing increasing production costs and decreasing (or constant) farm prices In Deschutes County, animal production accounts for 75 percent of farm income. This includes thoroughbred Arabian and quarter horses, llamas, cattle, hogs, and sheep. (Butler, Jesse N.; Hewell, Denny; Sullivan, Michael C. Overall Economic Development Program for Central Oregon, for FY 1988-1989. Central Oregon Intergovernmental Council, 1984.)

Manufacturing

The manufacturing component of the Forest Influence Area is dominated by the wood products industry. This industry currently employs about 17 percent of all workers in Central Oregon, 75 percent of employment in manufacturing The remainder is made up of diverse light industries. In Deschutes County, 12 percent of the workforce is employed in wood products

Nationally, wood products manufacturing is directly tied to the national housing market, which rises and falls according to mortgage interest rates. Pine products from Central Oregon, however, are used less exclusively in new housing than fir from western Oregon This slightly insulates operators here from the impact of low housing starts.

Timber Industry

In fiscal year 1988, 154 million board feet of timber was harvested on the Forest (not including firewood). This was approximately 12 percent less than in 1987. The reduction is attributed to reduced operations because of fire danger and a strike at the local DAW Forest Products plant.

Eight-five percent of the harvest, about 130 million board feet, was sawtimber, principally Ponderosa pine. Fifteen percent was dead lodgepole, used for pulp and paper production. Twelve million board feet, primararily dead lodgeple, was removed by firewood collectors.

From 1980 to 1984, the average timber harvest was 186 MMBF.

Mills in Deschutes County are heavily dependent on timber supplied by the Forest. The relationship, however, is changing. Ten years ago, more than 80 percent of the logs bought by Deschutes County mills came from this National Forest By 1983 only 47 percent of the timber sold from the Deschutes was purchased by operators within the traditional Forest Influence Area Much of the volume now goes west over the Cascade Mountains due to the prospects of timber supply reductions there. A more competitive market for wood from the Deschutes is anticipated in the foreseeable future.

Primary Processing

Currently two major sawmills are operating in the Forest Marketing Area, one in Bend and one in Gilchrist. In addition, Prineville has one major sawmill and five smaller sawmills. The three major mills have both large and small log handling capability Together these mills have an estimated installed capacity, operating two shifts, of about 463 million board feet per year. Of this total, 72 million board feet is small log capacity. A veneer plant which has a capacity of 50 million board feet is located in Redmond.

Secondary Manufacturing

The dominant secondary wood processing activity in the Forest Marketing Area is millwork manufacturing. Ponderosa pine boards are the most common raw material for this industry and there are several furniture and cabinet making firms in the area.

Receipts to Counties

Twenty-five percent of the receipts from timber sales from the Forest are returned to the counties in lieu of taxes which would be paid if the National Forest was privately owned. In 1988, this amounted to $5,511,293 and it was divided between Deschutes County, 61 percent; Jefferson County, 10 percent; Klamath County, 18 percent; and Lake County, 11 percent. These funds are used by county school districts and for road construction or reconstruction.

Recreation and Tourism

The recreation and tourism industry, always important in Central Oregon, has become essential in recent years. Winter and summer recreation have contributed an element of stability to offset fluctuations in wood products.

In 1987 the tourism and recreation industry was the second largest source of income in Central Oregon with direct income of just under 200 million dollars Visitation estimates developed for Central Oregon were discontinued in 1983 when 1.54 million people visited the region with expenditures of $187.2 million. From 1975 to 1986 tourism related employment to 138 percent which was almost twice the increase for all other employment. The number of tourism related jobs rose to 4,030 by 1987. (Mr. Michael Mahan, Mid-Oregon Labor Force Economist for the Oregon Employment Division., 1988.)

Growth in recreation is expected to continue.

Social Environment

People and communities in the Forest Influence Area have important, but different, relationships with the Forest. Activities called for in management alternatives would affect each somewhat differently.

Four types of communities have been identified and will be described. In addition, two types of relationships between the Forest and community have been identified One tie between Forest and community is the contribution of raw material for industry and the jobs it provides. A second is the scenic and recreational environment the Forest offers to recreationists and residents. The link with the Forest of two of the community types is very distinct while that of the other two is more complicated

Rural Industrial Communities

Rural industrial communities are closely bonded to the Forest in work, subsistence, and play, with the supply of available timber being the main economic link. Employment in timber harvesting, wood processing, and transportation are all involved. The wood products industry predominates in towns like Crescent, Gilchrist, Prineville, and Redmond. But this is not the only link. People in these communities use fuelwood, fish, and game for part of their subsistence. Recreation is also a central element in the life styles of these communities Therefore, the existence of diverse recreation opportunities on the Forest is also a major concern.

Rural Recreation and Residential Communities

Rural recreation and residential communities adjacent to, and within, the Forest are dependent primarily upon forest based recreation activities and recreation residences for their livelihood. Environmental and scenic amenities and nearby

recreational opportunities are the reason for their existence. Towns and settlements along the Metolius River and the upper Deschutes River, such as LaPine and Sisters, are included in this community type. Local service-oriented businesses provide convenience items and cater to tourists, skiers, and sportsmen.

Management activities which result in changes in the environmental quality, or appearance of the forest setting, amenities, and recreation opportunities all could have direct impacts on these communities.

Central Oregon Urban Center

This community type includes Bend which is the dominant community in the Forest Influence Area. It has a large industrial sector based on wood products, and a large service sector keyed to recreation and tourism. It is the major shopping and service center for outlying communities. The socio-economic health of the wood products industry and the service sector, and the quality of the environment, are all central concerns to residents of Bend.

As a larger and more diverse community, some conflicts over Forest management can be absorbed without much social disruption. While more sensitive issues tend to pull people together within the smaller communities, they tend to polarize a community like Bend, which has economic and emotional ties on all sides of the issues.

Westside Communities

While activities on the Forest do not directly impact the daily lives of people in the populous communities west of the Cascades, they are important to many of them for various reasons. Over the last few years, more and more Forest timber sales have been purchased by the westside wood products industry. In addition, residents from the Willamette Valley participate in a wide diversity of recreational activities provided on the Forest.

These communities represent the more diffuse Regional publics which are affected by management decisions on the Forest Conflicts over resource management decisions on the Forest are more likely to be seen as symbolic of broader issues Responses may reflect the position of specific interest groups rather than the sentiment of local residents who are more directly affected by the issues.

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Chapter 4

Environmental Consequences

Changes from DEIS to FEIS for Chapter 4

In response to public comment and direction from the Regional Office, this Chapter has been significantly revised and expanded. A considerable amount of information which appeared in Chapter 4 of the DEIS has been moved to Chapter 2, which is the portion of the document in which alternatives are compared

This Chapter now includes more explicit description of what would happen if each of the Alternatives became the Forest Plan Instead of discussing how an alternative would affect Forest Service programs (how managing riparian areas to protect habitat can reduce timber harvest), the focus is now on the environment itself (how timber harvest and road construction can affect fish habitat.)

New resource discussions have been added, including Wild & Scenic Rivers, Old Growth, and Socio/Economic

Elements of the Forest environment are presented in the same order as in Chapter 3, the Affected Environment The physical aspects of the environment are addressed first, then the biological and social Many of the Issues, Concerns, and Opportunities (ICOs), which are the major planning problems addressed by these documents, pertain specifically to these environmental elements. When this is the case, the ICO is stated Each section begins with a description of the most significant interactions which occur when ground disturbing activities affect the environmental element under discussion

In reading this Chapter, keep in mind that the effects of timber harvest and road construction called for by each alternative are not given under vegetation and transportation Rather, they are found under discussion of environmental elements which are impacted by harvest and construction, among others, soils, water, wildlife and fish habitat, and cultural resources

Chapter 4

Environmental Consequences

Introduction

Chapter 4 provides the scientific and analytic basis for the comparison of the Alternatives presented in Chapter 2. Environmental consequences are discussed in short and long-term and occasionally by decade A plan for any alternative would last 10 to 15 years Effects beyond the first decade are to look at long-term implications and explore the potential if an alternative were implemented beyond the first decade

The reasons for and causes of environmental effects of the Alternatives, and the interrelationships between resources, land uses, and environmental conditions are presented here. The discussion also indicates the basis or source of some estimates, and directs the reader to other places in the document where more information on a topic is available

Because extensive quantitative information about effects is available in Chapter 2 (particularly in Figures 2 - 50 & 64), the outputs and environmental effects may not be repeated in as much detail in this Chapter The material in Chapter 4 explains the relationships between resource outputs and environmental qualities and consequences It includes, where relevant, the ties between quantitative and qualitative aspects of the information.

The net public benefits related to the existence and management of the Deschutes National Forest are generated from Forest-based resources for which either market or assigned dollar values can be determined (i.e., range, recreation, and timber), as well as from resources and forest conditions for which meaningful prices can not be associated (i.e., lifestyles, scenic quality, water quality, etc.). These latter nonpriced benefits are composed of both quantifiable and qualitative outputs and effects. A familiarity with the priced benefits as well as both quantifiable and qualitative nonpriced benefits is crucial in order to obtain a better understanding of the environmental consequences and the net public benefits associated with each proposed alternative A more detailed discussion of both priced and nonpriced benefits and their relationship to net public benefits is presented in Chapter 2 and Appendix B. In this Chapter, the environmental consequences associated with the provision of these benefits are discussed.

Overview

The discussions of the physical, biological, social, and economic effects in this Chapter are designed to give more of the types of consequences that need to be considered and their inter-relationships rather than a detailed comparison of their magnitudes as is shown in Chapter 2. However, the anticipated duration and significance of the outputs and effects are discussed here too

The resource sections which follow include discussions of direct, indirect, and cumulative effects that do not vary significantly between alternatives and resources and those that do

Direct Effects - are generally the result of land allocations to Management Areas that prescribe permissible activies on lands within the area's perimeter. Agency activities and the inherent capability of the land provide goods and services that may be consumed by the public Government expenditures that finance agency activities are treated as a direct effect in the economics sections of this Chapter.

Indirect Effects - generally occur when the public takes advantage of the opportunities provided in each alternative. Public use of the Forest for recreation (including hunting and fishing), timber harvest, and mineral withdrawal, for example, can have adverse effects on various components of the environment The value to society (benifits) of goods and services are treated as indirect effects in the economics

section of this Chapter, as are the impacts on revenues, jobs, and income.

Cumulative Effects - are the impacts 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. Some of the effects are described in qualitative terms, while others are described in quantitative terms.

Mitigation measures are included in regards to environmental consequences which are potentially detrimental in nature.

Mitigation - is, in general, a measure taken to cause an action to become less harsh or severe. Mitigation includes:

Avoiding the impact altogether by not taking a certain action or parts of an action,

Minimizing impacts by *limiting* the degree or magnitude of the action and its implementation;

Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action, and

Compensating for the impact by replacing or providing substitute resources or environments.

All of the outputs and effects are estimated in a consistent manner for each of the Alternatives Many of the environmental consequences are related to the amount of timber management and related road construction activities that are scheduled to occur in each alternative, of which Alternative C has the most and Alternative G has the least. In addition, some of the effects are short-term while others are long-term (beyond the 10-15 year life of a plan), and some are direct while others are indirect consequences of a proposed management activity. While the frequency or likelihood of an output or effect occurring may vary between alternatives (depending on the amount of related activities proposed), the consequences may not be significantly different between the Alternatives due to the common application of standards/guidelines (S&Gs) across all Alternatives. Standards/Guidelines, which are detailed for each resource in the accompanying Forest Plan, are the governing protective and mitigating measures for management activities On the other hand, the consequences of some outputs and activities can not be mitigated through the application of S&Gs and significant differences do occur between alternatives and are addressed.

Additional means to resolving issues (planning problems) are land allocations and capital investments.

The allocation (assignment of land to various management areas may change existing land status because it establiches the permissible activities and uses that can occur on an acre of land, as described in Chapter 3. Taken collectively, the land allocation "decision," with its associated activities and uses, provides the primary mechanism for creating environmental effects. Agency activities permitted within each management area are treated as the causative agent for all direct environmental impacts presented in this Chapter. Agency activities also produce, or make available, the goods and services necessary to resolve most planning problems The public's consumption of those opportunities creates, in turn, indirect environmental effects, removed in time and space from most initial agency actions

Relative to the General Forest Management Area, lands assigned to other management areas limit site-disturbing activities by varying degrees Depending upon the objective of each management area, standards/guidelines establish the acceptable degree of site disturbance and the kinds of uses permitted on lands within its perimeter. S&Gs governing Wilderness, for example, greatly limit site disturbance. General Forest S&Gs, on the other hand, permit a considerable degree of site disturbance to accommodate a broad range of multiple uses, subject to the provisions included in Forest-wide S&Gs.

Capital investments are inputs that increase the stock of natural or manmade resources (assets) needed to maintain or increase the flow of outputs in the future. Benefits resulting from capital investments are normally recouped in excess of one year

Geothermal development could significantly affect other resources Assessment of the consequences must await a time when more is known about the character of the resource and the technology being proposed for its development. Therefore, the discussion in this Chapter treats in a generic way some of consequences experienced in developing geothermal resources in other locations

Further detail about environmental consequences of geothermal development can be found in a June 1985 publication by Bonneville Power Administration, Volumes I and II, "Evaluation and Ranking of Geothermal Resources for Electrical Generation or Electrical Offset in Idaho, Montana, Oregon, and Washington," by R. G Bloomquist, G L Black, D.S. Parker, A. Sifford, S.J. Simpson, and L.V. Street.

The following outline was used to structure the discussion of resources in this Chapter.

Name - (of the Resource to be discussed)

Introduction - (Optional item, some resources begin with Interactions)

Interactions - (discusses the interactions of other resources with the featured resource)

Assumptions - (management methods, resource conditions, and scientific facts etc. relevant to the resource discussion)

Related ICOs - (lists the Forest Goals which relate to the resource being discussed)

Effects That Do Not Vary Between Alternatives

Effects That Do Vary Between Alternatives

Direct Effects - Discussions of effects on featured resource by alternative (may be combined with Indirect if they are closely related and the discussion is short)

Indirect Effects - Discussions of effects on featured resource and others

Cumulative Effects

Mitigation

Unavailable Information

Monitoring

Coordination With Plans and Policies of Others

Geology - Physiography

The order in which resorces are discussed is the same as in Chapter 3, as much as possible.

Caves

Introduction

Caves are an identifiable resource. The resources associated with caves are often unique and sensitive. Serious impacts may occur from recreational or commercial activities and vandalism.

Interactions

Caves can be impacted directly and/or indirectly. Direct impacts include; disturbance of geologic features, cultural resources within the cave, biota that inhabit the cave, etc Indirect impacts include, alterations to vegetation outside the cave that serves as habitat for species using the cave, external activities that may affect water movement through a cave, disturbance of cultural sites not at a cave but which may be associated with a cave site, etc. Impacts on any one cave are dependent on those resources that are associated with that cave.

Assumptions

As cave visitation increases, direct impacts to the associated resources will also increase. Due to incomplete scientific information, indirect impacts cannot be fully assessed for all associated cave resources.

Related ICO's

Consideration of economies, lifestyles, and population levels in managing Forest Lands

Providing for intensive recreation, now and in the Future.

Meeting the need for dispersed recreation

Identification and protection of cultural resources.

Effects That Do Not Vary Between Alternatives

Forest activities that may have major adverse effects on caves include recreation, timber management, and the transportation system.

Recreation

Cave visitation accounts for most direct impacts. Negative impacts by visitors can be intentional and unintentional Some intentional impacts include vandalism, removal of geologic features or artifacts, harassment of wildlife, and littering. Some unintentional impacts include trampling of geologic features, trampling of plants, disturbance of wildlife, and human waste

Consequences can include wildlife populations permanently leaving a cave, loss of information from cultural resource sites, loss of a plant species from a cave, and the loss of unique geologic features

Timber

Timber management activities, including timber harvest, slash treatment and site preparation, can effect habitats for wildlife utilizing caves, introduce foreign materials, and change water movement through a cave.

Consequences may include: wildlife species abandoning a cave, pesticides or herbicides destroying cave biota, heavy equipment operating over a thin cave roof causing its collapse, and increased visitation through exposure

Transportation System

Transportation system effects on caves are very similar to those of timber management activities. Roads have the potential to direct large volumes of water (and possibly foreign substances) into caves, and greatly increase visitation.

Effects That Vary Between Alternatives

Without an inventory of caves and their resources, it is difficult to assess the impacts of each alternative However, some comparative statements can be made. Alternatives C that maximize outputs of timber production and recreation will have the greatest impact on cave resources. Less management intensive alternatives will affect cave resources the least.

Cumulative Impacts

No known cumulative impacts have been identified at this time. Cumulative impacts will be monitored for as more information becomes available

Mitigation Measures

In response to the Cave Management Act of 1990, an inventory of caves and associated resources will be conducted and a management plan developed.

Proposed projects that may affect cave resources will be assessed on a project-by-project basis.

Mitigation measures will be developed to protect cave resources when potential impacts have been identified.

When new caves are discovered, they will be inventoried and a management strategy developed.

Unavailable Information

The Forest does not yet have a complete inventory of caves and their associated resources There is also incomplete information on habitat needs of species that inhabit caves or their sensitivity to changes in their environment

Monitoring

Sensitive caves will be monitored periodically to determine if sensitive features have been impacted

Soils

Introduction

Soil is considered a "basic resource" in the management of the Forest. It contains the nutrient elements required by all vegetation It is the medium in which plant roots can find anchorage, and in which many small life forms important to the health of the forest ecosystem can thrive Stable and fertile forest soils are critical in the production of timber, forage, wildlife habitat and clean water. It is considered a non-renewable resource because soil formation requires very long periods of time

The harvest of timber with the related post-harvest activities such as machine slash piling have the greatest potential to effect soil productivity. These effects can vary in intensity and severity depending on the amount of an activity area in which the soil has been changed by compaction, displacement, erosion or severe burning. Sensitive soils are those with high or very high hazards for any one of the above four conditions Up to 20 percent of an activity area can be detrimentally impacted before Forest standards/guidelines are exceeded. The cumulative effect of repeated entries using uncontrolled ground based equipment has the largest potential of reducing soil productivity.

To determine consequences of harvesting trees and treating slash, the soil-landform types on the Forest were grouped into nine soil management limitation classes based on the Soil Resource Inventory (Larsen, 1976). These classes will be referred to as areas with Soil Risk. They include the number of acres per year, that have special management limitations due to soils problems or potentials, where timber harvest will take place. The limitation classes used in this process are:

* Soil that will compact when moist
* Low productivity soils due to low annual rainfall
* High elevation cold soils with short growing season
* Cold air pockets in basins with radiation frost problems
* Slopes over 30 percent
* Soils that are stony or have exposed lava flow rock
* Soils that are unstable to wind and water erosion
* Areas with seasonal high water tables
* Shallow (less than 20 inches) soils over hard rock

Interactions

Timber harvest

The common logging system for most of the stands with slopes less than 30 percent is some type of ground based machinery Use of rubber tire skidders or tractors equipped with grapples are the most common Aerial systems like helicopters and skyline-cable logging systems are used on special situations where slope are in excess of 30 percent or other constraints restrict the use of ground based machinery. Mechanical harvesters like front end mounted saws, boom saws or shears are being used with increased frequency These machines will have wide spread application as technology evolves. Their use will increase on most logging sites due to safety concerns. Extensive soil monitoring will be needed to determine the effects of mechanical tree harvesters on forest soil productivity

Experience has shown that multiple trips with ground based machinery on moist or wet soils that are sensitive to compaction can cause changes that will reduce seedling height and diameter

growth (Cochran and Brock 1985). The research indicates that a 13 percent increase in soil bulk density can result in a 26 percent reduction in leader growth. Compaction reduces site productivity by reducing the air space in the soil, creating a physical barrier to plant roots, and changing the infiltration and percolation rates of water into and through the profile (Sidel, 1980). In areas of limited rainfall, compaction can create droughty conditions and poor root development. Pumice and ash soils will compact under certain moisture conditions, however the period of vulnerability is short due to their sandy nature

Unrestricted ground-based logging equipment operations on slopes has caused excessive soil displacement, gouging and mixing when the soils are very dry and loose. In areas considered sensitive to displacement and gouging, alternative logging systems have been prescribed to protect soil productivity. The removal of topsoil layers by machinery is considered a long term effect. Fertility is reduced by removing the nutrient rich layers that support the shallow rooting systems of trees. During sharp turning and maneuvering of machinery, deep gouges and holes can be created which expose the sterile subsoils layers (Boyer,1975) These have lower fertility levels and will have lower growth potentials Although soil mixing is not considered detrimental to tree growth, it will restrict the number of planting spots available during reforestation

Cable or skyline logging systems move logs to the landing by dragging or partially suspending the logs with cables. These systems cause less soil displacement and gouging than tractor logging and can be used where tractors are not suited Road density is usually less with cable systems since yarding can be done over longer distances with a stationary machine.

For each harvest entry, the extent of soil disturbance depends on the logging system and associated road network, terrain and soil factors, volume of timber removed, size of logs, length of skids, weather, and the skill of the individual equipment operators. The most complex and expensive yarding systems are designed to operate in the steepest terrain. They create the least impact in terms of soil compaction and displacement. Damages from unrestricted machine operations on gentle terrain can exceed those of special logging systems used on the steeper more sensitive slopes. The lack of skill or concern by the machine operator can create soil related changes which vary from difficult to impossible to correct.

The application of uneven-aged management, individual tree or group selection, to forest stands presents some interesting soil problems Application of these regimes to Ponderosa pine or mixed conifer timber types will require special land stewardship that we do not presently practice. The soils objective in these units is to maximize soil areas capable of producing uneven-aged, multi-storied stands.

Logging Residue Management

The residue management objective for the activity area will determine how slash will be treated and the final condition of the site. Machine treatment of slash can greatly increase the area of soil in a displaced, compacted or mixed condition depending on the method and the fire risk. Generally, the more slash that remains after a machine piling operation, the lower the level of soil damage A balance between fire risk and soil damages must be evaluated for each management activity. In the process of meeting slash piling objectives, a more complete job of clean up (one that exceeds the original objective), should not be considered to be a better practice. Usually it is the soil resource that is detrimentally impacted Growth reductions can be expected in areas where surface soil has been pushed into windrows or piles along with stumps and logging debris In addition, soil compaction will create growth reductions due to rooting problems and soil moisture shortages

Prescribed burning is effective in treating slash in most sites. The burning prescription is used to determine the burning condition and allowable effects. Meeting the objective requires careful analysis of duff and soil moisture, weather, terrain and slash loading within the site The objective of all burning should be low to moderate intensity fires which will leave adequate soil litter, duff and large woody material to prevent accelerated soil erosion and meet the long term site productivity requirements The burning program needs to be carefully evaluated at the end each season to see if the objectives were met and the prescriptions were accurate.

Livestock Grazing

During spring, when soils are wet or damp, cattle hooves can sink a foot or more into the mud. If enough cattle walk through an area, they mechanically churn the soil. As these areas dry out, they become very hard. The litter layer at the soil surface is scattered or disrupted which reduces the effectiveness of the soil to absorb water. Exposure of lower fertility subsoils and an increase in wind and erosion create reductions in yields.

Grazing animals also damage the cushion of mosses and lichens on surface soil. This layer which gives the soil its stability, reduces water loss and contributes to soil fertility, is highly vulnerable to trampling and disappears rapidly. *Too many* livestock placed on an allotment *too early* in the season and left to graze *too long* has the greatest negative effect on soil and rangeland productivity.

Recreation

Soils at recreation sites can often be an important factor in determining a site's ability to support recreational activities. For the majority of activities, soil is the base on which recreation takes place, and soil quality has a direct effect on recreational experience. Potentially negative soil effects include surface drainage problems from over use and compaction, loss of fertile topsoil from dust or accelerated erosion which reduces the revegetation potential and resulting aesthetic quality, and muddy or water saturated soils that limit travel within or use of facilities for periods of the year. Most of the effects are site specific, but can contribute to other watershed problems that may accumulate over larger areas

Other Interactions

Long Term Productivity

The maintenance of soil litter, duff and coarse woody debris on the forest floor provides many desired functions for long-term soil and site productivity Standing snags provide sites for insects and fungi populations After snags fall to the ground the process of decomposition accelerates as beetles, termites or other borers invade the wood. These bugs open up the wood to moisture, bacteria, and fungi which hasten the decomposition process. As the wood grows softer and more porous, rodents begin tunneling through the decayed logs. In the last stages of decay, a rotting log may contain more living cells that it did when alive as tree roots, bacteria, fungi, insects, and small reptiles and mammals take up residence. As the logs age they also grow richer in nutrients, filling with the feces and carcasses of insects and animals, as well as decaying vegetative matter. They also absorb nitrogen from nitrogen fixing bacteria. These processes make each log a natural storehouse of nutrients and moisture for living trees which feed on them Water retention may be one of the most significant roles this material will play in areas that are moisture limited

Assumptions

* Logging will be done using ground based machinery except in special situations
* The use of mechanical tree harvesters will increase in the future
* The greater the amount of ground based activity allowed on an area, the greater will be the impact on long-term productivity.
* The effects of soil compaction will last at least one rotation.
* Soil productivity can be restored to about 75 percent of original following mechanical soil tillage, or smoothing (Boyer, 1976).
* The extent and completeness of machine piling of logging slash will decrease due to the concerns for long-term productivity.
* Uneven-aged management of Ponderosa pine will increase, resulting in more entries over time and more cumulative effects to soils.
* Grazing in riparian areas where soils are sensitive to compaction will continue.
* Road created erosion will be minimal and many of the effects can be mitigated prior to

the water reaching stream channels or live water.

* Forest fertilization to increase timber growth in Ponderosa pine will not be economical except in special cases.

Related I.C.O.'s

* How much timber should be harvested and on what schedule?

* How should the Forest manage its lakes, streams and wetlands to prevent degradation?

* To what extent should the Forest enhance or maintain soil productivity and control erosion?

Effects That Do Not Vary Between Alternatives

Soil Productivity

In all Alternatives, the soils will be impacted either by compaction, displacement, mixing, severe burning or erosion. The level of impact will vary depending upon the extent of logging and the soil types, but any management activity which includes the use of heavy equipment, has the potential of reducing soil productivity.

Concentration of livestock in wet lands and riparian communities will occur in all Alternatives These have been identified as sensitive and will require special management considerations for soil protection

Dispersed and concentrated recreation use will occur in areas where soils will limit development. Rehabilitation of these soils will be difficult due to high water tables and degree of impact to areas.

Geothermal development will occur in all Alternatives. The sites selected will be small and effects will be limited to the sites, roads, and distribution lines.

Mining of pumice and cinders will not vary by alternative. These will occur on cinder buttes and other areas where extractable aggregate is available. Restoration of the areas following extraction will be difficult due to the lack of adequate topsoil to reclaim and revegetate

Effects That Vary By Alternative

Figure 4-1 displays the extent of timber harvesting in soils with management limitations Figure 4-2 summarizes each alternatives outputs and factors that affect soil productivity

Figure 4-1 Extent of Harvest Activities on Sensitive Soils

Factors	Units	No Change	Alt. A	Alt. B	Alt. C	Alt. E	Alt. G
Soil Risk	thousands						
first decade	of acres	No	9 0	14 7	20.7	15.0	10 2
second decade	per year	Data	13.9	10.5	13 5	11.0	9.4
fifth decade			45.2	10.6	10.4	10.5	8.6
average for 5 decades			17.7	10.9	13 1	11 7	9.4
Ranking 1 is lowest, 8 is highest	amount of soil risk	7	7	4	6	3	1

Soil risk is the acres per year where timber will be harvested on soils with special management limitations.

Figure 4-2 Factors Associated With Changes In Soil Productivity

Factors	Units	No Change	Alt. A	Alt. B	Alt. C	Alt. E	Alt. G
Timber volume	million						
Chargable Volume	cubic feet	37.1	24 8	25 9	34	21 1	15 6
% Change from Current Dir.	per year	+50	-	+2	+37	-15	-37
Suited lands	%	?	?	95	91	88	98
Stands							
Ponderosa pine	percent						
first decade	of total	76	57	33	36	35	51
second decade	harvest		50	28	45	35	33
fifth decade			39	59	50	21	18
lodgepole pine	percent						
first decade	of total	24	13	10	12	31	12
second decade	harvest	14	29	19	11	19	
fifth decade		44	1	37	65	47	
mixed conifer	percent						
first decade	of total		22	37	35	34	26
second decade	harvest		24	27	18	53	32
fifth decade			12	8	7	14	22
mountain hemlock	percent						
first decade	of total		8	19	17	0	12
second decade	harvest		11	16	18	1	16
fifth decade			5	3	6	1	13
Roads							
first decade	miles/year	66	66	60	90	69	52
second decade		53	53	60	96	65	43
fifth decade		31	31	45	69	49	28

Direct Effects

Alternative A

Implementing this alternative would continue the present rate of logging and associated post sale activities. Entry into lodgepole pine stands will be maximized and account for 13 percent in the first decade of the total volume harvested. These areas are not considered sensitive except in special areas where high ground water tables exist. Most of the areas have gentle slopes and are suited for mechanical tree harvesters and whole tree yarding.

Due to the large volume that will be harvested from high productivity mixed conifer stands in these alternatives (accounting for 24 percent of the total volume removed in the second decade), entry onto steeply sloping lands that are sensitive due to soil limitations will be increased.

Approximately 70 miles of road per year will be built or reconstructed based on needs to access the timber resources in the first decade. These

added roads will subtract acres from the timber growing base, thus reducing the commercial forest lands. Road closure activities will continue based on other resource needs but not to restore acres to productive forest lands

Treatment of slash will be required due to the large volume of material left after harvesting in the mixed conifer and lodgepole pine stands. Tractor piling will be the preferred method in lodgepole pine stands, and prescribed burning will increase on slopes over 30 percent Tractor piling will occur on some steep slopes due to economics and limitations of days that prescribed burning would not exceed air quality restrictions. Machine operations on steep highly productive mixed conifer stands have the potential of detrimentally impacting soil productivity through displacement, compaction, severely burning or erosion of the soils

To manage these stands, about 17,700 acres per year will need special management prescriptions due to soil concerns. During the fifth decade, over 45,000 acres per year of these lands will be entered All Alternatives have been given a relative rating as to total acres requiring special management guidelines. This is called the Soil Risk rating with 1 being the least number of acres entered and 5 being the most Alternative A has a 5 rating for acres of soil risk

Alternative B

Under Alternative B, management activities will include similar volume removed in the first decade, but a 21 percent increase for the second decade. Entry will occur in 95 percent of the suited lands A major portion of this volume, 37 percent, will be from mixed conifer stands in the first decade but will shift to Ponderosa pine stands in the second and fifth decade Nineteen percent of the voloume in the first decade will come from mountain hemlock stands which have a short growing season, cold soils, and poor success for reforestation Some of this volume will require special logging systems and slash disposal methods About 60 miles of road will be constructed or reconstructed per year. In addition, 10,500 acres per year of soils with special soil management limitations will be entered to obtain this volume Alternative B has been given a 2 rating (5 being the highest) when comparing the acres of soil risk.

Alternative C

Alternative C is the maximum commodity option with a 27 percent increase in timber harvested in the first decade The volume will be generated from the three major timber types, but 17 percent of the volume in the first decade will come from mountain hemlock stands which have a short growing season, cold soils and a poor success rate for reforestation. In addition, 35 percent of the volume in the first decade will come from mixed conifer stands. These stands grow on steep slopes and will require special logging systems and slash disposal methods to protect long-term productivity. Entry will occur in 91 percent of the suitable lands Over 90 miles of road will be constructed or reconstructed per year for the first decade to access this volume. Alternative C has a 4 rating for acres of soil risk (5 being the highest) and entry will occur on about 13,100 acres a year that will require many special soil management prescriptions

Alternative E (Preferred)

Alternative E, the Preferred Alternative, will harvest 15 percent less volume than the current situation. The volume is distributed rather evenly throughout the three major timber types, but the Ponderosa pine and mixed conifer stands will have large areas of uneven-aged management Only limited entry (less than one percent of the volume) will occur in the high elevation, cold soil area in mountain hemlock stands. To access this volume, over 65 miles of roads will be constructed or reconstructed yearly Alternative E has a 3 rating (5 being the highest) with about 11,700 acres per year requiring some type of special soil management prescriptions

Alternative G

This Alternative harvests 37 percent less than the current situation It will enter most stands with equal priority with about half of the volume in the fifth decade coming from lodgepole pine stands. About 9,400 acres per year of lands with special soil management limitations will be entered and 50 miles of additional roads will be required per year. Alternative G has a 1 rating (5 being the highest) for acres of soil risk

Indirect Effects

As discussed earlier, soil is a critical factor relating to the abundance and distribution of all other renewable resources. Reductions or increases in soil productivity produce corresponding reductions or increases in vegetative cover. Thus, alternatives that would preserve soil productivity would also preserve the Forest's capacity to provide timber, forage for domestic livestock and big game, high-quality water, habitat for numerous wildlife species, and natural appearing recreational settings.

Other sections of this Chapter (Vegetation; Water; Range) describe in more detail the indirect effects of soil productivity loss on other environmental components.

Cumulative Effects

The cumulative effect upon the soil resource over short and long-term periods have been considered Effects on the soil resource from individual management activities may be acceptable, but collectively, the effects may result in conditions which impair the productivity of a given site. For example, over a short period of time the same site might receive a timber sale and harvest, slash and residue treatment, site preparation and tree planting The cumulative effect of these activities, under adverse conditions, on a specific soil characteristic like bulk density, might result in impairment of the site productivity.

Road construction and reconstruction without an active program of road closure and returning areas to productivity will decrease the lands available for tree growth Most lands occupied by road system will be completely removed from the productive soil base. Add skid trails, landings and burn piles, and lands tied up in the transportation system will quickly exceed the Forests standards/ guidelines in most of the Alternatives With the application of management strategies such as overstory removal or uneven-aged management tillage is logistically very difficult. The machinery necessary to alleviate dense soil layers also damages the roots of existing crop trees so the ideal time to till is during the regeneration phase of the rotation. Destruction of existing crop trees in order to alleviate compaction is done only under the most severe conditions, as the productivity lost from tree removal may outweigh the benefits of relieving the compacted soils

The cumulative effect of the application of uneven-aged management (individual tree or group selection) to forest stands produce problems with regards to soil management Stands will be entered more frequently, harvest units will be very large, less controls over the logging operations may occur, and the opportunities to restore soil productivity by mechanical means will be limited. The treating of slash by under or broadcast burning is limited because of the multi-storied stands that are being emphasized. Machine piling of slash will be limited to concentrations or openings. Unless careful measures are applied, these openings will not be productive or capable of tree growth due to compaction or displacement The log transport system including skid trails, landings and haul roads will need to be designed for the long-term. These systems will need to be identifiable prior to and during each entry and those not being used will have to be returned to productivity. If during the initial evaluation of suitability for uneven-aged management the areas do not meet the standards/guidelines for allowable soil damage, than reclamation measures such as mechanical soil tillage will have to be completed prior to initial entry. The area should meet the allowable soil damage levels prior to uneven-aged management.

The cumulative effect of harvesting many timber stands that are not wind firm will cause accelerated blowdown problems. Timber that occurs adjacent to managed stands will also be at risk of wind damage Winds can cause trees to lean, bend, break off above the ground, or blow over at the base. As we increase the roughness of the land through our cutting practices, more turbulence and erotic winds will occur Leaving trees for snags, snag replacements or visual concerns will require careful evaluation of the risk for blowdown.

The cumulative effects of land management activities on adjacent and intermingled ownerships were considered. No measurable off-site effects on soils are anticipated. Compaction and displacement, the major effect on long-term soil productivity, is confined on-site. Some soil erosion for adjacent private lands may result in a slight increase in stream sedimentation. Burning activities on adjoin-

ing private lands may enter National Forest lands under conditions where soil damages may occur as a result of wildfire situations.

Alternatives A and C have the highest soil risk ratings and have the most lands entered that are sensitive due to soil management limitations. They also are expected to have the most cumulative effects relating to long-term productivity and watershed characteristics.

Alternatives B,E and G have the lowest soil risk ratings and the fewest lands entered that are considered sensitive.

Mitigation Measures

Mitigation measures are designed to eliminate or reduce the impact of an activity on the soil resource. All measures consider the protection of top soil layers, soil organic matter, soil biological activity and soil drainage. The ability of the soil to repair itself after disturbance is called its resilience It forms the basis for any protective recommended measure. Soil standards/guidelines are discussed in Chapter 4 of the Forest Plan They allow no more than 20 percent of an area to be in a detrimentally displaced, compacted, eroded or severely burned condition

These measures are based on Forest-wide situations. Environmental analysis done for project level activities will present more detailed mitigation based on on-site evaluations to protect soil resource values There will be some effects that occur from operations that will not be mitigated completely

Measures Related to Logging System Selection

All slopes over 30 percent are considered sensitive to soil displacement, gouging and mixing using ground based logging equipment. The use of aerial or cable systems with one end suspension are preferred where timber volumes are more than 7000 board feet per acre and the yarding distance is longer that 200 feet Use of ground based skidding machinery is allowed on low volume per acre stands or short skids if directional falling to designated skid trails and pulling drum line are required.

Designated skid trail spacing of 100 feet, leads to 11 percent of an area in skid trails. Spacing of 150 feet yields 7 percent In combination with random skidding, haul roads and fuel treatments, it's easy to occupy 10 to 30 percent of an area in skid trails for cable and tractor harvest, respectively.

Soils in low-lying topographic positions with high water tables, or on the fine textured soil areas in the Metolius, Green Ridge and the Fox Butte-Long Butte areas will compact and puddle easily following unrestricted machine activity. In these areas, a seasonal restriction in the Timber Sale Contract is required This restriction can include periods of time when the soils are dry, frozen to at least 4 inches or covered with 20 inches of snow. Use of low ground pressure machinery is well suited for these settings Restricting entry under these conditions would reduce the severity and extent of compaction, but would not eliminate the problem entirely. Mechanical soil tillage is justified where old logging operations have been allowed and the area exceeds the limits of tolerable soil compaction.

In areas that are dominated by exposed basalt ridges and narrow sandy swales, the swales are considered sensitive because they are the only productive growing sites Operations like road construction, skid trail and landing locations should not be allowed in these sites Placing the transportation system at the margin of, or on the rocky ground, will retain these swales as productive growing sites.

An analysis of capability to produce sustained yields should be in each environmental analysis Lands that are dominated by rough broken lava flows or barren cinder slopes with large diameter timber but lack suitable stocked understory are suspect with regards to timber suitability.

In areas that are suitable for mechanical tree harvesters, like boom saws, boom clippers or front end clippers operation, care should be taken to minimize the area covered by machinery because they easily displace, gouge and compact soils This can be accomplished using boom types of machinery Machines that must travel to each tree to harvest it can create excessive soil damage levels. Operations of front end clippers or saws on sensitive soils will require special restrictions

like parallel skid trails, operations on frozen ground (at least 4 inches), or 20 inches of snow.

Measures Relating to Reforestation

During site preparation, keeping the amount of displacement and mixing to a minimum is desirable. The protection of the surface litter and duff materials is critical to soil moisture maintenance as well as reducing the chance of frost heaving and seedling frost damage. Extensive shallow root damage can occur in thinned stands when machinery is allowed to maneuver around trees to increase natural seedling sites.

The use of burning for site preparation should be done with care to protect soil litter and duff deposits. Hot burns consume all or most of the surface soil organic material, as well as removing all shade These conditions create a blackened surface that will have very hot soil temperatures and can cause sun scald of young seedlings.

Measures Related to Fuel Management

All slopes over 30 percent are considered sensitive to soil displacement, gouging and mixing when tractor piling equipment is used. On these slopes, prescribed burning methods such as concentration or jackpot burning are the preferred fuels treatment for protecting long-term site productivity. Burning prescriptions should favor conditions that produce light or moderate burns and leave the large woody debris intact Burning in spring rather than fall would be emphasized, especially on sensitive soil areas. Spring burning is preferred because surface soils are moist and the results of burning are generally reduced as compared to fall burns. If no alternative method except machine piling exists, only piling slash concentrations to break up fuel continuity or yarding with tops attached will lower the amount of slash left on sensitive steep areas.

Areas that are identified as sensitive to soil compaction during harvesting activities are also sensitive to machine piling of slash. The same restrictions apply to both types of operations.

In the areas dominated with exposed basalt ridges, mechanical slash piling should not detrimentally displace or gouge the sandy basins. Burn piles should be placed on rocky sites instead of sandy basin areas. If no other alternatives exist, piling should be done on frozen ground Machine crushing or prescribed burning do not produce the levels of effects that machine piling in dry soil conditions does

In frost pockets or areas prone to radiation frost that will damage small seedlings, leaving logging slash on the ground will absorb daytime heat and release it at night. This will moderate the local climate around small seedlings and lower the probability of frost damage. Leaving 12 tons of slash per acre, in all size classes, will help protect seedlings.

Measures Related to Erosion Control

Surface water erosion is normally not a major problem on the Forest. Occurrances are limited to areas that have fine soil materials at the surface that will not absorb rainfall or areas where water is allowed to concentrate from roads, landings or skid trails Measures to control erosion are needed where the Erosion Hazard Ratings are High or Very High. Measures such as water barring and grass seeding are suggested to protect soils Scattering logging slash on the surface or arranging woody debris parallel to the slope has been effective in controlling runoff

Wind erosion is a problem where large areas of loose and easily detached soils are left open and exposed to the winds. Dust clouds are common after large burns due to the loose ash that is present. Soil loss from wind is critical in the drier portions of the Forest and sand blasting of small seedlings can create reforestation problems

Hot or extreme burn intensities associated with prescribed or wild fires can create hard to wet soil layers at the surface that will repel water. Once the thin layer is saturated with water, accelerated soil erosion and runoff is common Keeping these burn intensities to a minimum is the best measure to protect soil productivity.

Measures Related to Soil Restoration

Restoring soils to their natural levels of productivity after being damaged is expensive and difficult. Damaged areas will be located during soil monitoring activities. The Forest has set a target of restoring 400 acres per year of damaged soils Specific criteria can be obtained from the Forest Soil

Scientist The best approach is to not cause the damages initially, but if measures are warranted, the following items are important to consider:

* First priority is soils that are capable of producing timber yields greater than 85 cubic feet per acre per year. These prime forest land soils justify restoration measures that include smoothing of soil mounds and berms, mechanical soil tillage (the mechanical breaking up of compacted soil), fertilizing for fertility improvement, or spreading biologically rich top soil or organic materials over areas where soil fertility has been eliminated by scalping

* Soils capable of producing 50 to 85 cubic feet per acre per year are second priority for restoration. Included in this priority class are lands where restoration is warranted to meet other resource values like campgrounds, riparian, eroded areas, or abandoned cinder pits.

* Tillage of compacted soils is not feasible where large volumes of rock are near the surface, or in areas that are wet, but are very effective on a wide variety of soils and conditions. Although no research has been completed, it is currently felt that tillage will restore soils to 75 percent of original productivity level (Boyer,1976).

Measures Relating to Recreation

Maintenance of erosion control structures on trails as well as the rehabilitation of damaged areas will help reduce the negative effects associated with recreational pursuits, especially off-highway vehicle use

All the mitigation measures discussed above are highly effective (90 percent or greater) in preventing or reducing effects to soil resource values on the Forest. However, the degree and quality of implementation is highly variable, ranging from poor to excellent. Unexpected or unusually severe climatic events, availability of funding and labor, knowledge and understanding of the measures by both operators and administrators, to name a few, are reasons why many of these measures are often only 60 to 80 percent effective.

Unavailable Information

The following information needs to be gathered to better understand the effects of many of the management activities.

* A better understanding of the effects of the many types of mechanical tree harvesters that will be used more frequent on the Forest This will require soil monitoring of the different equipment types and characterize their effects under different soil conditions.

* Knowing the effects of repeated entries during uneven-aged management will need to be determined This management strategy will require more frequent entries using ground based machinery and the logistics of maintaining lands capable of producing timber will be a challenge.

* A better understanding of the consequences of machine piling on long-term productivity will need to be gained This residue management technique is very cost effective, but has major effects on soils and its productivity. Having a replacement method that will still meet the goals of fire management will be needed in the future.

* The Forest is active in mechanical soil tillage to restore compacted soils. No growth studies have been completed to determine if the productivity levels are being improved. It is our assumption that 75 percent of the productive capacity is being restored This has never been tested by Research

* The Forest does not know the present levels of damage on most of the commercial forest lands. No widespread soil condition monitoring has been organized and the Districts are not staffed to do this level of monitoring.

Monitoring

Soil monitoring is a systematic process by which data is gathered to detect changes in chemical, biological and physical soil properties resulting from management activities Information obtained through soil monitoring activities provides a means

to evaluate attainment of land management objectives.

The primary objective of soil monitoring is to provide information that will assist in making better land management decisions It is conducted to determine if Land Management Plans are being carried out within the environmental constraints agreed upon during project planning. Soil monitoring can be described in several ways depending on the projects objectives. These include:

* A characterization of soil resource condition

* A measurement of soil resource condition resulting from management activity.

* A measurement of compliance to standards/ guidelines.

Soil monitoring can be conducted at several levels of intensity. The intensity level is dependent on the kind of activity and the types of soil management problems that are important. Some monitoring projects may consist only of a series of visual observations or photographs made over time. Other projects may require development of acceptable sampling procedures and statistical analysis of data collected in order to draw proper conclusions. Specific soil monitoring methods can be found in Guidelines for Sampling Some Physical Conditions of Surface Soils (Howes 1983).

The soil resource effects that will be monitored (F S M. 2520, R6 Supp 50 6/87) are the following.

* Compaction and/or Puddling.

* Displacement

* Percent of area not protected by vegetation or litter after land management operations.

* Changes in soil properties due to slash burning.

* Erosion rates from road cuts and fills.

* Changes after timber harvest in soil moisture and temperature in areas where reforestation has been difficult.

Potential Conflicts With Plans and Policies of Other Jurisdictions

There are no known potential conflicts with other jurisdictions Coordination will occur with the following agencies Soil Conservation Service for detailed soil mapping in Deschutes, Lake, Jefferson and Klamath Counties; Winema, Ochoco and Fremont National Forests for consistent soil interpretations on sensitive soils, Warm Springs Indian Reservation on areas with special soil management needs, Pacific Northwest Forest and Range Experiment Station, Bend Silviculture Laboratory on long-term productivity research.

Literature Cited In order of their appearance in the soil section above:

Larsen, Dan, Soil Resource Inventory, Deschutes National Forest, 1976, 381 p

Cochran,P.H., Terry Brock, Soil Compaction and Initial Height Growth of Planted Ponderosa Pine. PNW-434, USDA-FS, 1985, 4p

Adams,P., Henry Froehlich, Compaction of Forest Soils, PNW-217, USDA-FS, 1980, 15p

Sidel, R.C., Impacts of Forest Practices on Surface Erosion, PNW-195, USDA-FS, 1980, 15p.

Boyer,D., Guidelines for Soil Resource Protection and Restoration for Timber Harvest and Post-Harvest Activities, USDA-FS, Region 6, 1976, 43p.

Howes, S , John Hazard, J Michael Geist, Guidelines for Sampling Some Physical Conditions of Surface Soils, USDA-FS, Region 6, 1983, 34p.

Water and Riparian Resources

Interactions

The condition of the water quality in stream, lakes, wetlands/riparian areas, and floodplains is a reflection of overall watershed conditions. A healthy overall watershed condition will retain excellent

water quality as the water moves through it. Water quality refers to its physical and chemical make up. Since riparian/wetlands, lakes, and streams are the conduits for water movement throughout the watershed, stream channel condition is an important indicator of watershed health and reflects the quality of the aquatic resource. Channel conditions are represented by the physical structure of the stream substrate, streambank vegetation and streambank stability. Many of the processes altered by land management activities affect both water quality and stream condition in the same manner The influences of land management activities on water quality and lake/stream conditions, and how it impacts the beneficial uses of water is addressed in this section.

Although riparian vegetation occupies only a small part of the overall acreage of the Forest, these areas provide critical diversity and stability in the forest ecosystem. In riparian corridors along streams, rivers and lakes, the presence of multiple vegetative layers provides a variety of nesting sites, cover areas and food sources for wildlife. The vegetation acts as a sponge to absorb nutrients and sediment, becoming a rich nutrient sink. The roots of riparian vegetation help to stabilize streambanks, lakeshores, and adjacent slopes. Vegetative screening maintains low water temperatures by shading steams from solar radiation, and woody material provides spawning and rearing habitat for resident fish. Riparian areas have different microclimates from the surrounding coniferous forests due to increased humidity, a higher rate of transpiration, shade and greater air movement These conditions are preferred by some wildlife species, as well as by people participating in a variety of water oriented recreation activities during the summer months. Within riparian areas disturbance to vegetation and soils is minimized, and scheduled harvest rates are eliminated in all Alternatives.

Water quality, quantity and the timing of runoff in a watershed are the product of the interactions of soils, vegetation, climate, the conduit system and management activities effecting each watershed. Nowhere within a watershed are management activities and the water resource more critically related than in riparian area/streamside management zones.

Some disturbances of soil and vegetation affect water quality and stream channel condition. Activities that disturb, expose, and/or compact soils and channelize water can produce erosion, and possibly cause soil to enter streams as sediment This can cause adverse effects on the quality of fish habitat and other benefical uses of water.

Increases in water yield generally benefit municipal water users unless the quality of the increased volume is reduced by sedimentation Water yield is altered by land-disturbing activities because soil disturbance triggers changes in the hydrologic regime (the timing, volume and quality of runoff). As infiltration decreases with increased soil disturbance, the potential for the duration of runoff decreases. If increased runoff is delivered directly to the channel networks, lower recharge rates for groundwater basins occurs; increasing water delivery to the creek, which increases the potential for stream channel erosion

To provide a point of reference, changes in the magnitude of soil disturbing activities by alternative are compared with the level of activities in Alternative A, which would continue current direction. Both short and long-term effects are considered using yearly averages for the first decade and fifth decade. The baseline is defined as the Forest in its current physical condition and reflects the effects of past activities, both recent and distant, plus variations produced by natural processes.

Data sources for this analysis include resource records for the Forest, professional literature, personal communications with adjacent National Forests, and professional judgment.

Forest activities that may have major adverse effects on water quality and yield include timber management, the transportation system, off-highway vehicle use, intensive recreation, and livestock grazing Watershed, fish and wildlife habitat improvements can benefit the resource. Consequences of these activities are assessed in terms of overall watershed condition as reflected in water quality, lake quality, streambank stability, wetlands/riparian quality and includes cumulative effects.

Timber

Timber management activities, including timber harvest, slash treatments, and site preparation, affect the water resource in varying degrees through the alteration or destruction of vegetation, the compaction or disturbance of mineral soil, and changes in sediment yield and temperature (Fredriksen and Harr 1979; Hewlett and Doss 1984).

Consequences can include reduced infiltration rates and capacity, water channelization, overland water flow, and increased susceptibility of the soil to detachment and displacement. Ground disturbance is the first step in a process that may lead to soil displacement. The potential for this impact becomes greater on steeper slopes and more erosive soils.

Removal of streamside vegetation may have a direct effect on water temperature with potential for increased temperatures during summer months (Brown and Krygier 1967), and for lower temperatures in winter. Reduced insulation increases the potential for ice formation in winter and can result in stream bank damage (Chamberlin 1982; Swanson 1980). Root systems of riparian vegetation maintains stability of the lakeshores and streambanks Long-term stability of the stream channel is dependent upon recruitment of large woody material (LWM) from this zone. The LWM provides stability of the channel by creating hydraulic controls and dissipating water energy Figure 4-3 and 4-4 display the amount of timber scheduled for harvest on an annual basis for the first and fifth decade. It is assumed the greater the amount of timber harvested, the greater the ground disturbance; therefore the greater the potiential for soil displacement.

Transportation System

Roads account for the majority of the sediment problems and are often the links between sediment source areas (skid trails, landings, cutslopes) and stream channels (Harr 1976; Houpt 1959, Kidd and Megahan 1972; Ric 1979; Stone 1973). The magnitude of the impact is determined by such factors as amount and season of use, soil type, terrain, vegetation and the likelihood of sediment from these areas reaching a watercourse.

Roads constructed adjacent to streams produce up to twice the amount of sediment as that from mid-slope or ridge top roads (Anderson 1974; Wooldridge 1980). Substandard roads left open after logging for recreation or other use can become sources of erosion and sediment (Anderson et al 1976). Maintenance operations themselves (clearing ditches, reshaping cutslopes, regrading road surfaces) can prolong hydrologic recovery and increase erosion and sedimentation (Bullard 1963) Roads paralleling streams may reduce shade on some sites by as much as 43 percent (Thomas 1979: Skeesick and Steward 1981)

The major portion of the transportation system on the Forest has been completed. Approximately 8,500 miles of road have been constructed A majority of the roads are on very gentle slopes containing coarse textured soils Runoff is generated on the road compacted surface but infiltrates quickly once the water is dispersed in the forest The Melolius basin and southerly to Bluegrass Butte on the Sisters District is the most sensitive area on the forest for road runoff problems. A few roads built decades ago paralleled drainages, degrading the character of intermittent draws and creating erosion problems. These are the high priority road the forest is working on to restore to a satisfactory watershed condition Figures 4-3 and 4-4 display the total miles of road construction and reconstruction on an annual basis for the first and fifth decade. It is assumed the greater the amount of road construction and reconstruction, the greater the ground disturbance, therefore the greater the potiential for soil displacement However, due to the permanent closure of unneeded roads and roads causing environmental damage, the potential for adverse impacts will be reduced (see the Wildlife section in this Chapter).

Off-Highway Vehicles

The operation of these vehicles can adversely affect water quality by destroying vegetation and compacting and rutting road surfaces The magnitude of the impact is determined by such factors as season and amount of use, soil type, terrain, vegetation and the likelihood of sediment from areas reaching a watercourse (Payne et al 1983; Sparrow and others 1978; Webb et al 1978). Figure 4-3 and 4-4 display the amount of land to remain in the roadless category on an annual basis for the first and fifth decade. It is assumed the less

land in the roadless category, the greater the ground disturbance, therefore the greater the potential for soil displacement.

Recreation

Intensive recreation can affect water quality primarily through the destruction of vegetation and compacting the soil. This results in reduced infiltration and channelization of water; and increased potential for eroded soil to enter streams as sediment. Recreation development also requires access and impacts associated with roads and trails are applicable.

Recreation use is concentrated around water bodies; over 50% of all recreational use and over 90% of developed recreational sites are associated with water features. Fishing, hunting, and wildlife viewing are popular activities, evident by fisherman and hiking trails around lakes and streams. Compaction of soils and destruction of riparian vegetation are the dominate impacts to the water/aquatic resource

Summer homes, recreation resorts (SUPs) and ski areas all have potential to impact water quality Besides the vegetative alterations which occur, additional impacts relating to septic system malfunctions and handling of hazardous materials pose additional threats. Many of the resorts and summer homes are along water bodies; therefore increasing the risk of potentially impacting the water resources. Spills of petroleum products in or adjacent to resorts on lakes is a possibility. Salt has been used to preserve snow at ski resorts but follow up studies have not detected detrimental increases of salt in the soil profile Figure 4-3 and 4-4 display the amount of recreational use projected on an annual basis for the first and fifth decade. It is assumed the greater the amount of recreational use, the greater the ground disturbance; therefore the greater the potential for soil displacement.

Livestock Grazing

Removal of vegetation and compaction (especially of moist riparian soils) by grazing animals can reduce infiltration and increase the potential for overland flow and changes in sedimentation, and channel morphology (Anderson et al 1976; Blackburn 1983; Gebheardt and Johnson, 1981; Lusby 1970; Platts 1981; Willott and Pullar, 1984). Grazing is reported to be 25 to 60 percent heavier on streambanks in riparian areas than on adjoining uplands (Nelson and Platts 1985). This concentration can lead to compaction in the surface one to two inches of soil, (Alderfer and Robinson 1947). Removal of streamside vegetation through mismanagement has a direct effect on stream temperature, especially on sites where coniferous shade is lacking or is insufficient, and where grasses and shrubs provide a large proportion of the effective shade

Sloughing-off and collapse of streambanks is an effect caused by mismanaged allotments along streams. The degradation of streambanks allows for increased sediment transport, filling of the pools with sediment and eventual evolution to a shallow, wide creek. The morphology change usually occurs on low gradient, high meandering streams flowing through fine substrates. Impacts to the chemical quality of water are quite variable and difficult to assess, but increases in organic matter and bacteria occur as a result of grazing (Francis and Schepers 1982, Skinner et al 1974).

There are five allotments within the forest that contain riparian pastures The remainder of the allotments are associated with upland, dryland range No adverse impacts to the aquatic resource has been documented on these upland allotments. Figure 4-3 and 4-4 display the amount of potential range outputs on an annual basis for the first and fifth decade It is assumed the greater the amount of range outputs, the greater the ground disturbance, therefore the greater the potential for soil displacement

Water Quantity and Runoff Timing

Increased peak flows have the potential to destabilize stream channels and slow recovery of streams that are moving toward a more stable condition. Natural attenuation of flows as they move downstream works to mask this effect Research studies have not detected significant changes in peak flows where logging has been conducted without severe soil disturbance (Ellison 1981; Harr 1976), (also see Effects on Soil).

There is currently no quantified relationship between annual runoff, amount of area vegetatively

altered and peak flows Incremental increases above the existing level of annual runoff could be expected to decrease stability on marginally stable stream channels; streamflow decreases could be expected to have the opposite effect.

There is debate over the effects of runoff (both annual and peak flow), and the role played by sediment delivery in determining channel stability (Galbraith 1973; Megahan 1979, Rice 1980). Recent research has focused on the potential of rain-on-snow events in causing increased channel damaging peak flows (Harr 1975). No adverse impacts to streams has be documented on the Deschutes National Forest from timber harvest and roads; either individually or in combination, such that the beneficial uses of the water has been impaired.

Evaluation of the Alternatives based on their effects on timing of runoff or channel stability was made on the Deschutes Evaluations by McCammon (1984) and other Forest hydrologists have discounted the potential of increased runoff to have detrimental effects to streambank stability and water quality That is because flows will not likely be affected by any of the Alternatives because of deep soils, high ground water reservoir capacity, the ability of nearly all the water to infiltrate on site, and the ability of the water to be released slowly as springflow. There are numerous acres of the watersheds that do not contain flow patterns on the surface of the landscape because of the extremely high infiltration rates. There are numerous lakes in the backcountry/wilderness areas along with low country lakes that further attenuate the runoff cycle. An example of this unique phenomena is the upper Deschutes River where the watershed has a large drainage area (estimated to be 132 square miles at the gauge but is really unknown because of the lack of surface expression of flow patterns) dominated by snowmelt runoff. The peak of the runoff cycle is in the month of August, being two to three months lag time from "normal" snow runoff dominated streams. What accounts for this phenomena is the infiltration of water into the pumice/lavas and a subsurface movement of water to the lake (Little Lava Lake) and the springs that feed the lake/stream system.

As streamflow on the Forest originates as springs, these groundwater aquifers have an unique ability to moderate the runoff cycle and stabilize the flows Even if increases in water yield occur, the moderation by the groundwater aquifers would minimize any potential for streambank damage and initiation of instability. Additionally, as openings in timber lands are created, water will move downslope and could possibly be used on adjoining lands by vegetation or percolate deep into the ground water system to eventually reach the lower Deschutes River. It is unknown as to where, if at all, the water will appear from clearing of vegetation as extra runoff in Forest streams

Other Interactions

Mining activities can affect water quality by exposing spoil piles to erosion, increasing the potential for sedimentation. Chemicals can also leach into stream courses from spoil piles or treatment processes Very little mining occurs on the forest.

Wildfire effects on water quality come about primarily through increased sedimentation and mass soil movement following the destruction of vegetation and exposure of mineral soil to increased runoff and direct rainfall impact (Helvey 1980). The flushing of ash deposits into streams may alter the concentration of some chemical elements, but this effect on water quality is not well understood (Swanson 1980). In addition, the loss of vegetation in riparian areas exposes the water surface to increased solar radiation which directly affects water temperature (Helvey et al 1976). Fire suppression measures can also degrade water quality (Barney and Steels 1983), as can salvage operations following a major fire (Bottom et al 1985, Cornish and Mackay 1982). Adverse effects caused by past wildfires have not been documented on the Forest

Prescribed burning has the potential to affect the water resource directly through the destruction of vegetation or slash. It can also change the character of some soils causing them to become water repellent or hydrophobic

Wildernesses, unroaded areas, Research Natural Areas, and stands of old-growth timber tend toward long-term stable vegetation In this environment, erosion and sedimentation is usually low and water quality high Such areas, however, would not be immune to disturbance by wildfire, insect attack or other natural disasters (Anderson et al

1976). Such catastrophic events may result in a impact to water quality.

Benefits to water quality may be obtained by management of beetle kill lodgepole and other vegetation disease conditions. Active management may reduce the potential for catastrophic fires or prevent the severe reduction of live trees in riparian areas. Reforestation benefits watershed stability by reestablishing vegetation.

Assumptions

Although sediment yield corresponds broadly to the amount of ground disturbed Forest-wide, the relationship varies from one location to another depending on soil characteristics, the presence or absence of streams, streambank characteristics, slope, precipitation, vegetation type, and other physical and biological factors.

It is assumed that the greater the magnitude of a soil disturbing activity, the greater the risk of incurring an adverse impact on the condition of the watershed.

Vegetation treatment for range and wildlife will have minimal effects on water quality, as treatments occur under carefully controlled conditions.

Forest-wide S&Gs will be applied to all management activities. They do disperse timber harvest activities both spatially and temporally within watersheds. Visuals, wildlife, old growth, soils and riparian area direction all disperse activities throughout the Forest, preventing the possibility that any one watershed would receive heavy impacts from multiple or large scale entries in any one decade.

Timber harvest (scheduled ASQ) is not planned within 100 feet of all Class I, II, and III streams, perennial lakes and other water bodies; and all wetlands/riparian areas. Timber related activities within these zones may be performed if the goal of improvement of riparian dependent resources is persued.

Related ICOs

How much timber should be harvested and on what schedule?

What areas on the Forest should be made available for geothermal leasing and development?

How should the Forest manage its lakes, streams, and wetlands to prevent degradation?

To what extent should the Forest enhance or *maintain soil productivity and control erosion?*

Effects That Do Not Vary Between Alternatives

Water Rights

Approximately 59,000 acre-feet of surface water per year are currently required to support Forest activities. This is expected to increase by 1 percent during the next 50 years under any alternative which was evaluated.

Recreation

The number of summer homes will not change by alternative. The potential for adverse effects on water quality will not vary. Emphasis will be placed on inspections and assuring that the home owners comply with all Federal, State and local laws.

The number of resorts is not expected to increase. The potential for petroleum spills and malfunctions of septic systems is always a reality. Again compliance with Federal, State and local laws will be enforced.

Mt. Bachelor Ski Area will continue to expand under each alternative. Removal of vegetation and modification of the landscape will result in additional runoff and soil erosion. The runoff does not reach any perennial water sources and therefore does not impact beneficial uses of the water. A reduction in soil productivity will occur.

Geothermal activities will be common by alternative. There are many unknowns at the present time as to the extent of the resource and the potential for

development. Potential impacts would be disturbance of vegetation, increased roading and possibly mixing of groundwater. It is unknown at this time the full potential impacts of geothermal development.

Mining activities will not vary by alternative. Vegetative disturbances and road building could increase runoff and cause erosion. As of yet, little interest in mining has occurred on Forest and is not expected to increase over the next decade.

Effects That Vary Between Alternative

Figure 4-3 displays the factors influencing water quality, streambank stability and wetland/riparian areas and how they would differ between management alternatives in the first decade. Figure 4-4 displays these factors influencing water quality, streambank stability and wetlands/riparian areas by the end of the fifth decade.

Figure 4-3 Factors with the Potential to Adversely Effect Water Quality in the First Decade

Factor	Unit of Measure	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Timber	MMCF	37.1	28.0 -25	30.6 -18	39.4 +6	22.8 -39	19.9 -46
Roads--% change	miles	66	66 0	60 -10	90 +36	69 +5	52 -22
OHV[1]--% change	M acres	145.1	145.1	138 -5	137 -6	145.1 0	145 1 0
Recreation--% change	M RVDs	1,718 0	1,718 0	3,024 +76	2,958 +72	3,025 +76	2,588 +50
Range--% change	M AUMs	29	29	32 +10	45 +55	32 +10	26 -10

[1]Acres not available for OHV use.

Figure 4-4 Factors with the Potential to Adversely Effect Water Quality in the Fifth Decade

Factor	Unit of Measure	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Timber	MMCF	37.1 +20	28.3 -24	30.4 -18	38.7 +4	22.6 -39	19.9 -46
Roads--% change	miles	31 -48	31 -48	45 -21	69 +9	49 -18	28 -54
OHV[1]--% change	M acres	117.3 -19	117.3 -19	102.3 -29	66.4 -54	145.1 0	121.7 -16
Recreation--% change	M RVDs	2,592 +51	2,592 +51	4,648 +170	8,822 +414	4,710 +174	3,306 +92
Range--% change	M AUMs	29	29	45 +55	45 +55	45 +55	26 -10

[1]Acres not available for OHV use.

Direct Effects

Alternative "No Change"

There would be a moderate level of soil disturbance from management activities if Alternative No Change is implemented. Increases in recreation and high timber harvest would produce localized sedimentation problems and degradation of some wetlands and riparian zones. Not all existing Forest-wide S&Gs could be implemented to meet the outputs of timber in this Alternative.

Overall, water quality requirements would be met but a moderate risk would be taken for short-term localized violations of water quality standards. Timber harvest volumes and related activities would remain the same. Entry into the lodgepole pine (low slope angles and high infiltration sites) would dominate the first and second decade; where the mixed conifer (moderate slope angle sites) will dominate the fifth decade. The risk for water quality degradation is low in the first two decades but increases in the fourth and fifth decades. The risk of degrading water quality may be moderate under this Alternative in the later decades. Project level analysis may identify a need for harvest dispersion in the latter decades under this No Change Alternative.

Approximately 66 miles of road would be constructed or reconstructed in the first decade, 30 miles in the fifth.

Recreational development will increase 51 percent by the fifth decade. Reflecting expected growth in the region's population, there will be 1,718 thousand recreation visitor days of use in the first decade and 2,592 by the fifth decade. Much of this recreation will occur near rivers and lakes, posing a moderate risk of water quality degradation in localized areas. The heavy use around the water bodies (and along the wetlands/riparian areas) will result in compacted soils and vegetation destruction. The risk will be moderate that sediment movement will occur and water quality is degraded at those receiving bodies of water immediately adjacent to the disturbance. These impacts will be very localized and present a very low risk of overall water quality degradation in any one watershed.

Roadless land is infrequently used by off-highway vehicles and the amount of land in this condition is a hedge against water quality degradation. In these alternatives, the amount of unroaded land in the Forest would not be substantially reduced in the next fifty years. Present impacts show small localized degradation of water quality by using roads when they are moist. Rutting and concentration of water is occurring. In very few cases the runoff does not reach any streams or lakes. Restoration activities and road closures/ maintenance tends to mitigate this impact. The risk is low overall on Forest for this to cause water quality violations.

The number of cattle and sheep on Forest allotments are expected to remain the same for the next fifty years, reflecting a low risk to water quality degradation

Alternative A and B

Implementation of these alternatives would maintain a high level of water quality on the Forest. There would be slight reductions in water quality over time in localized areas due to increases in recreation. These impacts will be related to increases in trailing and destruction of riparian vegetation around lakes and streams by the continued increase of use along water bodies. Sediment would wash off trails and campsites, reaching the water bodies The amount of sediment would be small and the impacts would be localized near heavy recreation use sites Since they would be small and isolated, these impacts would not constitute a threat to Forest watersheds.

Timber harvest would decrease 20 percent in the first decade and the fifth decade. Road construction would decline slightly in the first decade and be down by a third to nearly half in the fifth.

Recreational use would pose a moderate risk to degradation of water quality because of the high levels of use on Forest. Streams, lakes, and wetlands/riparian areas are the attractors and the compaction of soils along with destruction of vegetation will occur A mitigation measure of pulling camping units away from water bodies and hardening these sites would reduce the risk of accelerated erosion. Consequently, localized water quality degradation would occur but the risk would be low for overall water quality degradation in any one watershed.

Roadless areas would decline 20 to 30 percent, increasing the possibility of reductions in water quality due to off-highway vehicles. Recreation would increase 76 percent to 3,024 MRVDs in the first decade and by 170 percent (4,648 MRVDs) in the fifth. Grazing would increase 10 percent (32 thousand animal unit months) in the first decade and by 55 percent (45 MAUMs) in the fifth under Alternative B. Streambank damage would be expected to occur on all allotments with wetlands and streams contained in them Localized adverse impacts to water quality and particularly fish habitat would occur.

Alternative C

The implementation of Alternative C would result in greater increases, than the No Change Alternative, in soil disturbance and some violations of water quality standards could be expected at the local level Virtually every acre on the Forest would be intensively managed to produce high levels of timber harvest, road construction, off-highway-vehicle driving, recreation and grazing. This would result in localized and potentially general reductions in water quality in some watersheds Not all existing Forest-wide S&Gs could be implemented to meet the outputs of timber, recreation, and range in this Alternative.

Floodplains and wetlands/riparian zones would be frequently entered for dispersed and intensive recreation, and grazing. Stream channels would degrade and sedimentation may be prevalent in some stream reaches or lake shore areas Adequate mitigation of these effect by application of Best Management Practices would be inadequate to lower the risk of water quality degradation to the point where water quality standards could be met year round. Pulses of sediment delivery to water bodies would occur during thunder shower and snow melt periods Direct and indirect effects would be evident on the ground and may be measurable in some stream reaches

Timber harvest would decrease 6 percent in the first decade (39.4 MMCF) and then increase 4 percent (38.7 MMCF) by the fifth decade Road construction would increase 36 percent (90 miles)

in the first decade and 9 percent (69 miles) in the fifth.

Roadless areas would decline 54 percent by the fifth decade, increasing impacts on water quality from off-highway-vehicles. Recreation would increase 72 percent to 2,958 MRVDs in the first decade and by 414 percent (8,822 MRVDs) in the fifth.

The large increase in recreation would result in localized damage to riparian/wetlands areas, stream channels and lakeshores. Sediment movement would be obvious in high concentration recreation sites. Localized sedimentation of streams, breaking down of the streambanks and lakeshores would result. All mitigation measures applied would not assure that localized degradation of water quality would not occur. Short-term violations on a localized level could occur with a moderate risk that long-term degradation of beneficial uses of water would be impaired The water quality standards would be met most of the time but annual inputs of sediment would result in fish habitat degradation at the local level. Overall, the impacts would be acceptable but persons rememebering the "good old days" would recognize adverse changes to some streams, lakeshores and riparian/wetland areas Grazing would increase 55 percent (45 thousand animal unit months) in the first decade and by the same amount by the fifth.

Alternative E (Preferred)

In this Alternative, recreation, and grazing would result in localized sedimentation in the streams, particularly in the developed and dispersed recreation sites.

Overall water quality requirements would be met but there would be trouble spots, particularly in the developed recreation sites and grazing pastures in wetlands This may result in short-term, localized violations of state and federal water quality. Overall impacts for this Alternative are similar to impacts described for Alternative B.

Timber harvest would decrease 39 percent (22.8 MMCF). Road construction would remain the same (69 miles) in the first decade and decrease 19 percent (49 miles) in the fifth.

Roadless areas would remain the same. Recreation would increase 76 percent to 4,025 MRVDs in the first decade and by 174 percent (4,710 MRVDs) in the fifth Grazing would increase 10 percent (32 MAUMs) in the first decade and 55 percent (45 MAUMs) in the fifth

Alternative G

Alternative G would maintain water quality on the Forest at the highest level. Slight reductions in water quality over time in localized areas may occur due to increased recreation development. Impacts will be concentrated and would not pose a threat to overall watershed conditions The risk of degradation of water quality would be very low, resulting in improvements over the present situation

Timber harvest would decrease 46 percent (19.9 MMCF). Road construction would decline 22 percent (52 miles) in the first decade and 54 percent (28 miles) in the fifth.

Roadless areas would remain the same. Recreation would increase slightly in the first decade and by 92 percent (3,306 MRVDs) in the fifth. Grazing would decrease by 10 percent of the current level.

Indirect Effects

Indirect effects can impact almost every aspect of water/lake/stream/riparian resources.

The ultimate effect on water quality is determined by how much sediment erodes from a site and/or is delivered to a watercourse or waterbody and the value placed on the use of that water; e g., fish production, irrigation, recreational or domestic use. Sediment can smother fish eggs and fry, smother and scour stream bottom plants and aquatic organisms, cloud water, abrade fish gills, and reduce the visual appeal of waters used for recreation. Sedimentation increases the cost of treating water destined for human use and reduces the capacity of reservoirs. Erosion reduces soil productivity, leaves areas visually undesirable and reduces quality and quantity of the aquatic habitat.

Indirect effects are hard to separate from cumulative effects and/or direct effects. The indirect effects

assessment is addressed by assumption of similarity of effects in the sections on direct effects and cumulative effects.

Cumulative Effects

Alternatives C and No Change have a low to moderate risk of creating cumulative effects on channel systems, because of their emphasis on livestock grazing, recreation development, off-highway vehicle use, and timber production outputs. Emphasis on uneven-aged timber management would require entering more timberland and more road construction. By the third decade timber harvest activities will have shifted from the lodgepole sites on flat slopes to the mixed conifer on steep slopes. Policy would protect riparian areas/wetlands but multiple entries into watersheds with moderate slopes would expose sensitive soils and run a high risk of creating overland flow; particularly during high intensity thunderstorms.

Cumulative increases in water temperature and yield would be less likely. Selective harvest methods would protect stream temperatures. The increase in livestock grazing could result in cumulative sediment and stream temperature effects.

Any alternative which has the potential to increase sediment would pose an increased risk of cumulative impacts to channel conditions. Increases in sediment at some point can exceed the ability of a stream channel to effectively adjust, producing disequilibrium Coarse sediments are deposited as channel and point bars, which deflect flows into the streambanks and initiate bank erosion. Bank erosion in turn leads to the addition of more coarse sediment to the stream A feedback system is thus established and can lead to the creation of wide and shallow channels and, in extreme cases, braided channels. Whether this occurs depends on the morphological characteristics of individual streams. With all Alternatives, however, the probability of such impacts to channels would be low, with the exception of Alternatives No Change and C.

A Forest hydrologist conducted a cumulative effects survey of Metolius River Basin in 1984. The final report identified no known or observable cumulative effects in the basin. This was attributed to the resilient nature of the soils, high stream bank stability, the health of riparian vegetation, and the runoff characteristics of the watershed, which originates as springs. Numerous lakes within the watersheds and the deep coarse soils help to attenuate runoff

One identified problem, in the above study, was road drainage water, requiring some changes in road design and the application of Best Management Practices during road and skid trail construction and maintenance. This has mitigated most of the potential to degrade water quality but very infrequent thundershowers do cause some turbidity in streams. This turbidity has been found in both wilderness and multiple use managed watersheds. A sediment search program is used to monitor sediment sources during rainfall events. Two years of work (1989 & 1990, including a 10 year precipitation event) revealed that the only traceable contribution to sediment from Forest activities was roads Contributions were low but above most background levels of sediment in Forest streams

The professional judgment of a number of watershed specialists conclude, adverse cumulative effects have not occurred on the Forest and the potential for future cumulative effects is small. The accuracy of this estimate will be determined by monitoring. It is important that a program of road closures and rehabilitation must be persued to maintain the near pristine conditions of water quality (includes lake quality and riparian/wetland resources) which exist on the Forest today.

Mitigation Measures

The National Forest Management Act (NFMA) of 1976 requires that timber will be harvested only where watershed conditions will not be irreversibly damaged.

The most important mitigation measure designed to protect water quality is the application of Best Management Practices (BMPs) These BMPs and site specific mitigation measures, summarized in Appendix H, will be applied to all Alternatives. All streams on the Forest have been classified by beneficial use. Application of Best Management Practices should eliminate or minimize impacts to water quality. They augment Forest-wide and

Management Area standards/guidelines (Chapter 4, Forest Plan).

Mitigation measures, which include buffer strips along streams, use of designated skid trails, and specific criteria for stream crossings, are designed to achieve a high rate of success (90 percent or greater) The success of particular applications, however, varies. Unexpected or unusually severe climatic events, availability of funding and staffing, knowledge and understanding of a measure by operators and administrators are factors which can reduce effectiveness.

Mitigation after the fact is often not as effective in reducing impacts as conducting the activity in a manner which reduces or controls the impact. Ripping and tillage following harvest is seldom as effective in maintaining the hydrologic properties of a soil as is the use of designated skid trails to control the amount of an area impacted High quality roads, initially more costly, reduce overall impacts on water quality and runoff over time.

To reduce the sediment production potential in Alternatives No Change, B, C, and E, extensive and intensive mitigation measures would be incorporated in project design. This should reduce sediment production, but will increase costs. Mulching of road cuts or fills near stream crossings, repeated applications of fertilizer to vegetated roads cuts and fills, slash filter windrows below road fills, and obliteration of temporary roads following harvest activity are examples.

Much of the road construction shown in the alternative descriptions is actually relocation of *roads which now pose a high risk of contributing* sediment to streams. Although these new roads would contribute some sediment they would represent significant reductions from their poorly located predecessors. This is an important mitigation measure which is not shown as a quantitative output.

No new parallel road construction would be allowed in the streamside management unit/riparian zones of perennial streams. Extreme caution would be used in the ephemeral draws.

A very important mitigation measure which would be applied to all Alternatives is avoidance Simply put, if the risk of producing undesirable effects are too great, the project or a portion of the project, would not be implemented.

Monitoring

Monitoring serves as a check on the effectiveness of mitigation measures. It also identifies necessary adjustments in the level and type of mitigations required to meet management objectives

Evidence of cumulative effects will be tracked by monitoring at the project/watershed level. Assessment of risk and assurance of optimum distribution of timber harvest impacts among watersheds will occur. This will be driven by project and watershed level analysis. Application of Forest-wide S&Gs calls for dispersion of harvest activities because wildlife, recreation and other activities limits the number of entries and the spatial and temporal allocation of timber harvest treatments. The intent is to avoid or minimize the potential for cumulative effects.

Potential Conflicts With Plans and Policies of Other Jurisdictions

This resource discussion was coordinated with other agencies and direction is not in conflict with most management plans of adjacent landowners or agencies. Throughout the planning process, the Forest has been in contact with the Oregon State Forestry Department, Oregon Department of Fish and Wildlife, local soil conservation agencies, county planners and the Bureau of Land Management.

There is a conflict with management of streamflow in the Deschutes River by the local irrigation districts. The release schedule of local irrigation districts contributes to streambank instability on about 35% of the Deschutes River from Wickiup Reservoir to Benham Falls. Mitigation of this situation could be accomplished by future water rights legislation and/or plugging leaks in the irrigation system, therefore making this distribution system more efficient and allowing more water to be available for instream flow.

Protection of water quality and quantity on the Forest is required by the laws which created the

National Forests, by the Clean Water Act (CWA), the Federal Water Pollution Control Act (FWPCA) and amendments, and most recently by the National Forest Management Act. The FWPCA permits the States to enforce State and local water quality laws on Federal land, and the National Forest Act states that National Forest lands will be managed "to prevent detrimental changes in water flow and water quality." In addition, many Federal and State laws regulate the establishment and existence of water rights on National Forest land. The policy of the CWA is to restore and maintain clean water. Oregon has a antidegradation policy for water quality. The State of Oregon and the Forest Service entered into an agreement on the management of the water resources on National Forest lands (see Chapter 3, EIS for additional information). The agreement requires the Forest Service to apply BMPs to all activities which may impact water quality. In application of BMPs, there is a control loop which calls for designation of an activity (application of a BMP), monitoring, and finally evaluation to assure implementation did the job it was intended to do. These BMPs are incorporated into the Forest Service planning process when an Environmental Assessment is written BMPs are part of the mitigation plan or actions for any project.

Fish

Interactions

The effects of implementing each of the Alternatives on fish habitat quality are discussed in this section.

The condition of fish habitat is a reflection of the condition of wetland/riparian areas, stream channels, lakeshore health, floodplains, water quality and overall watershed condition. The capability of streams to rear trout and char is primarily influenced by four factors: 1) pool volume and depth, 2) stream flow; 3) large woody material, and 4) water temperature. The capability of lakes to rear trout, char, salmon and bass is primarily influenced by four factors: 1) water clarity; 2) water temperature; 3) residual reservoir pool volume; and 4) water quality.

To maintain good to excellent fish habitat, high water quality and good watershed management stewardship is essential. Alternatives which adversely affect water quality and watershed condition will also adversely impact fish habitat Each alternative has the potential to influence fish habitat quality. Disturbances which cause displacement of soils and channelize water can trigger erosion and cause soil to enter streams as sediment. Potential adverse effects include reduced pool volume and depth, decrease in water quality, increased sedimentation and water temperature, and reductions of available large woody material in stream channels and floodplains. There are also features in the Alternatives which could improve fish habitat

To provide a point of reference, changes in the quality of fish habitat by alternative is compared with the level of activities in Alternative A, which would continue current Forest management. Both short and long-term effects are considered using yearly averages for the first decade and fifth decade. The baseline reflects the Forest in its current physical condition and takes into account the effects of past activities, both recent and distant, and those produced by natural processes

Forest activities that have potential for adverse effects on water quality, overall watershed condition and, hence, fish habitat include timber management, the transportation system, off-highway vehicle use, recreation, and livestock grazing. Watershed and fish habitat improvements can benefit the resource.

Data sources for this analysis include resource records for the Forest, professional literature, personal communications with adjacent National Forests, and professional judgment.

Timber

Timber harvest, slash treatments, and site preparation can affect water quality and fish habitat by altering or removing vegetation, compacting or disturbing mineral soil, and changing stream channel characteristics, sediment yield and temperature (Fredriksen and Herr 1979; Hewlett and Doss 1984).

Consequences can include: 1) reduced infiltration rates and capacity; 2) water channelization, 3)

overland water flow, and 4) increased susceptibility of the soil to detachment and displacement by the impact of raindrops. Ground disturbance is the first step in a process that eventually leads to soil movement, stream sedimentation, and the degradation of fish habitat Pool volume and depth are decreased when the sediment supply exceeds the ability of streams to transport coarse sediments through the stream network. Most fish holding habitat occurs in pools greater than three feet deep. Best quality aquatic insect habitat is in clean gravels and cobbles relatively low in fine sediment.

Removal of streamside vegetation has a direct effect on water temperature with potential for increased temperatures during summer months (Brown and Krygui 1967), and for lower temperatures in winter. Less insulation provide by the streamside vegetation can increase ice formation and result in streambank damage (Chamberlin 1982; Swanson 1980). Increased water temperature also reduces the amount of oxygen that can be dissolved in water (Ruttner 1963). At higher temperatures the decomposition of organic debris (needles, leaves, branches) in streams is more rapid, which may reduce dissolved oxygen below critical levels for fish (Berry 1975). Figure 4-5 and 4-6 display the amount of timber scheduled for harvest on an annual basis for the first and fifth decade. It is assumed the greater the amount of timber harvested, the greater the ground disturbance; therefore the greater the potiential for soil movement to a water body.

Transportation System

Roads account for a majority of the sediment problems on forest. They are often the links between sediment source areas (skid trails, landings, cutslopes) and stream channels (Harr 1976; Haupt 1959; Kidd and Megahan 1972). Roads can also reduce water quality and affect fish habitat by reducing infiltration and increasing runoff. The Deschutes National Forest is a low relief landscape, exhibiting high infiltration watershed characteristics. Because of this characteristic, impacts of road construction and increased runoff on the fish resource present a low risk to adversely impact fish habitat.

Reduction in residual pool volumes, increased fines in gravels and cobble substrates, and reduction in benthic invertebrate production all result from increase in sedimentation of stream systems from roads. The impacts of transportation systems are discussed more extensively in the Water section of this Chapter. Figure 4-5 and 4-6 display the amount of road construction and reconstruction scheduled on an annual basis for the first and fifth decade. It is assumed the greater the amount of road work done, the greater the ground disturbance; therefore the greater the potiential for soil transportation to a water body.

Off-Highway-Vehicles

See the discussion under Water The same impacts addressed in the water section relate to impacts on the fish resource. Figure 4-5 and 4-6 display the amount roadless acres existing on foret on an annual basis for the first and fifth decade. It is assumed the lesser the amount of roadless acres, the greater the ground disturbance, therefore the greater the potiential for soil displacement to a water body.

Recreation

Recreation activities can affect fish habitat primarily by destroying riparian vegetation and compacting soil along streams and lake shores. Results include eroded soils and streambanks, sedimentation of the substrates and reduced water quality. Recreation development also requires access and the impacts associated with roads apply and are discussed above

Intensive recreation along streams or at lakes goes hand in hand with fishing pressure. Access roads for vehicles, campgrounds, and well maintained trails are associated with heavy fishing pressure. To maintain quality fishing in intensively fished areas, fishing regulations or supplemental planting of fish will be required. Even if these measures are taken, demand is expected to exceed supply in the most popular lakes and streams. Recreational use will continue to grow with the increase in population and leisure time. Figure 4-5 and 4-6 display the recreation use anticipated on an annual basis for the first and fifth decade. It is assumed the greater the amount of recreation use, the greater the ground disturbance; therefore the greater the potiential for soil displacement to a water body.

Livestock Grazing

Removal of vegetation and compaction (especially of moist riparian soils) by grazing animals can reduce infiltration and increase the potential for overland flow and changes in sedimentation, peak flows, and channel morphology (Anderson et al 1976; Blackburn 1983; Gebheardt and Johnson, 1981; Lusby 1970; Platts 1981; Willott and Pullar 1984. Grazing is reported to be 25 to 60 percent heavier on streambanks in riparian areas than on adjoining uplands (Nelson and Platts 1985). The concentration can lead to compaction in the surface one to two inches of soil, especially in moist riparian areas (Alderfer and Robinson 1947). Removal of streamside vegetation through over-grazing has a direct effect on stream temperature, especially on sites where coniferous shade is lacking or is insufficient and where grasses and shrubs provide a large proportion of the effective shade The streambanks are broken down by livestock as they access the stream to obtain a drink or travel along it. These streambanks are important in providing cover and stability to the fish habitat. There are 5 allotments on the Deschutes that contain riparian pastures. Problems with meeting utilization standards and adversely impacting riparian vegetation have been documented Direction to update AMPs and enfore utilization standard should improve the existing situation Figure 4-5 and 4-6 display the amount of potential grazing levels on an annual basis for the first and fifth decade. All increased are targeted for dryland range and should not impact fish habitat

Other Interactions

Mining activities can affect fish habitat by reducing water quality and increasing the potential for sedimentation Chemicals can also leach into streams from spoils or treatment processes. Little mining has occured on the Forest in the past.

Wildfire effects on water quality come about primarily through increased sedimentation and mass soil movement following the destruction of vegetation and exposure of mineral soil to increased runoff (Helvey 1980). In addition, the loss of vegetation in riparian areas exposes the water surface to increased solar radiation which directly affects water temperature (Helvey et al 1976) No adverse impacts to fish habitat from wildfire has been documented on the Deschutes National Forest

Fire suppression measures can degrade water quality (Barney and Steels 1983), as can salvage operations following a major fire (Bottom et al 1985; Cornish and Mackay 1982).

Wildernesses, unroaded areas, Research Natural Areas, and stands of old-growth timber tend toward long-term stable vegetation. In this environment, erosion and sedimentation is usually low and water quality high. Such areas, however, would not be immune to disturbance by wildfire, insect attack or other natural disasters (Anderson et al 1976) Such catastrophic events may result in a one time major impact to water quality.

Assumptions

Fish habitat quality is a reflection of the quality and quantity of streamflow, water quality, riparian wetland condition, stream channel condition, floodplain condition and overall watershed health.

Although sediment yield corresponds broadly to the amount of ground disturbed forest-wide, the relationship varies from one location to another depending on soil characteristics, the presence or absence of streams, streambank characteristics, slope, precipitation, vegetation type, and other physical and biological factors

It is assumed that the greater the magnitude of a soil disturbing activity, the greater the risk to impact watershed conditions and fish habitat quality.

Some of the potential adverse impacts in Alternatives No Change and C of timber harvest in a floodplain would be offset by soil, water or fish habitat improvement projects financed by the timber sale program. Increases in timber harvest provided increased funding for restoration and enhancement projects.

Forest-wide S&Gs will be applied to all management activities. They do disperse timber harvest activities both spatially and temporally within watersheds Visuals, wildlife, old growth, soils and riparian

area direction all disperse activities throughout the Forest, preventing the possibility that any one watershed would receive heavy impacts from multiple or large scale entries in any one decade

Timber harvest (scheduled ASQ) is not planned within 100 feet of all Class I, II, and III streams, perennial lakes and other water bodies; and all wetlands/riparian areas. Timber related activities within these zones may be performed if the goal of improvement of riparian dependent resources is persued.

Due to the increase in recreational demand, the fishing experience and fish populations can't be maintained at present levels. To maintain a quality fishery, some restrictive angling regulations will be necessary. The lake fisheries in the roadside waters are presently depressed and require supplemental plantings to provide high catch rates. Some of those waters may need regulation changes to maintain quality. The Kokanee populations are healthy and are an underutilized resource at present Future fishing pressure may shift to this and white fish to mitigate angling pressure on other salmonids.

Related ICOs

How much timber should be harvested and on what schedule?

How should the Forest provide for intensive and dispersed recreation, now and in the future?

How should the Forest manage its lakes, streams, and wetlands to prevent degradation.

To what extent should the Forest enhance or maintain soil productivity and control erosion?

Effects That Do Not Vary Between Alternatives

Certain activities which either benefit or degrade fish habitat are beyond the control of the Forest Service. The management of Crescent Lake, Crane Prairie, and Wickiup Reservoirs determines water elevations in lakes and instream flow releases below reservoirs It is based on old water rights which currently cannot be altered by the Forest Service. If the situation arose, it would be desirable to place drawdown constraints on these reservoirs and to establish an instream flow regime which would benefit (restore) fish habitat in Crescent Creek and the Deschutes River.

Stream diversions authorized by the old water rights have harmed fish habitat and the stream fisheries. Fish are lost in the diversions ditches and some reaches of stream are essentially dried up. It would be desirable to screen diversion ditches to protect the fisheries and to establish instream flow releases to restore the fishery in dried up and degraded reaches.

Geothermal, mining, the number of summer homes and resorts are not to vary by alternative. The potential for septic tank failure and petroleum spills are a real possibility (see discussion in water section). The main concern with these activities are summer homes and resorts are concentrated around water bodies; therefore, increasing the potential for adverse impacts.

Effects That Vary Between Alternatives

Figures 4-5 and 4-6 show how the factors influencing fish habitat quality would differ between management alternatives in the first and fifth decade.

Figure 4-5 Factors with the Potential to Adversely Effect Fish Habitat Quality During the First Decade

Factor	Unit of Measure	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Timber	MMCF	37 1	28.0 -25	30 6 -18	39.4 +6	22 8 -39	19.9 -46
Roads--% change	miles	66	66 0	60 -10	90 +36	69 +5	52 -22
OHV[1]--% change	M acres	145.1	145.1	138 -5	137 -6	145.1 0	145.1 0
Recreation--% change	M RVDs	1,718	1,718 0	3,024 +76	2,958 +72	3,025 +76	2,588 +50
Range--% change	M AUMs	29	29	32 +10	45 +55	32 +10	26 -10

[1]Acres not available for OHV use.

Figure 4-6 Factors with the Potential to Adversely Effect Fish Habitat Quality During the Fifth Decade

Factor	Unit of Measure	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Timber	MMCF	37.1	28.3 -24	30.4 -18	38.7 4	22.6 -39	19.9 -46
Roads--% change	miles	31 -48	31 -48	45 -21	69 +9	49 -18	28 -54
OHV[1]--% change	M acres	117.2 -19	117 3 -19	102.3 -29	66 4 -54	145.1 0	121 7 -16
Recreation--% change	M RVDs	2,592 +51	2,592 +51	4,648 +170	8,822 +414	4,710 +174	3,306 +92
Range--% change	M AUMs	29	29	45 +55	45 +55	45 +55	26 -10

[1]Acres not available for OHV use.

Direct Effects

Alternative "No Change"

Implementation of this Alternatives would maintain fish habitat quality at its current high level. Fish habitat restoration and enhancement projects will result in the recovery of some previously lost habitat. The incorporation of large woody material into streams will be emphasized to provide cover and habitat diversity. The enhancement of cover where it is lacking in roadside and backcountry lakes will also be stressed.

Timber Harvest volumes and related activities would remain the same. Entry into the lodgepole pine on the flats would dominate the first through third decades. A moderate risk to water quality and fish habitat would occur in the fourth and fifth decade as the emphasis in harvest shifts to the mixed conifer on sensitive soils (steep slopes).

Recreational development will increase slightly in the first decade and 51 percent by the fifth decade This reflects expected increases in population, which would result in 2,592 thousand recreation visitor days of recreation by the fifth decade. Increased pressure on the fish resources will require supplemental planting, reduced harvest regulations or catch and release fishing in some portions of the Forest to maintain a quality experience.

Recreational development will increase 51% over the next five decades Much of the recreation use will occur around rivers, lakes and wetlands/riparian areas. The result will be compacted soils, broken down streambanks and lakeshores and destruction of vegetation. The risk will be low to moderate that sediment movement will occur to the water bodies, reducing water quality and fish habitat. These impacts will be localized and will present a low probability of impaction to overall fish populations in streams and lakes.

Alternative A

Implementation of this alternative would maintain or improve fish habitat quality. Timber outputs would be reduced by 25%, lowering any risk of degradation to water quality and fish habitat. Fish restoration and enhancement projects will result in recovery of degraded habitat Enhancement of cover where lacking in roadside and backcountry lakes will be emphasized

Range and recreational development will be the same for this Alternative as Alternative No Change

Alternative B

There would be an increase in soil disturbance from management activities called for in Alternative B. This increase in potential sedimentation would be partially offset by an increase in funds available for fish habitat improvement. Increases in recreation and grazing would produce localized sedimentation problems. The potential for degradation of wetlands and riparian zones would also increase due to the increase in grazing.

Overall, fish habitat would be maintained at near current level but there would be localized sedimentation in streams with allotments and heavy recreational use areas

Timber impacts would be approximately the same as Alternative A. Recreation impacts would pose an moderate risk to degradation of fish habitat and water quality because of high projected increases (76% on the first and 170% by the fifth decade) in use on the Forest. Streams, lakes and wetlands/riparian areas are the attractors for people. Compaction of soils along with destruction of vegetation will occur. Mitigation measures like pulling camping units away from the water bodies and hardening these sites would reduce the risk of sediment reaching water bodies. Consequently, localized impact to fish habitat would occur but the risk would be low for overall degradation to fish habitat and fish populations in any one watershed.

Alternative C

The implementation of Alternative C would result in further increases in soil disturbance and increased sedimentation of fish habitat Many acres on the Forest would be intensively managed to produce high levels of recreation (including off-highway-vehicles), road construction, timber, and grazing. Violations of water quality standards

would occur, particularly in the ephemeral draws and the Class III and IV streams.

Floodplains and wetlands/riparian zones would be areas in which recreational use and grazing will concentrate. Stream channels would be degraded and sedimentation would be prevalent throughout the stream system. Recreational use will increase 72% in the first decade and 414% by the fifth decade. These uses concentrate on the water land interfaces, being a major attraction area for humans and animals. Compaction of soils, destruction of vegetation and the breakdown of streambanks and lakeshores will be evident. Localized water quality and fish habitat degradation will occur. There will be substantial losses of fish habitat and reductions in fish populations (salmonids and white fish) at a localized level Population viability will not be threatened but habitat capability will be reduced.

The application of Best Management Practices and fish restoration and enhancement projects would not always provide adequate mitigation. Direct, indirect and some cumulative effects would be evident and possibly measurable.

Alternative E (Preferred)

In this Alternative, recreation, off-highway-vehicles, and grazing would result in localized sedimentation of streams, particularly in the developed recreation sites and roaded areas.

Fish habitat quality would be maintained at a relatively high level but deterioration would occur in the developed recreation sites, areas where access is improved, and in wetland grazing pastures Overall impacts will be similiar as defined in Alternative B above.

Funds available for fish habitat restoration and enhancement would mitigate most of the habitat quality reduction.

Alternative G

This Alternative would maintain fish habitat and water quality on the Forest at the highest level Slight reductions in water quality over time in localized areas may occur due to increased recreation development Impacts would be localized and would not pose a threat to overall fish habitat quality or population viability.

Fish habitat restoration and enhancement projects would result in a slight net improvement in fish habitat quality.

Indirect Effects

Indirect effects can be very important and heavily influence water/riparian/fish habitat complex The essential factors are the amount of sediment reaching a watercourse and the value placed on the fish habitat of that water body Sediment can smother fish eggs and fry, smother and scour streambottom plants and aquatic organisms, cloud water which reduces fish feeding efficiency, abrade fish gills, and reduce the visual appeal of waters used for recreation Heavy recreational use can depress fish populations by overharvesting. Angling regulation may need to be adjusted to maintain a quality fishery in lakes and streams.

Cumulative

The cumulative effects are combinations of activities occurring over time. They are not expected to result in negative effects on water quality and fish habitat in any alternative except C and No Change. Impacts to stream channels can be caused by sediment increases attributable to timber harvest. They are not expected to be serious, however, because of the generally flat nature of the landscape of most activity areas, the numerous lakes which help attenuate runoff, and the spring-fed origins of most drainages.

Runoff from harvest units is primarily subsurface and enters surface waters through springs. The subsurface ground water reservoirs and numerous lakes dampen seasonal runoff events resulting in relatively stable flows throughout the year Increases in peak runoff caused by past timber harvest has been buffered by these spring-fed systems, and no evidence of excessive stream channel scour has been noted

Similarly, the potential for cumulative impacts from sedimentation from combinations of land management activities are anticipated only in

Alternative C and No Change (see discussion in the Water section to visualize Alternative C's cumulative effects) This is also due to the flat slopes and the dominance of subsurface runoff. The adoption of erosion abatement guidelines in riparian areas and the implementation of Best Management Practices for all ground disturbing activities also reduce sedimentation When erosion does occur it rarely reaches surface waters except by way of roads as a conduit. This is due to the sediment trapping effects of riparian areas and their present good health.

Roads are generally the major source of sediment entering forest streams On the Deschutes, most roads are on flat ground and a significant distance from streams. Most approach water courses only at crossings. By adopting Best Management Practices at stream crossings, potential sediment additions should be kept to a minimum.

Mitigation

Best Management Practices to protect water quality are used to maintain/protect fish habitat also. All activities which maintains a healthy watershed condition, maintain fish habitat. Application of Forest-wide standards/guidelines for Fisheries, Riparian Area Management, Water and Floodplains/ Wetlands will all provide protection for the fishing resource (see discussion under water for additional mitigation measures).

To reduce sediment production and maintain fish habitat additional mitigation measures will be incorporated Hardening campsites, pulling back from the waterbodies, no harvest in Class I, II, and III streams around lakes are but a few. Environmental assessments for projects will be used as the avenue to address specific needed mitigation measure necessary to maintain or enhance fish habitat and populations

Fish habitat restoration/improvement activities will occur under each alternative Opportunities with KV monies and an improvement target of 100 structures for fisheries per year will enhance the present condition of the fishery resource on the Forest.

Monitoring

Monitoring serves as a check on the effectiveness of mitigation measures. It identifies necessary adjustments in the level and type of mitigations required to meet management requirements.

Cumulative effects will be tracked by monitoring at the project/watershed level Assessment of risk and assurance of optimum distribution of timber harvest impacts among watersheds will occur The intent is to avoid or minimize the potential for cumulative effects. At present, the potential for cumulative effects are very slight under the Preferred Alternative (Alternative E)

Monitoring will be pursued to determine if water quality and fish habitat objectives are achieved. It will include reviews of the implementation and effectiveness of standards/guidelines, and best management practices in project work. In addition, water temperature, peak flows, aquatic insect populations, sediment levels in trout spawning sites, and trout populations will be monitored at indicator segments of all major streams Trends in fish habitat quality and channel conditions will be monitored on all major streams

Fish habitat enhancement will occur with all Alternatives Habitat surveys and management plans will be prepared for streams and lakes occupied by fish. These plans will identify habitat improvement opportunities. Each alternative calls for an increase in fish habitat improvement accomplishments

Potential Conflicts With Plans and Policies of Other Jurisdictions

This resource discussion was coordinated with other agencies and direction is in conflict between the objectives of irrigation system operators and managers of fish habitat on the Forest Direction to establish Reservoir Regulation Plans, which incorporate emphasis in maintaining good fish habitat, recreation management, a reduction in shoreline erosion, and water quality, conflicts with irrigations primary purpose of water storage.

Establishment of a flow regime for regulated/ diverted reaches of the Deschutes River, Squaw

Creek, Lake Creek, First Creek, Jack Creek, and Tumalo Creek would permit the recovery of a considerable amount of lost fish habitat. It would also conflict directly with the primary purpose of the establishment of the existing water rights. If avenues are opened in the future to address this issue, it would be desirable to mitigate some of the lost fisheries opportunities

Management Requirement/ Management Indicator Species

Introduction

The **peregrine falcon, northern bald eagle,** and **northern spotted owl** are discussed in the Endangered, Threatened, and Sensitive species section of this Chapter.

Management Requirement (MR) wildlife species are the **northern goshawk, three-toed woodpecker**, and **pine marten** Management Indicator Species (MIS) animals, in addition to the PETS and MR species listed above, include **osprey, woodpeckers, elk**, and **deer.**

Interactions

Both recreation activity at developed sites, trails, or dispersed areas, and mineral extraction activity, will have adverse effects on some very localized wildlife populations, especially for species like the goshawk and elk which are particularly sensitive to human presence Off-highway motor-vehicle use, especially during the critical periods of reproductive or winter stress, will detrimentally influence the use of habitat that would otherwise be suitable for these species.

Depending on location and extent, timber harvest can improve forage quantity and quality, or lessen security or thermal cover, for big game.

Open roads will allow greater public access to wildlife habitats. This will benefit some wildlife-associated recreation activities like hunting or bird-watching. However, it also will provide access for illegal activities like poaching, removal of raptor nestlings, and man-caused wildfire. And sensitive species like the goshawk, elk, and, to a lesser extent, deer are expected to avoid use of otherwise suitable habitat adjacent to traveled roads (Brown, 1985, Pedersen, 1978) New roads directly remove habitat area

Livestock grazing will occur on big game habitat, often simultaneously Some competition for forage and space will take place. Elk may alter their pattern of using traditional habitat with the introduction of livestock each season or in new areas.

While beneficial to target species and some others as well, wildlife habitat improvements, both structures and vegetative manipulation, will lessen or eliminate habitat suitability for still others.

Fuel-reduction will re-distribute, reduce or eliminate woody debris habitat used by many animals.

Some kinds of special-use activities will lessen or eliminate suitable habitat for some species on a small area

Other Interactions

Many species of wildlife are migratory and winter off the Forest Because land management practices outside the control of the Forest Service can also influence species viability, the relationship between local and offsite practices, and resulting population status, is often difficult to document or quantify.

The osprey, for example, winters in Mexico or Central America where pesticides banned in the United States are still used. Egg-shell thinning, a symptom of pesticide poisoning, can diminish reproductive success in local breeding habitat. Similarly, private land development takes a toll on migrating or wintering deer and elk through animal harassment and habitat loss

The quantity and quality of big game hunting recreation can vary within any established target for animal harvest. Kill quotas will be reached in a relatively short time period if animals are vulnerable

because they have few areas in which to hide. Conversely, controlling vehicle access and providing an abundance of high-quality, well-distributed hiding areas will prolong the harvest period. In this manner, the amount of recreation can be controlled by habitat conditions.

Habitat conditions similarly influence recreation quality. Generally, the best hunting recreation experience combines limited awareness of other hunters and a reasonable expectation for animal contact. An additional complication is that hunters, whether by choice or necessity, put forth varying levels of effort, as in road-hunting and backcountry packing. Therefore, habitat conditions for quality recreation must account for divergent hunter expectations.

Assumptions

Habitat availability is the limiting factor for a species. When suitable habitat is spaced and sized according to Regional standards for MR species, it is presumed that population needs for viability will be met.

Animal dispersal, whether by adults relocating from habitat loss, or by offspring looking for their first territory, will not be impeded by land management activities occurring outside of MR allocations

Habitat for MR wildlife species with the most demanding requirements will be used by other MR species with less-stringent needs To illustrate, pine marten MR sites in mixed conifer forest, spaced no more than 3-miles apart and sized at 160 acres, will also be suitable for the goshawk needing only 60 acres of nesting habitat spaced no more than 5-miles apart.

Because of the mountain pine beetle epidemic, nearly all lodgepole pine forest types have already suffered extensive mortality of trees larger than 5-inches d b h , or, they have been harvested

Pine marten habitat east of Highway 97 is marginally suitable because of the lodgepole mortality. Accordingly, no pine marten MR areas are designated there

Management areas, which emphasize resources that can simultaneously accommodate MR wildlife species needs, count as part of the MR network. For example, Spotted Owl Management Areas and Research Natural Areas (of suitable forest-type) contribute to the MR network for the pine marten.

Related ICOs

Provide habitat for viable populations of all vertebrate species currently found on the Forest, and maintain or enhance the overall quality of wildlife habitat

Protect and manage habitat for the perpetuation of plants which are listed by State or Federal agencies as threatened, endangered, or sensitive.

Preserve and provide interpretations of unique geological, biological, and cultural areas for education, scientific, and public enjoyment purposes

Provide old-growth tree stands for (1) preservation of natural genetic pools, (2) habitat for plants and wildlife species associated with over-mature tree stands, (3) contributions to the diversity spectrum, (4) aesthetic appeal.

Provide a range of quality recreation opportunities in an undeveloped forest environment.

Effects That Do Not Vary Between Alternatives

The population density of the northern goshawk, three-toed woodpecker, and pine marten in lodgepole pine forest-types will naturally decline as lodgepole pine forest-types loose suitability from beetle-kill or prior timber harvest

Naturally occurring osprey nesting habitat at Crane Prairie Reservoir will decline in quality and quantity as snags within the wetted-zone topple with age.

One woodpecker species, the black-backed woodpecker, is expected to naturally decline because beetle-killed lodgepole pine or mixed pine stands will loose suitability Since this

woodpecker is the most common primary excavator in lodgepole pine forest-types, secondary cavity-nesting species there will also decrease in population.

Effects That Vary Between Alternatives

Direct Effects

No Change Alternative

The goshawk is expected to decline dramatically because no distributional network is established. The three-toed woodpecker and pine marten would similarly plummet in population density because beetle-killed lodgepole stands would loose suitability. Osprey outside of the Crane Prairie Osprey Management Area would not be protected and are expected to diminish in numbers there with increased timber harvest. Woodpecker species in lodgepole forest types would decline to 40 percent of potential. With no protective measures for elk, distribution would be reduced. The amount of elk and deer hunting recreation would drop as harvest objectives were met in a very short time period, limiting the length of hunting opportunity.

Alternative A

The goshawk is expected to decline because timber harvest levels would still be high. The three-toed woodpecker and pine marten would similarly plummet in population density because beetle-killed lodgepole stands would loose suitability. Osprey outside of the Crane Prairie Osprey Management Area would not be protected and are expected to diminish in numbers there with increased timber harvest. Woodpecker species in lodgepole forest types would decline to 40 percent of potential. With no protective measures for elk, distribution would be reduced. The amount of elk and deer hunting recreation would drop as harvest objectives were met in a very short time period, limiting the length of hunting opportunity.

Alternative B

The goshawk is expected to decline. The three-toed woodpecker and pine marten would similarly plummet in population density because beetle-killed lodgepole stands would loose suitability. Osprey outside of the Crane Prairie Osprey Management Area would not be protected and are expected to diminish in numbers there with increased timber harvest. Woodpecker species would decline to 40 percent of potential. Elk distribution would be somewhat reduced with an increase in timber harvesting, but numbers would build with improved forage. The amount of elk and deer hunting recreation would drop as harvest objectives were met in a very short time period, limiting the length of hunting opportunity.

Alternative C

Goshawk, three-toed woodpecker, and pine marten populations will decline more with this alternative than any other because of a substantial increase in acres allocated to timber management. Osprey populations would decline because nesting habitat protection is not assured outside of the Crane Prairie Reservoir Osprey Management Area. Woodpecker populations would thin dramatically as dead-tree habitat is managed for minimum viability (20% of potential) on harvested lands.

Elk distribution would be reduced with the increase in timber harvesting. The amount of elk and deer hunting recreation would drop as harvest objectives were met in a very short time period, limiting the length of hunting opportunity.

Alternative E (Preferred)

The goshawk is expected to decline. The three-toed woodpecker and pine marten would similarly plummet in population density because beetle-killed lodgepole stands would loose suitability. Osprey outside of the Crane Prairie Osprey Management Area would be protected, and are expected to stabilize in numbers. Woodpecker populations would be 50 percent of potential Elk distribution would increase with more timber harvesting, and numbers would build slowly with improved forage. The amount of elk and deer hunting recreation will drop as harvest objectives are met in a very short time period, limiting the length of hunting opportunity.

Alternative G

The goshawk is expected to decline in lodgepole pine forests. The three-toed woodpecker and pine marten would similarly plummet in population density because beetle-killed lodgepole stands would loose suitability. Osprey would stabilize at existing numbers. Woodpecker species would be at the highest level of any alternative, 80 percent of potential. Elk distribution would increase with timber harvesting providing improved forage and cover well distributed. The amount of elk and deer hunting recreation would stabilize or even increase.

Cumulative Effects

Except for situations involving PETS species and big game on winter range, no compensation on National Forest land for the activities of adjacent landowners is planned. The Forest contains relatively little private-land which is in checkerboard parcels Thus, the combination of activities on Forest Service and other ownerships is not expected to be significant

Monitoring

Monitoring is especially desirable for species with relatively little localized habitat-use information available, like the pine marten, goshawk, three-toed woodpecker, and other woodpecker species.

Potential Conflicts With Plans and Policies of Other Jurisdictions

There are no known conflicts with other jurisdictions. A close relationship with the Oregon Department of Fish and Wildlife is required to effectively respond to big game habitat changes brought about by the mountain pine beetle or conflicting land management practices. Changes in big game hunting season regulations or human access could be required in some areas.

Coordination, or at least information-sharing, between the Forest and adjacent landowners is equally important for optimum big game management.

Literature Cited:

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Pedersen, R H. 1978. Management and impacts of roads in relation to elk populations. In: Proceedings of Recreation Impact on Wildlands Conference, Univ. of Washington, Seattle. Pg. 169-173.

Endangered, Threatened, and Sensitive Plants and Animals

Introduction

There are 33 Proposed, Endangered, Threatened, and Sensitive (PETS) species known or suspected to occur on the Deschutes National Forest. Of these, 3 have been listed, or are proposed for listing, by the USDI Fish and Wildlife Service. They are the American peregrine falcon (endangered), northern bald eagle (threatened), and northern spotted owl (threatened).

In addition to the above species, the Regional Forester has also designated as Sensitive 3 invertebrates, 2 fish, 3 birds, 3 mammals, and 19 plants (FSM 2670, R-6 Interim Directive No. 6, dated August 15, 1989) These are, respectively:

Alsea micro caddisfly
Cascades apatanian caddisfly
Klamath limnephilan caddisfly
Redband trout
Bull trout
American white pelican[1]
Ferruginous hawk
Western sage grouse[1]
Greater sandhill crane
Long-billed curlew
Preble's shrew[1]
Pacific western big-eared bat
Pygmy rabbit[2]
California wolverine
Agoseris elata
Allium campanulatum
Arnica viscosa
Artemisia ludoviciana spp *estesii*
Aster gormanii
Astragalus peckii
Botrychium pumicola
Calochortus longebarbatus var. *longebarbatus*
Campanula scabrella
Castilleja chlorotica
Cymopterus bipinnatus
Draba aureola
Gentiana newberryi
Hieracium bolanderi
Lobelia dortmanna
Lycopodium annotinum
Mimulus jepsonii
Ophioglossum vulgatum
Penstemon peckii

[1]Labeled incorrectly as *not* being documented or suspected on the Forest.

[2]Labeled incorrectly for this Forest because the species is not Sensitive in the state of Oregon.

Discussion concerning fish species is located in the Fish sections of this FEIS (Chapters 3 & 4)

Interactions

The presence of humans, especially during the stressful periods of reproduction and winter, and/or the alteration of habitat, are the two primary concerns for PETS species protection.

Recreational activity is greatest during the summer; with the start of the fishing and hiking season, and the onset of bird reproduction, regularly coinciding. For sensitive animal species like the peregrine falcon, bald eagle, and western big-eared bat, human disturbance during harsh winter weather forces energy-robbing flight, movement to thermally-undesirable conditions, or disruption of essential foraging activity.

It is expensive, and sometimes nearly impossible, to traverse every square foot of ground in the search for PETS species or habitat--especially in extensive project areas. Furthermore, the season when some PETS plant species are recognizable in the field may be as short as a few weeks. These problems elevate the risk of oversight in finding all occurring species or populations.

The environment in caves like those used by the western big-eared bat can be changed by timber harvest or other vegetative manipulation around cave openings.

Open roads allow easier public access into PETS species habitat, increasing their vulnerability to such illegal activities as poaching and man-caused wildfire New roads directly remove habitat area.

Livestock grazing can damage populations of Sensitive plant species through consumption or trampling of above-ground foliage, tearing of root-systems, and soil compaction.

Without modification, some range or wildlife habitat improvements can lessen or eliminate habitat suitability for some PETS animals, and damage or destroy susceptible plants Similarly, fuel-reduction projects, and special-use activities that introduce or increase human presence, or disturb ground vegetation, can lessen or eliminate habitat suitability.

Other Interactions

A few species of wildlife are migratory and winter off the Forest, or have extensive home ranges that include a significant amount of non-Forest Service land. Because land management practices outside the control of the Forest Service can also influence species viability, the relationship between local and offsite practices, and resulting population status, is often difficult to assess or quantify

For example, the population of greater sandhill cranes that breeds or summers on the Deschutes National Forest winters in California's Central Valley (Stern, et al, 1987). Of the known Oregon breeding population in 1986, 74 percent nested on private lands The American white pelican may fly 150 miles from nesting colony to feeding area (National Geographic Society, 1983).

Macroclimate conditions at the time of establishment for existing populations of Sensitive plants may be impossible to duplicate.

Assumptions

Habitat availability is the limiting factor for a species. When suitable habitat is spaced and sized according to Recovery Plans or Regional standards for MR species, it is presumed that population needs for viability and recovery will be met.

Animal dispersal, whether by adults relocating from habitat loss, or by offspring looking for their first territory, will not be impeded by land management activities occurring outside of designated management areas or MR allocations.

Because of the mountain pine beetle epidemic, nearly all lodgepole pine forest types have already suffered extensive mortality of trees larger than 5-inches d.b.h , or been harvested.

Related ICOs

Provide habitat for viable populations of all vertebrate species currently found on the Forest, and maintain or enhance the overall quality of wildlife habitat.

Protect and manage habitat for the perpetuation of plants which are listed by State or Federal agencies as threatened, endangered, or sensitive.

Preserve and provide interpretations of unique geological, biological, and cultural areas for education, scientific, and public enjoyment purposes.

Provide old-growth tree stands for (1) preservation of natural genetic pools, (2) habitat for plants and wildlife species associated with over-mature tree stands, (3) contributions to the diversity spectrum, (4) aesthetic appeal.

Effects That Do Not Vary Between Alternatives

Protection for any Federally-listed species is required by the Endangered Species Act Except for the No Change Alternative, the northern spotted owl would have suitable habitat of sufficient distribution and area to maintain viable populations as determined by the 1989 Supplemental Environmental Impact Statement for the Regional Guides. Habitat for the California wolverine will be protected because nearly all suitable habitat occurs in designated Wilderness' or the Oregon Cascades Recreation Area.

Effects That Vary Between Alternatives

Direct Effects

No Change Alternative

Species viability is not assured with this alternative The arrangement and size of habitat areas for the northern spotted owl would be inadequate for their long-term survival. Sensitive plant species populations in areas of timber harvest, livestock grazing, concentrated recreation, or range and wildlife habitat improvement projects would not be protected if doing so resulted in diminished wood yields or other resource objectives. Thus, species like *Penstemon peckii*, *Mimulus jepsonii*, and several others would be jeopardized. The western big-eared bat would similarly be vulnerable from uncontrolled recreation at inhabited caves, and would decline in numbers and distribution.

Alternative A

Sensitive species of animals and plants would be protected at viable populations as required by the National Forest Management Act. Some species like the pelican and sage grouse would remain at existing numbers because timber harvest, livestock grazing, dispersed recreation, and range or wildlife improvements would not affect their habitat.

Some Sensitive plant populations in areas of timber harvest, livestock grazing, concentrated recreation, or range and wildlife habitat improvement projects would not be protected if doing so resulted in diminished wood yields or other resource objectives.

Alternative B

Sensitive species of animals and plants would be protected at viable populations as required by law. Some Sensitive plant populations in areas of timber harvest, livestock grazing, concentrated recreation, or range and big game habitat improvement projects would not always be protected if doing so resulted in diminished wood-yield or other resource objectives.

Alternative C

Sensitive species of animals and plants would be protected at viable populations. However, some Sensitive plant populations in areas of increased timber harvest, livestock grazing, concentrated recreation, or range and big game habitat improvement projects would not always be protected if doing so resulted in diminished wood-yield or other emphasized resource objectives

Alternative E (Preferred)

Sensitive animals, overall, would increase in population and distribution because of protective standards/guidelines. Sensitive species of plants would be protected at existing, or slightly reduced, population levels and distribution Species of especially infrequent distribution or low numbers would almost always be protected However, less vulnerable species occasionally may be compromised so long as the need for listing was avoided and species viability maintained

Alternative G

Known populations of sensitive species would be protected Some species like the pelican and sage grouse would remain at existing numbers because timber harvest, livestock grazing, dispersed recreation, and range or wildlife improvements would not affect their habitat. Habitat improvement funding would benefit many others however

Unavailable Information

Relatively little knowledge is available concerning the habitat relationships for several of these species, especially the invertebrates and plants.

Monitoring

Monitoring activities that require the presence of humans in close proximity to sensitive wildlife could itself be detrimental without precautions.

Identification of the major prey species, and their importance to bald eagles, during the nesting and wintering periods, would increase the effective-

ness of planned management. Also valuable to know is how nesting bald eagles respond to chemical treatment of waters for fish control or management

Potential Conflicts with Plans & Policies of Other Jurisdictions

The U.S. Fish and Wildlife Service has formally consulted regarding proposed management strategies for listed species identified in the Draft Plan. Their April 7,1982 Biological Opinion concluded that conservation of the bald eagle and peregrine falcon would be promoted with implementation of the proposed plan. The Final Plan does not differ significantly from the Draft, so another Formal Consultation was not necessary.

To assure protection from "May Affect" activities on National Forest land, coordination with adjacent landowners supporting Federally-listed or proposed species will be initiated

Literature Cited·

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Stern, Mark, Carroll D. Littlefield, and Geoff Pampush. 1987 The status and distribution of greater sandhill cranes in Oregon, 1986. The Nature Conservancy, Portland, OR. 18 pp.

Other Wildlife and Animal Diversity

Introduction

Certain kinds of habitats are considered special or unique because of their scarcity or irreplaceability (Thomas, 1979) Among these are seeps and springs, "edge", snags, fallen trees and other woody debris, cliffs, talus, and caves

Environmental effects associated with seeps and springs are described under the "riparian" resource.

Animal diversity refers to the distribution and abundance of different animal communities and species within the area covered by this Plan

Interactions

Habitat conditions favoring one group of species may be unsuitable for yet other species

As a general rule, the value of "edge" for wildlife habitat is a function of the area and contrast of opposing sides, large blocks being better than small, and stark contrast better than minimal.

Snag use by animals, and snag standing life, both depend on tree species, diameter, height, hardness, and surrounding environment. Ponderosa pine is preferred over incense-cedar, but may rot and topple sooner Large-diameter trees provide more area for nest-chamber development, and resist better the forces of wind and gravity, than thinner trees. Tall trees provide more surface area for habitat than shorter ones, but that surface also increases wind exposure. New or charred snags are often too hard for woodpeckers to excavate until sapwood or heartwood rot begins A snag surrounded by forest canopy will be used by different animal species, and stand longer, than one in an opening.

Animal use, and longevity of fallen trees, snags, and other woody debris, are affected similarly by the characteristics mentioned for snags

The environment of caves is affected by temperature, humidity, light, and air quality. Animal use, especially by bats, is also influenced by the presence of humans. Environmental changes around cave vents can alter the quality of air entering the cave, as well as modify foraging suitability for exiting bats

The presence of humans, especially during the already-stressful periods of reproduction and winter, causes many animals to use energy reserves fleeing the disturbance, or avoid habitat that would otherwise be suitable. Raptors, except those species nesting in tree-cavities, are especially sensitive to human encroachment

Open roads will allow greater public access to wildlife habitats. This will benefit some wildlife-associated recreation like hunting and bird-watching. Conversely, it eases access for illegal activities like poaching, removal of raptor nestlings, and man-caused wildfire. New roads directly remove habitat area.

Timber harvest and special use activities introduce human disturbance and modify vegetation.

Livestock grazing consumes or tramples concealing vegetation for ground-nesting birds or rodents

Fuel reduction will re-distribute, reduce, or eliminate woody debris habitat used by many species.

Range or wildlife habitat enhancement projects can modify vegetative structure or composition. For example, prescribed burning to stimulate shrub sprouting could consume fallen trees, snags, and other woody debris. Planting of aspen or cottonwood might introduce these species to a site.

Other Interactions

Many species of wildlife, especially birds, are migratory and spend part of the year off the Forest, or have extensive home ranges that include a significant amount of non-Forest Service land. Because land management practices outside the control of the Forest Service can also influence species viability, the relationship between local and offsite practices, and resulting population status, is often difficult to assess or quantify.

Cavity-nesting birds, most of which are insectivorous, and ants, are known to lengthen the time intervals between which forest insect pests explode to epidemic proportions.

Assumptions

Habitat availability is the limiting factor for a species.

Animal dispersal will not be impeded by land management activities occurring outside of suitable habitat.

Because of the mountain pine beetle epidemic, nearly all lodgepole pine forest types have already suffered extensive mortality of trees larger than 5-inches d.b.h., or been harvested.

Related ICOs

Provide habitat for viable populations of all vertebrate species currently found on the Forest, and maintain or enhance the overall quality of wildlife habitat.

Preserve and provide interpretation of unique geological, biological, and cultural areas for education, scientific, and public enjoyment purposes.

Provide old growth tree stands for (1) preservation of natural genetic pools, (2) habitat for plants and wildlife species associated with over-mature tree stands, (3) contributions to the diversity spectrum, (4) aesthetic appeal.

Provide a range of quality recreation opportunities in an undeveloped forest environment.

Effects That Do Not Vary Between Alternatives

Wildlife habitat associated with cliffs, rock outcrops, and talus are not expected to change between alternatives

The only two known great blue heron nesting colonies on the Forest will be protected.

Effects That Vary Between Between Alternatives

Direct Effects

No Change Alternative

Raptors, especially forest species like the accipiter hawks and great gray owl, will not be protected in this alternative and would decline precipitously with timber harvest Without protection, species

associated with dead woody debris would similarly thin in numbers because harvesting would salvage merchantable wood and fuel treatment would alter remaining material. Cavity nesting species would decline in lodgepole forest types to 40 percent of potential

Species favoring "edge" would prosper with increased timber harvest Game species like the blue and ruffed grouse would correspondingly increase. Species associated with early successional stages will increase slightly over existing levels.

Alternative A

Raptors, especially forest species like the accipiter hawks and great gray owl, would decline with timber harvest. Viable populations would be maintained Species associated with dead woody debris and snags would similarly thin in numbers, but remain viable, because harvesting would salvage merchantable wood and fuel treatment would alter remaining material. Cavity nesting species would fare similarly to the No Change Alternative

Species favoring "edge" would prosper with increased timber harvest Game species like the blue and ruffed grouse would increase. Species associated with early successional stages will increase over existing levels.

Alternative B

Raptors, especially forest species like the accipiter hawks and great gray owl, will decline in numbers and distribution with increased emphasis on market products like timber. Without protection, species associated with dead woody debris and snags would similarly thin in numbers because harvesting would salvage merchantable wood and fuel treatment would alter remaining material Cavity nesting species would decline to 40 percent of potential.

Species favoring "edge" would prosper with increased timber harvest Game species like the blue and ruffed grouse would benefit. Species associated with early successional stages will increase significantly over existing levels, with about double the amount of that type produced.

Alternative C

Raptors like the accipiter hawks and great gray owl will decline in numbers and distribution with increased emphasis on market products like timber. Without protection, species associated with dead woody debris and snags would similarly thin in numbers because harvesting would salvage merchantable wood and fuel treatment would alter remaining material. Cavity nesting species would decline to the lowest density for viability - 20 percent of potential.

Species favoring "edge" would prosper with increased timber harvest Game species like the blue and ruffed grouse would benefit. Species associated with early successional stages will increase, with more than two-fold acres expected in this condition

Alternative E (Preferred)

Raptors, especially forest species like the accipiter hawks, will decline below existing numbers Species associated with dead woody debris would stay at approximately existing levels. Cavity nesting species would diminish in numbers, especially in mixed conifer forest where even-aged forest management prescriptions would provide habitat for 40% of potential. Forest-wide, approximately 50% of potential is the expected average.

Species favoring "edge" would prosper with increased timber harvest Game species like the blue and ruffed grouse would benefit. Species associated with early successional stages will increase with slightly less than double the acres of this type produced

Alternative G

Raptors like the accipiter hawks and great gray owl would decline only slightly due to the loss of lodgepole pine forest suitability Species associated with dead woody debris and snags would remain stable in numbers, except in lodgepole forests where future snags would not be available for several decades

The amount of "edge" will diminish with less timber harvest. Game species like the blue and ruffed grouse would remain at approximately existing

numbers Species associated with early successional stages will increase slightly.

Monitoring

Monitoring of the Cooper's hawk and sharp-shinned hawk would document population declines produced by unfavorable forest management activities. Monitoring activities themselves could be disturbing to cave-dwelling bats.

Cumulative Effects

Habitat diversity will increase over present conditions as clearcut stands from previous timber harvest mature to young forest, and as new openings are created. Stand thinning from mountain pine beetle mortality on private land will increase the proportion of early successional stages in all Alternatives Alternatives A and G will see the least effects. Alternative E will see accelerated changes in early successional stages over present conditions, just slightly less than double. Alternative B will double the proportion, and Alternative C will increase by 2 1/2 times the early seral conditions because of extensive areas devoted to timber production

Unavailable Information

Habitat relationships are little understood for dozens of wildlife species found on the Forest This is especially the case for nongame species like the reptiles, amphibians, bats, rodents, and passerine birds.

The effect of habitat loss in adjacent areas of the State, in combination with local losses, is unknown.

Wilderness

Introduction

The environmental qualities of naturalness and solitude will continue to characterize designated Wilderness, although as a consequence of implementing any of the proposed alternatives there will continue to provide a range of recreation opportunities that interweave the physical and biological features of water, air, soil, geology, vegetation, fish and wildlife with particular social factors such as isolation, remoteness and personal challenge.

The Wilderness Act of 1964 states that Wilderness is to be managed in such a manner "devoted to the public purposes of recreational, scenic, scientific, educational, conservation and historical use"·only to the extent that the essential wilderness character of the area is protected. Managers are faced, therefore, with the problem of accommodating human use yet preserving an area's wilderness quality

Given that any use of the environment produces at least some impacts, managers must identify where, and to what extent, vareying degrees of change are appropriate and acceptable within wilderness settings. This is accomplished through the use of the Wilderness Resource Spectrum (WRS) system. Wilderness settings are characterized within the WRS as Pristine, Primitive, Semiprimitive and Transition classes.

Changes in WRS classifications result primarily from resource conditions affected by the amount and type of user activities and the inside of designated Wilderness. Although activities, such as timber harvest, can cause localized effects near wilderness boundaries, the most significant effects on wilderness settings are relative to access and the amount and type of recreation use that a particular area receives.

Roads provide access to wilderness settings, and trails facilitate and organize recreation use within designated Wilderness. Trails allow people to take advantage of primitive and un-confined types of recreation opportunities. An extensive trail system can result in fewer contacts between users but could cause increased effects to physical and biological aspects of the environment. Increased access can also cause overuse of desirable campsites and attractions. For example, pack and saddle users outfitters and guides may introduce large groups to some wilderness settings, affecting the solitude and isolation of individuals or smaller groups of users.

Elsewhere within Forest Wilderness there are places where few people visit and natural conditions remain undisturbed The Pristine WRS classification would apply to these undisturbed areas. Between these opposing ends of the WRS are the Primitive and Semiprimitive classes, which apply to the intermediate conditions of use resource quality of wilderness.

Interactions

Fire plays an important role in the development of ecosystems. Periodic fires reduce the risk of a catastrophic, high intensity fire and reduce the risk of insect and disease epidemics which can adversely affect resources inside and outside of the wilderness

Air quality in the wilderness is determined by how much, where, when, and what type of pollutants are emitted from sources outside of the Wilderness With four wildernesses having Class I air-sheds, it is necessary to be aware of all elements that may affect the wilderness air quality.

Assumptions

It is assumed that each wilderness has a limited capacity for recreation use Further, it is assumed that as more people use the wilderness the impacts will also increase (more litter, human waste, increase in compacted bare ground, and a reduction in water quality)

As more management activities take place adjacent to the wilderness, there will be increased access, increased opportunities for motorized and mechanized vehicle trespassing, and an increase in noise from commercial and nonwilderness recreation activities As use increases, impacts will also increase and the opportunities for solitude and remoteness begin to diminish.

As the local population grows, it is anticipated that use will continue to increase, regardless of which alternative is chosen.

Some portions of the Mt. Jefferson, Mt. Washington, Three Sisters, and Diamond Peak Wildernesses are currently at or exceeding "limits of acceptable change" standards during part of the year.

Fire may have to be introduced into parts of the wilderness where the natural process is out of balance and there is potential for a catastrophic event (fire, insect or disease epidemic) that could adversely impact resources inside and/or outside of the wilderness.

Clean air is an integral resource of the wilderness and an assumed characteristic of a wilderness experience. It is assumed that management activities on the Forest which reduce air quality, primarily slash burning, will not negatively impact air quality in the Class I air-sheds This assumption is made because of the standards/guidelines which will be applied to slash burning activities (see Chapter 4, Forest Plan). Air quality impacts on the Class I air-sheds will come primarily from forest, agricultural, and industrial activities west of the Cascades. Additional impacts can occur from wildfire occurrences inside or outside the air-sheds and any fire that is used to meet management objectives inside the wilderness.

It is assumed that the trail system in the wilderness is generally in place. New trails will be constructed only if it is necessary to eliminate sections of trail that are causing resource problems.

Related ICOs

Consideration of economies, lifestyles, and population levels in managing Forest lands

How much timber should be harvested and on what schedule?

How should the Forest meet an expanding demand for dispersed recreation?

How should the Forest manage its lakes, streams, and wetlands to prevent degradation?

Effects That Do Not Vary Between Alternatives

It is assumed that recreation use will increase in all Alternatives. It may be necessary to limit the

number of people using a wilderness at any one time or to manage behavior of users more intensely

Activities that can have major adverse impacts on the qualities of the wilderness include timber management, the transportation system, recreation, grazing, mining, and fisheries projects.

Timber

Adjacent timber management activities can affect both the user and administrators of the wilderness. Timber harvest impacts administrators by creating additional and closer access Consequences of better access will usually be detrimental. Additional and closer access may draw more people into the Wilderness and it increases the risk of additional Wilderness Use Violations such as mechanized vehicle use and others. The direct impact to the user is increased noise from management activities and the reduced quality of experience of traveling to a wilderness. Depending on the intensity of the harvest activity, the transition between wilderness and nonwilderness may be abrupt. The sense of getting further and further from man's influence will be lost Alternatives NC, A, B, and C would create the greatest external empacts on Wilderness and Alternatives E and G the least.

Harvest activities can also affect wildlife species which utilize habitats both inside and outside of the wilderness

Transportation System

Further development of the transportation system is often a result of timber management activities. Depending on how the transportation system is managed, additional access close to wilderness boundaries may be managed at acceptable levels. Even though roads may be closed, they often continue to be used by OHVs and mountain bikes, which increases the risk of wilderness (use violations) trespassing. The effects of the alternatives as discussed in the previous paragraph on timber would be the same for the transportation system.

Recreation

Recreation activities which take place outside and inside of wilderness can have a major impact on wilderness qualities. For example, if motorized use is permitted close to the wilderness, the wilderness user may have to travel much farther to find solitude Providing more recreation opportunities outside of the wilderness may result in less people using the wilderness.

The consequences of exceeding a wilderness' carrying capacity can be environmental and/or social Environmental effects can be the interruption or alteration of natural processes, reduction of water quality, soil compaction, etc Social impacts can be losing the sense of remoteness, a reduced opportunity for solitude, a reduction in challenge, etc.

Mining

Mining creates many of the same effects as the previously mentioned activities and, depending on the type of operation, the magnitude of the impacts can be much greater Mining requires access, creates noise, creates impacts that are often irreversible, and generally requires construction of structures and use of motorized equipment.

Consequences from mining vary greatly depending on the operation. Thus, the wilderness values and the magnitude of impact would also vary

Mining in the past and the present, has had minimal impact on the wildernesses associated with the Forest. Geothermal exploration and development along the perimeter has the greatest potential for long and short-term impacts, primarily noise, odors, and year-round accessibility.

Grazing

Generally, grazing does not characterize wilderness values. In cases where grazing was an established use prior to the enactment of Wilderness Legislation, Congress recognized grazing as an acceptable practice.

Consequences from grazing can include trampling of vegetation (exposed soil), reduction in water quality, and loss of riparian habitat. The affect of having domestic animals or seeing evidence of their presence in the Wilderness diminishes the quality of the wilderness experience for some people.

Fisheries Projects

The Oregon Department of Fish and Wildlife routinely stock many of the wilderness lakes Providing good fisheries attracts users and concentrates use, which in turn creates impacts. Resulting impacts can be new trails created by users, destruction of riparian vegetation, litter, soil compaction, human waste problems, and others.

Creation of good fisheries in the Wilderness can attract people for enjoyment of fishing only, rather than an overall wilderness experience.

Other Direct Effects

Large catastrophic fires affect successional cycles of vegetation, reduce visual quality, and increase soil movement

Fire suppression activities impact the wilderness by creating additional evidence of human presence.

Insect and disease epidemics can have a greater impact on resources outside of the wilderness than inside the wilderness.

Effects That Vary Between Alternatives

Alternatives A, B, and E

The impacts to wilderness would be very similar for these three alternatives. Pressures on wilderness use would continue to increase as the Forest continues to be managed and used intensively. It will become increasingly difficult to meet wilderness management objectives Limiting use will be a major consideration in the first decade. Unauthorized wilderness uses would gradually increase.

Impacts from management activities outside the wilderness would not increase or decrease significantly from what they are today.

Alternative C

This Alternative will have the greatest impact on wilderness The wilderness will be the primary source for dispersed recreation. In order to accommodate the increased use, much of the wilderness would have to be rezoned. This change would further degrade the wilderness.

Management activities outside of wilderness would greatly impact wilderness qualities regarding noise, the visibility of management activities, and access. It would also greatly reduce nonwilderness dispersed recreation opportunities

Limiting use in the first decade would have the highest probability under this Alternative.

Unauthorized use of the Wilderness would increase much more rapidly.

Alternative G

Of the Alternatives, this one would have the least impact on wilderness. Increased use in wilderness will continue, but at a lesser pace than the other alternatives. There will be opportunities to expand dispersed recreation outside of wilderness.

Impacts from external activities will be less than the other alternatives

Cumulative Effects

In general there are three groups of cumulative effects on Wilderness that may occur.

1. As roadless areas are developed and roaded the loss of primitive recreation opportunities they have provided could displace use to remaining roadless areas and Wilderness

2. Construction of new roads in the proximity of Wilderness boundaries allows easier access for users. This increases the difficulty of managing to protect natural conditions and processes in Wilderness and to maintain opportunities for solitude. As adjacent roadless areas and other lands are roaded and developed the noise from developmental activities and their visibility from within Wilderness increases and diminishes the quality of the experience.

3. A variety of cumulative effects may occur particularly with Alternatives requiring higher timber outputs and more roadbuilding. These effects may include greater deposition of airborne pollu-

tants in wilderness, reduced air quality, increased noise pollution, and reduction of certain types of wildlife habitat outside Wilderness (and therefore greater dependance on Wilderness) may reduce substitutable types recreation opportunities (those dependent on near-Wilderness conditions.

Mitigation Measures

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 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) will be an effective way to monitor the effects of use in the wilderness and to change recreation use patterns when limits are exceeded.

A wide range of management techniques will be explored to mitigate adverse impacts (see Standards/Guidelines, Chapter 4, Forest Plan) and individual Wilderness Management Plans in Appendix 4 of the Forest Plan.

Use will be limited in the wilderness when it has been determined that other management techniques have been unsuccessful in mitigating past impacts on preventing impacts or the loss of solitude.

Slash burning will be done under conditions that will not put smoke into Class I Air-Sheds.

Monitoring

Monitoring will be conducted on an ongoing basis to determine the effectiveness of standards/ guidelines

Air quality in Class I air-sheds will be monitored to identify impacts on air quality related values for each wilderness.

Those organisms or micro-organisms most susceptible to pollutants will be the basis for establishing baseline monitoring standards.

Because wilderness use would continue to increase, use may have to be limited late in the first decade

Potential Conflicts with Plans & Policies of Other Jurisdictions

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There are no known conflicts with other jurisdictions. The agency will coordinate with other government agencies and the State in monitoring air quality. The Forest has coordinated with other National Forests to create management plans for wilderness areas that cover more than one Forest. Appendix 4 of the Forest Plan contains these area plan

Wild and Scenic Rivers

Introduction

The Wild and Scenic Rivers Act of 1968 established a method for providing federal protection for certain of our remaining free-flowing rivers, and preserving them and their immediate environments for the use and enjoyment of present and future generations Rivers are included in the system so that they may benefit from protective management and control of development for which the Act provides.

Since the DEIS was published in 1986, the Omnibus Oregon Wild and Scenic River Act has added segments of six streams on the Forest to the Wild and Scenic River System. At this time Segments of the Deschutes River, Metolius River, Squaw Creek, Crescent Creek, Big Marsh Creek, and Little Deschutes River are designated Wild and Scenic Rivers. These streams are shown on a map on page 3-?? and descriptions follow Portions of the Deschutes and Metolius Rivers have also

been designated as State Scenic Waterways. In addition all or portions of five additional streams have been determined to be eligible for Wild and Scenic River status. Those streams include the headwaters of the Deschutes River, Fall River, Browns Creek, Paulina Creek, and Jack Creek. These streams are shown on a map on page D-2 of appendix D and descriptions of each stream are found in Table III and subsequent text of Appendix D

Interactions

The setting of a wild and scenic river provides for a wide range of recreational opportunities which are enhanced by the river's free-flowing condition and "outstandingly remarkable" values and the quality of its surrounding environment. Activities that could affect river values include timber harvest, road and bridge construction, prospecting and mineral extraction, geothermal development, expansion of hydroelectric generating facilities, and development of private land in the area. Environmental changes in river corridors resulting from these activities could limit a rivers future consideration for inclusion into the National Wild and Scenic Rivers system.

Assumptions

Demands for the use of river related resources to enhance the quality of life for future generations will continue to increase as populations grow.

Management plans will be developed for each designated river in the near future that will protect or enhance the values for which the river was deemed to be of wild and scenic quality.

Interim protection provided in all alternatives for designated rivers will be adequate to preserve the important river values until final management plans are completed.

Interim protection provided in the Preferred Alternative for rivers determined to be eligible for W&SR status will provide adequate protection for the river values identified until such time as suitability studies can be completed and subsequent recommendations can be made to Congress for including or not including these streams in the Wild and Scenic River System.

Related ICO's

Timber harvest levels or ASQ

Ability of the Forest to provide both developed and dispersed recreation capacity

Effects That Do Not Vary Between Alternatives

The location and extent of the effects of the alternatives on designated river values is relative to the particular management areas applied to river corridors. In the case of the six designated rivers all alternatives specify measures to preserve free-flowing conditions, and protect "outstandingly remarkable" scenic, recreational, geologic, fish, wildlife, historical/cultural, biological and ecological values. These standards and guidelines have a high likleyhood of protecting river values until such time as management plans for the river are completed Since all alternatives have the same standards and guidelines for each designated river the effects of the alternatives on river values do not vary.

Effects That Do Vary Between Alternatives

Direct and Indirect Effects

In the case of rivers determined to be eligible for Wild and Scenic River Status only Alternative E (preferred) provides specific measures to preserve free-flowing conditions, and protect "outstandingly remarkable" values of each of these rivers. Eligible rivers in any other alternative would only be protected by riparian guidelines or to the extent that a scenic or recreation designation might incidentally overlap the stream corridor Eligible rivers would be more heavily impacted by those alternatives that provide high commodity outputs, such as Alternatives B and C, and impacted to a lessor extent by alternatives that provide more

recreation and scenic outputs, such as Alternative G.

Through the interim protection of river values provided both designated and potential Wild and Scenic Rivers in the preferred alternative, corridors would be managed to provide opportunities for a broad range of river oriented recreation activities such as boating, rafting, fishing hiking and camping Other activities, including road construction or timber harvest would be permitted within these corridors providing that such activities would not lower a rivers potential W&SR classification or affect it's eligibility for inclusion into the National System Campsites within these river corridors would remain accessible from existing roads and other improvements within these corridors, such as signing and parking areas, when planned would be designed to enhance user experience and protect resources in accordance with the requirements of the Wild and Scenic River Act. Construction of dams and development of a river's hydroelectric potential would not be permitted in any alternative for designated rivers and in alternative E for eligible rivers This protection would be extended until a river has been determined unsuitable for W&SR status.

Cumulative Effects

Although immediate corridors of designated rivers are protected with standards and guidelines there is the potential that river values could be negatively impacted over the long-term by increased flows, sedimentation, and harvest activities immediately adjacent to river corridors that may result from the choice of alternatives that produce high commodity outputs. Conversely river values are not likely to be impacted at all over the long-term by the choice of alternatives that emphasize recreation, backcountry and scenic outputs Although demand for recreation river experiences may increase, as natural settings are altered the opportunity for the Forest to provide wild and scenic river settings would be diminished or forgone.

Mitigation Measures

The designation of a stream into the National Wild and Scenic Rivers System has the potential to increase levels of recreation use and subsequent effects on river environments To prevent degradation of resources and maintain the quality of recreation experiences, management plans will provide for the establishment of carrying capacities for managing use levels and mitigating effects. The effects of crowding on campsites and trail systems can be reduced by substituting facilities and dispersing recreation use. Access to river corridors, provided by the construction and maintenance of signs and trails, will govern the location and degree of effects to these areas from public use.

Potential Conflicts With Other Jurisdictions

Designation of eligible rivers included into the National Wild and Scenic Rivers system could affect private land use and development. Effects would include compliance with county zoning regulations as well as stipulations of scenic easements. Stipulation may limit vegetation management practices, and establish requirements regarding maintenance and development of private lands. Geothermal resource use and development on private land could be subject to additional constraints similar to those constraining geothermal development on public land. Cooperative efforts will be required with various county planning agencies as participants in the river management planning process.

The current objectives of the Oregon State Scenic Waterways System are not in conflict with the effects of any of the proposed alternatives. The Deschutes and Metolius Rivers are included in the State Scenic Waterways System Continuing coordination with the Oregon State Parks Division and the Oregon State Marine Board will be conducted to assure compliance with State regulations for access, use and management of designated rivers In addition, cooperative efforts will continue with these and other agencies of the state as participants in the development of river management plans for designated Wild and Scenic Rivers on the Forest.

A significant portion of the Metolius Wild and Scenic River boarders the Warm Springs Indian Reservation making the Confederated Tribes of the Warms Springs a partner in developing a management plan for that river. Many of the river corridors on the Forest were important as cultural sites and food gathering areas to many of the Central Oregon native americans and as such consultation is required with these groups as management plans are developed.

Unavailable Information

All essential information was available for assessing W&SR eligibility of Forest Rivers.

Transportation

Introduction

This section explains the effects that the transportation system (roads and trails), included in each alternative, would have on the environment of the Deschutes National Forest. Information on the past and present characteristics of the transportation system is found in Chapter 3 and program information on transportation under the various alternatives is found in Chapter 2 of the FEIS

Interactions

Roads have significant interactions with nearly all environmental components discussed in this Chapter and have direct, indirect, and cumulative effects on various resources

When reviewing the effects of the road system on resources (e.g , water, fish), it is important to note the distinction between road construction, road reconstruction, and the maintenance activities associated with the existing road system. For example, there are usually short term effects on water quality as a result of constructing a new road After construction completed, it is expected that these impacts will diminish to level comparable to other existing roads. Thus, when comparing mileages in the tables for road construction and reconstruction, it is important to realize that the percent increase in mileage for any alternative represents only a small fraction of the total Forest mileage

Alternatives that promote high recreation use or high commodity production will generate higher traffic volumes. Conversely, low levels of use or production will reduce traffic The location of activities, whether dispersed evenly throughout the Forest or concentrated in localized areas, will have a direct effect on traffic volumes on specific roads. Also, if activities within an area are scheduled to occur at a high level for a short duration, followed by periods of non-activity, the intermittent traffic volumes could exceed the acceptable road capacity and may require reconstruction to a higher standard, which has a direct effect on other resources Therefore, the quantity, the location and the timing of timber and recreation program activities on each alternative have a indirect effect on soil, water and wildlife

Each alternative will generate different traffic volumes on the road system In addition to the potential for reconstruction to a higher standard, higher traffic volumes also cause the need for more maintenance on gravel and native surface roads which will have short-term effects on water quality. Traffic types and volumes have a direct effect on wildlife habitat.

Roads can affect scenic quality by introducing strong linear elements that are incongruous with the landscape. If new roads are constructed within scenic corridors, changes to scenic quality would increase For example, roads constructed on steep, sloping landscapes require more extensive cuts and fills Such development can affect scenic quality by introducing negative contrast in line, form and color

Geothermal development will have a significant effect on the road system for specific areas. During the development phase some roads will require widening or re-alignment to accommodate large drill equipment. After development, some use will continue for the support of daily operations. Some visitor traffic is expected but the amount is unknown.

The construction and maintenance of the trail system will cause environmental effects similar to

roads, however, normally at a smaller scale. These effects are discussed under recreation in this Chapter

Assumptions

Forest Service road standards will remain essentially the same for the next decade, and beyond. This is realistic because they were updated within recent years and the higher standard roads are based on national guidelines used by state and county agencies (with cooperation of the Federal Highway Administration).

The Forest Service will continue to have the authority to implement traffic restrictions to allow a cost efficient road management program.

Roads designed and maintained for passenger car use will meet the intent of the Highway Safety Act.

Related ICO's

How much timber should be harvested and on what schedule?

How should the Forest provide for present and future developed recreation?

How can the Forest keep pace with expanding demands for dispersed recreation?

How can the Forest maintain scenic beauty while providing for timber production and other goods and services?

How should the Forest manage key roads, particularly those lower standard roads that cross the Cascade Crest?

Effects That Do Not Vary Between Alternatives

Road construction affects timber stands by removing acres from productivity. Although the initial harvest would occur on these areas, volume from future managed stands would be foregone.

Although there are differences between the number of new road miles constructed by alternative, the overall impact under any alternative would be insignificant.

Specific environmental effects associated with road construction and reconstruction on resources such as soil, water, visual and wildlife are explained further in this chapter under each resource heading. With the exception of Alternatives NC and A, the miles of road construction and reconstruction, the total system mileage, and miles of closed roads will vary with alternative. Therefore, most direct and indirect effects on Forest resources will be different for each alternative.

Some indirect effects resulting from changes in the road system can alter the following: ROS setting and recreational opportunities; erosion and stream sedimentation rates; access for timber management; potential for disturbance of wildlife habitat; access to the Forest for woodcutters, anglers, and hunters, off-road vehicle opportunities, visual quality; and the timber production land base

Effects That Vary Between Alternatives

Road Construction and Reconstruction

A summary of road construction and road reconstruction mileage by alternative is contained in Figure 4-7. There are two listings which were separated to distinguish the type of funding. The first listing (Forest Road Program) represents construction or reconstruction of all roads in support of many Forest activities and is established by Region-wide priorities The second listing (Timber Purchaser) represents access for timber management activities and is predominately associated with local roads The mileages are added together to get the total mileage for each alternative.

With only a few exceptions, the existing arterial and collector road system can safely accommodate the expected traffic for all Alternatives Thus, a small percentage of the miles listed under Forest Road Program is for upgrading an arterial or collector road to a higher standard to meet

increased traffic volumes. All the miles for construction (new roads) are local roads.

Figure 4-7 Road Construction and Reconstruction (miles)

	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Forest Road Program						
Construction	5	5	4	8	5	3
Reconstruction	10	10	10	12	11	9
Timber Purchaser						
Construction	11	11	10	17	10	9
Reconstruction	40	40	36	53	43	31

Approximately 40 percent of the reconstruction mileage is for rebuilding roads to their original standards, wherein a more appropriate term would be restoration or rehabilitation

Mileages are shown for the first decade only. Successive decades are listed in Figure 2-50

Although some new construction will occur for all Alternatives, the total system mileage will be lower in the first and successive decades. This is a result of permanently closing (obliteration to as close as possible their original condition) roads no longer needed for access Most of these roads were built during the early development years of the Forest and would not meet the standards/ guidelines for the alternatives considered herein.

Road Management (Operations and Maintenance)

The management of the road system (operations and maintenance) has a direct, long-term and short-term effect on Forest resources and will be different for each alternative, except for Alternative NC and Alternative A which are the same Existing roads, whether closed or open, have varying effects on water, visual, vegetation, and wildlife that depends on several factors, such as the amount of road use, the types of vehicles, and the location of the road.

With the exception of roads having an asphalt pavement, increasing traffic on roads will have a direct effect on water quality High traffic volumes and vehicle speed will adversely affect some wildlife Maintenance operations will vary with road use and cause short-term effects on vegetation and water quality, yet the lack of maintenance could lead to extreme erosion Roads in steep terrain generally will have more erosion than on flat ground.

Roads that are permanently closed are prepared to be self-maintaining to the extent possible, and since they do not have traffic, should have minimal erosion. Seasonal closures will have have slightly more erosion potential due to some traffic use during the year Both closure types will have a direct, beneficial effect on wildlife habitat

The mileages shown in Figure 4-8 are estimates based on the expected road use generated from the resource needs of each alternative. The roads maintained for passenger cars are the highest standard and serve both commercial hauling and recreation traffic. The seasonal closures are estimates based primarily on wildlife protection as described for each alternative. About 10 percent of seasonal closures are for resource protection (unstable roads) during the spring and fall. Long-term closures are local roads serving the timber management program where it is economically feasible and environmentally prudent to store them for future use. In addition to saving

maintenance funds, long term closures may improve wildlife habitat for sensitive areas. Long-term closures may result in roadside vegetation growth over time preventing access for fire suppression, but this could be offset by lower potential for man-caused fires. The net effect is difficult to assess and depends primarily on the proximity to populated areas, both on the Forest and on private lands.

Figure 4-8 Road Operational Status by Alternative (miles)

Alternative & Decade	Passenger Car, Open	High Clear. Open	High Clear. Seasonal Closure	Long-term Closure	Total System Mileage
No Change					
Dec. 1	800	5800	500	1400	8500
Dec. 2	850	5450	400	1300	8000
Dec. 5	900	4600	300	1200	7000
Alt A					
Dec 1	800	5800	500	1400	8500
Dec 2	850	5450	400	1300	8000
Dec. 5	900	4600	300	1200	7000
Alt. B					
Dec. 1	800	4500	850	2350	8500
Dec. 2	900	4100	750	2250	8000
Dec. 5	950	3500	650	1900	7000
Alt. C					
Dec. 1	1100	5200	1700	500	8500
Dec. 2	1200	5200	1500	400	8300
Dec. 5	1300	5000	1400	300	8000
Alt. E					
Dec. 1	850	4250	1100	2300	8500
Dec. 2	950	4150	900	2000	8000
Dec 5	1000	3600	800	1600	7000
Alt. G					
Dec. 1	650	2850	1500	2500	7500
Dec. 2	650	2550	1300	2000	6500
Dec. 5	650	1350	1000	2000	5000

Issue Roads

The DEIS requested a response to four "issue" roads having significant features. A summary of proposed actions is displayed in Figure 4-9, followed by a summary of the probable effects.

Figure 4-9 Proposed Action by Alternative for Issue Roads

Alternative	Irish-Taylor Road	Todd Lake-Three Ck. Lake Road	Windigo Pass Rd, Waldo Lake Road, Charlton Lake Road
No Change and Alt A	Maintain at current standard	Maintain at current standard	Maintain at current standard
Alt. B	Maintain at current standard	Maintain at current standard	Improve for increased traffic by adding additional turnouts and rock surfacing.
Alt C	Improve for increased high-clearance vehicles	Improve for passenger car use	Improve to two-lane standard with rock or asphalt surfacing
Alt. E	Maintain for high clearance vehicles	Maintain for passenger cars from Hwy 46 to 4600380 and for high clearance to Three Creek	Maintain at current standard with minor improvements allowed. Both roads may be considered for improvement to two-lane paved standard with NEPA documentation.
Alt.G	Permanently close to all traffic	Permanently close to all traffic	Maintain at current standard with no planned future improvements

Estimate of the effects of various road standards of the four issue roads:

Irish-Taylor Road: This road traverses over the Cascade Crest and connects with a road on the Willamette National Forest. Typically, users of the road desire a primitive driving experience in a two-wheel drive, high clearance vehicle Maintenance is difficult due to steep grades and poor access for maintenance equipment Any significant increase in traffic would require some widening for turnouts and additional surface stabilization on grades. Closing the road would eliminate impacts on wildlife and water, although these are currently considered minor due to the low use, and would deny access for a primitive driving experience.

Todd Lake-Three Creek Lake Road: The lower section of this road, from the Cascade Lakes Highway (Hwy 46) to the turnoff to Crater Ditch Trailhead, receives heavy use during the summer months and is maintained for passenger cars at low speed. From the Crater Ditch turnoff to Three Creek Lake the road standard is acceptable for two-wheel drive, high clearance vehicles. Current use is low. Improving this section to a passenger car standard would require extensive reconstruction and would have significant environmental impacts. Closing the lower section of the road would reduce use of Todd Lake and Crater Ditch Trailhead. Closing the upper section would have the same effects as with the Irish-Taylor Road.

Windigo Pass Road: The current standard of this road is single lane with adequate turnouts, grades, and surfacing for passenger car travel. Bounded along one side for most of the road is the Oregon Cascades Recreation Area. As it crosses the crest it joins a road of slightly higher standard on the Umpqua National Forest Improving to a two-lane paved road would have considerable environmental impacts It has been determined by the Umpqua and Deschutes National Forests that an assessment using the NEPA process would be conducted before proceeding with any major improvements.

Waldo Lake-Charlton Lake Road· This is perhaps the most controversial of the issue roads. It

connects the Cascade Lakes Highway with Waldo Lake on the Willamette National Forest, passing over the crest of the Cascade Range. Construction to a two-lane paved highway would serve as a bypass to Highway 58 for travelers going to and from Eugene and Bend. The expected increase in traffic on Forest Road 42 would exceed current capacity, causing a need for reconstruction to a higher standard. Also, the resulting traffic reduction on Highway 58 would have a direct economic effect on retail businesses along that highway. The Willamette and Deschutes National Forests have agreed that major improvements will not be done for any alternatives without evaluation through the NEPA process.

Cumulative Effects

Under all Alternatives, the Forest's transportation network will decrease in total mileage, and the mileage of closed roads will increase. Access for some types of recreation and woodcutting will be reduced as roads are closed or obliterated; however, the total miles of roads left open will provide an adequate balance between access needs and environmental effects. Over time, this reduction of total system miles and the increase in miles of seasonal and long-term closures will have indirect cumulative effects on other Forest resources, such as soil, water, and visual quality, wildlife habitat, and recreation opportunities. These effects are detailed in each resource section of this Chapter

Mitigation Measures

The construction, reconstruction, and maintenance of roads can produce increases in erosion, sedimentation of streams, wildlife disturbance, and landscape alteration Various mitigation measures will be employed to avoid or reduce environmental effects These mitigation measures, the extent of their application, and their probable success, are described in the sections in this chapter on soils, water, fish, wildlife, and visual.

Most of the arterial and collector road system is currently constructed to a standard adequate to meet the needs of activities for all alternatives Certainly, over time, all roads will need reconstruction or restoration work which will cause some short-term effects. Past experience on the Forest indicates that when proper road location and design is implemented, followed with timely maintenance, the prescribed mitigation techniques are highly successful Because restoration work does not change the existing standard, the environmental effects should be minor For those roads needing reconstruction to a higher standard, which may include some re-alignment and widening, the short-term effects will be more significant.

As a mitigating measure, all road reconstruction proposals will consider traffic management options, such as placing restrictions on commercial or recreation traffic to remain within the safe capacity of the road, thus eliminating the need for reconstruction.

Potential Conflicts with Plans & Policies of Other Jurisdictions

The Forest road network is integral with state and county highways During the transportation analysis of alternatives these highways were included to determine whether estimated future traffic from Forest activities would have adverse affects on their transportation systems. The percentage of traffic generated from Forest activities was fairly low on the state highway system, except for the highway to Mt. Bachelor Ski Area The percentage of Forest traffic on the county system varied widely (20 to 90 percent) depending on the proximity to Forest lands and private land developments within the Forest boundary.

Two funding programs under the auspices of the Federal Highway Administration (the Forest Highway Program and the Public Lands Program) are available to assist with the improvement or restoration of state and county highways, providing that a significant percentage of the traffic is generated from Forest activities. Close coordination will continue between the Forest and these agencies to ensure that the effects resulting from changes in Forest activities are adequately assessed and that road standards are consistent.

Monitoring

The same monitoring process will apply for all Alternatives The portion of the road system maintained for passenger cars would receive condition surveys twice a year as a minimum. A traffic surveillance program will be conducted annually on these roads to monitor the amount and type of vehicle use

The rest of the system is surveyed every one to three years, depending on amount of traffic and the risk to the environment from erosion These surveys monitor the condition of road surfacing, bridges, drainage structures, roadside vegetation, hazard trees and signing The implementation of road closures will be monitored upon final inspection of all projects, if closures are planned. The effectiveness of road closures will be reviewed during the recurring condition surveys

Cultural Resources

Introduction

Cultural resources, unlike natural resources, are non-renewable. Effects to cultural resources must be carefully considered and managed to insure that valuable information is not destroyed. Either the sites must be preserved, or information must be taken from the sites through data recovery, thus preserving the information for the benefit of the public and scientific communities.

Interactions

Natural environmental phenomena as well as man-caused activities affect the condition of cultural resource sites on the Forest. Frost heave, bioturbation (disturbance by roots), snow melt, and wind and water erosion all affect artifacts above and below the surface. Activities such as road construction, logging, and recreation site construction directly affect cultural materials and contribute to natural phenomena such as wind or water erosion. Thus, the condition of the cultural resource sites is a result of natural forces, management activities, and the interaction of the two.

Management activities with the most significant effects on cultural resources are timber management and recreation development Timber management (harvest, silviculture treatments, sale road construction) affects large expanses of land, thus increasing the chance to affect cultural resource sites Recreation development does not affect nearly as much land, but there is a close correspondence of developed recreation site locations with significant archaeological sites, therefore there is an increased potential of effects to significant cultural sites. These activities have the potential to disturb or destroy a cultural resource site through direct ground disturbance by heavy equipment or by increasing access into areas and thus creating the threat of illegal excavation and theft.

The same ground-disturbing activities which could destroy a site also provide the opportunity for discovery. Most Forest sites known and recorded to date were located during the course of compliance inventories for management activities. When a survey is conducted, the Forest data base is increased, along with knowledge of the past. Increasingly, significant sites located during these inventories are evaluated and effects caused by management activities are mitigated through scientific excavations. These evaluations and mitigation excavations greatly increase our understanding of this area's human past Management activities which open up an area to vandalism also open it up to potential enhancement or interpretation of significant sites This is especially true in recreation developments

In summary, effects of the Alternatives on cultural resources are both direct (heavy equipment) and indirect (access), and effects are both positive and negative Management activities can damage sites directly, but provide the vehicle for discovery Increased access can allow more theft and illegal excavation, but can also increase opportunities for interpretation.

Caution is necessary, however, in thinking that high levels of development and timber management is always good for cultural resources because of opportunities presented for discovery, investigation, and interpretation. They do present opportunities, but the work load becomes so great, that it is much easier to miss sites or inadvertently damage them Also, when development and timber harvest

levels are high, time may not be available to properly evaluate sites and mitigate adverse effects, therefore protection of the sites usually takes the form of avoidance, i.e. designing projects around sites so as not to harm them. While this protects the site, it does not further our understanding of the area's human past. In short, high levels of development and construction pose a real threat to the resource and a challenge to the workforce.

Other Interactions

Other ground-disturbing activities that can affect cultural materials include spring development for livestock grazing or wildlife guzzlers, wildfires, controlled burning, planting, and fire suppression.

Locations of springs often coincide with cultural resource sites. Development of the springs invites increased use and thus poses a danger of displacement and breakage of cultural materials on the surface or shallowly buried Compaction also becomes a problem

Wildfires and controlled burns can most certainly damage or destroy any above-the-ground historic wood structures. Fire can also fracture surface stone artifacts. Suppression activities pose a threat to the resource by heavy equipment.

Assumptions

Preservation laws, regulations, and policies dictate a process of inventory, evaluation, preservation, and protection of cultural values that may be affected by management activities. Each alternative will employ these laws and regulations through application of the standards/guidelines (see Chapter 4 of the Forest Plan). Under each alternative, all project areas will be inventoried, all sites located will be recorded, the sites will be evaluated for their eligibility to the National Register of Historic Places, and harmful effects will be avoided or mitigated.

All Alternatives call for varying levels of timber harvest and recreation development, (see Figure 2-50 in Chapter 2 of this EIS). While other activities certainly affect the cultural resources, these two have the greatest effect and thus are a good measure of the potential to affect sites on the Forest. Therefore, for the purpose of estimating effects on cultural resouces, the Alternatives have been grouped according to the number of acres in scheduled timber harvest and numbers of new recreation developments.

Related ICOs

How much timber should be harvested and on what schedule?

How should the Forest provide for intensive recreation, now and in the future?

How should the Forest identify and protect cultural resources?

Effects that Do Not Vary Among Alternatives

Cultural resources will be protected in all alternatives through the application of standards and guidelines which apply to all management activities with the potential to disturb sites. The standards and guidelines implement the National Historic Preservation Act and Executive Order 11593 and insure that all ground-disturbing activities will include a professional inventory for cultural resources, evaluation of sites located, and mitigation of effects of management activities on any significant cultural resource. See Figure 2-50

Effects that Vary Among Alternatives

Because laws govern all planned management activities, the only variable we can discuss in terms of cultural resources is the potential to locate sites. That potential presents the possibility of the negative effects (disturbance or destruction through use of heavy equipment and theft or illegal excavation due to increased access), and positive effects (increase in the data base and opportunities for interpretation). Alternatives calling for greater harvest and road construction levels and more intensive management of developed recreation sites would increase both the potential

for locating sites and for inadvertently disturbing sites during management activities.

Direct and Indirect Effects

Timber Harvest

Based on the estimated volume in the first three decades, Alternatives C and E have the greatest potential to affect cultural resources The higher volumes in these two Alternatives necessitate survey of more acres for cultural resources This increases the potential for discovery of sites and thus the potential for evaluation and interpretive developments High volume also implies more harvest activity and sale road development thus increasing the potential for disturbance to cultural materials above and below the ground surface Increased access resulting from the road construction often results in damage to archaeological sites by looters or curious recreationists.

Alternative G displays the lowest volume. Lower harvest levels will result in fewer acres being surveyed for cultural resources and fewer chances for discovery of new sites and the corresponding evaluation and interpretive opportunities. Lower harvest levels would result in fewer roads into sensitive areas and less chance for disturbance or destruction of significant sites.

Developed Recreation

Developed recreation site construction has the potential to directly affect sites through mechanical disturbance to the ground The danger is intensified because good locations for developed campgrounds often coincide directly with significant prehistoric campsites Prehistoric inhabitants looked for the same amenities we do today: shelter, water, scenery, and flat places to camp Therefore, it is likely that developed recreation construction will affect a significant cultural resource.

Based on the number of acres planned for developed recreation sites, Alternatives C and E show the highest levels and thus the greatest potential to affect cultural resources. Alternative E also shows high levels of dispersed recreation, which affects cultural resources mostly through increased use and access, thus opening the door not only to collecting, but to disturbance from repeated use of popular areas Alternative C focuses almost exclusively on developed recreation.

The high level of recreation development construction in Alternatives C and E would undoubtedly increase opportunities for evaluation of significant sites and for mitigation of effects of construction on those sites. The high correspondence between campgrounds and significant cultural sites also presents the possibility of interpretive developments in the campgrounds

However, more developed recreation site construction means that more significant cultural sites are in danger of disturbance or destruction. While evaluation and mitigation are always options, it is not always wise to excavate every significant site we locate Preservation of sites is also a goal of the cultural resource management program so that sites will be left for future, improved scientific methods and new research questions. The high correspondence of significant cultural resource sites with developed campground locations, makes it mandatory that we carefully consider the fragile balance between demand for recreation and significant, non-renewable, cultural values

Alternative G displays the lowest level of campground development Assuming this will result in fewer acres being surveyed for cultural resources in conjunction with the recreation program, this alternative offers less chance for discovery of new sites and the corresponding evaluation and interpretive opportunities However, the lower construction levels would result in fewer chances for destruction of significant sites.

Cumulative Effects

The cultural resources on the Deschutes National Forest are part of a much larger cultural environment comprised of the Northern Great Basin, the Great Basin proper, Northern California, and possibly even the Columbia Plateau. Activities over time on these lands have disturbed or destroyed cultural remains, both prehistoric and historic. Hydro-electric developments on the rivers, illegal collection of artifacts, mineral exploration, gas transmission lines, among many other development activities have seriously depleted the

non-renewable cultural resources. The cumulative effects of these actions over time result in the loss of a large body of information that can never be regained. This loss, in turn, raises the value of what remains, and much of what remains is on National Forest land This points to the need for even more careful consideration of the cultural resources in the future.

Every ground-disturbing activity has the potential to directly affect cultural resources, resulting in loss of that resource Continued road construction on National Forest lands increases access to sites and thus potentially results in increased disturbance. The existing compliance process requires Federal land managers to consider cumulative effects of any any proposed action on cultural resources. Potential adverse effects can be avoided or mitigated through a variety of measures Scientific data recovery is a common form of mitigation of effects to archaeological sites. However, data recovery (excavation) is inherently a destructive process, especially if it is spurred by the need to "salvage" sites in advance of ground disturbing projects Data recovery plans address current research questions by using current theories and techniques, but such projects may also destroy data that would be needed in the future when new theories and techniques are developed.

There is no adequate compensation for the physical loss of some sites. These are resources which, in part, are aesthetically significant and convey, by their existence in place, a special human link with the historic past. For example, the images evoked by the prehistoric carving on a rock outcrop or a rustic cabin are just as strong, maybe even stronger, in a young child as in a trained scholar. The cumulative effects of the various alternatives on these types of resources cannot be mitigated.

In summary, effects to cultural resources include those invoked by ground disturbance either from projects or illegal excavation, as well as destruction of the resource in the process of scientific data recovery. All of these effects over time, result in the loss of a non-renewable resource. Scientific study seeks to learn something in the process, but we have no way of predicting what will be important about these sites in the future, thus it is still imperative to preserve some sites *in situ*. The cumulative effect of inadvertent destruction of a site by a ground-disturbing project, intentional destruction of a site by looters, or destruction of *in situ* artifacts through scientific data recovery, is the gradual depletion of a resource data base before we understand the whole picture We take away one piece at a time before the whole puzzle comes together, without knowing the importance of any one piece in the puzzle

Mitigation Measures

Effects to cultural resources discussed so far are those resulting from management activities Illegal collection and excavation also affect the cultural resources, and while we have less control over those activities, certain mitigation measures can lessen their impacts. The following discussion will include mitigation measures for management activities and for illegal activities.

Mitigation of Effects Caused by Management Activities

Mitigation measures for cultural resources minimize effects of management activities on the cultural sites and their environmental setting A number of possible measures exist which protect all or a portion of the site in place or extract the information from the site before it is destroyed Each requires consultation with the State Historic Preservation Officer and the Advisory Council on Historic Preservation if the property is eligible to the National Register of Historic Places.

Avoidance, i e designing or modifying an activity in such a way as to avoid adversely affecting a cultural property, is an alternative to mitigation. If cultural resources are located and evaluated in the earliest stages of project planning, it is usually easy to modify the project to avoid and thus protect the sites However, avoidance, while it protects the site, does not increase our knowledge of cultural history, therefore it is not necessarily the preferred option. In deciding between mitigation and avoidance, we must take into consideration the site's potential for new information, site type redundancy, opportunities for public interpretation, and the relative value of the cultural property and the proposed activity Following are some possible mitigation measures available.

Directional felling of trees away from a site will minimize direct impacts to the site, though it could still damage the site's environmental setting. Aerial or full suspension yarding will also avoid direct impacts including soil displacement or disturbance of above-ground cultural remains. Restriction of yarding to months when the ground is frozen and covered with an ample layer of snow to protect it would protect sub-surface cultural remains as well as geomorphological features. When tractor logging is necessary, excessive damage to sites can be avoided by limiting the number of skid trails or using already existing ones. With linear features such as historic wagon roads or Indian trails, it is possible to limit skid trail crossings of these features to segments already disturbed, thereby maintaining the integrity of the more undisturbed segments.

If it is impossible or economically infeasible to minimize the effects to the cultural site in place, other mitigation options exist In the case of a significant archaeological site, data recovery is often the chosen method Data recovery involves the removal of material remains through systematic excavation and recordation This must be done by a qualified archaeologist and must be according to an approved research design Selection of this mitigation measure is only appropriate if the value of the site lies in it material contents. It would not be appropriate for a site whose value is its location, such as a site of religious importance to American Indians

Data Recovery of a structural site is often documentation including scaled drawings, maps, and photographs. Such documentation may be required prior to modification of a historic structure or removal of the structure from its original setting. The documentation seeks to provide a permanent record of the original condition of the site

These are only a few of the mitigation measures available to protect or minimize damage to cultural resources, though they do represent the most commonly used. Given the wide variety of types of sites found and the many different types of effects they are subject to, the selection of mitigation measures is necessarily unlimited More often than not, several methods will be used in combination. There is no way to predict what kinds of sites we will find in the future Managers must be innovative in finding ways of protecting these resources

Mitigation Measures for Illegal Activities

Destruction of valuable cultural resource sites and theft of artifacts result from ignorance of the laws and intentional criminal intent. Recreationists, unaware of the laws, may casually collect artifacts from the surface. Others, more intent on their hobby may make a point of "arrowhead hunting", unaware of the information they are destroying. The commercial collectors are very familiar with the laws, yet engage in illegal excavation and collection as a lucrative commercial endeavor Just as the reasons for the threat to cultural resources range from ignorance to criminal intent, so must the mitigation measures range from education to law enforcement

To reach the general public and those who may not be aware of the sensitivity of the resource or the laws protecting it, the Forest is increasing the number of interpretive opportunities. These opportunities include signed archaeological sites, public excavations, tours of Forest cultural resource sites, educational seminars offered through Lava Lands Visitor Center, and programs offered through the schools, libraries, and other organizations on request Hopefully, education and increased awareness will result in a decrease in the casual collection of artifacts from sensitive sites It may also indirectly affect the activities of the commercial collector if more casual Forest visitors are likely to report suspicious activity.

When education fails, law enforcement becomes necessary The Archaeological Resources Protection Act (ARPA), prohibits excavation or collection of Indian artifacts from federal land Illegal excavation resulting in damage to the archaeological value of a site in excess of $500 is a felony. Criminal penalties under ARPA are $20,000 and two years in prison for a first offense and $100,000 and five years in prison for a repeat offense. The Forest has successfully prosecuted two individuals under ARPA in the last five years We will continue to use ARPA to prosecute cases of illegal collection or excavation.

Monitoring

The Forest has developed a monitoring and protection plan which will be fully implemented by Fiscal Year 1992 This plan provides for systematic monitoring of management activities, disturbed sites that are repeatedly looted, and sensitive areas in which we believe looting is concentrated

Potential Conflicts with Plans & Policies of Other Jurisdictions

Cultural resources, like many of the natural resources, do not respect present-day land ownership boundaries One can only gain an accurate picture of past activities and cultures from material remains by studying those remains in a broad context, one which crosses all ownership boundaries. Significant sites also occur on land owned by private individuals, the State Parks Department, private timber companies, and the counties It is possible that projects undertaken by these individuals or agencies could disturb or destroy sites with information bearing on the understanding of this area's history.

In cases where other agencies or private landowners are entering into agreements with the Forest Service such as land exchanges, cost-share projects, or road rights-of-way, the cooperator must comply with federal laws governing cultural resources

The Confederated Tribes of the Warm Springs Indians, the Klamath Tribe, and the Northern Paiute all have traditional lands on the Forest. Tribal members understandably have a great concern for how Forest Service management activities could affect those lands. This is particularly important in relation to religious sites and human burials To date, there have been no major conflicts. The Forest has an informal agreement with each tribe, to notify them of activities which might affect their traditional lands. Under each alternative, the cultural resource program would include such coordination with the American Indian community

Vegetation

Introduction

A forest is an extensive wooded area made up of many plant communities. Trees and shrubs predominate, and in combination with other plants, occur in all stages of growth and decay Plant communities have the quality of self-perpetuation and the ability to develop into an ecological or fire climax.

Plant diversity is both an environmental component and an important attribute of the Forest. Therefore, the discussion of effects on forest plant diversity has been combined with the effects on forests. The water and range sections of this Chapter include discussions on the effects on riparian vegetation and range vegetation

Interactions

The management activities described in the various alternatives would have many direct and indirect effects on vegetation. Forest management activities can affect the species composition, density, horizontal and vertical structure, health, vigor, and age of the Forest, and growth of useable plant products. Because of the nature of the analysis process, many of the effects on Forest components are covered in other sections. Activities such as timber harvesting often have obvious effects on forests. However, activities which may involve little alteration of present Forest conditions, such as roadless management, can also have effects, although they may not be so evident. The extent of the direct and indirect effects of activities on vegetation depends on the type, size, location, and timing of the management activities included in each alternative.

The interactions of management activities and the direct and indirect effects they could have on vegetation, whenever and wherever the activities are prescribed, are summarized in this section.

Cutting and Removing Vegetation:

This type of activity includes cutting and removing or rearranging trees, shrubs, and other vegetation for a variety of reasons, mostly for production of wood products and for wildlife habitat management. Vegetation is also removed to manage population levels of insects and diseases which affect valuable plant species, to provide other forest products to the public, to reduce fire hazard, to enhance views and aesthetics of special places, and to maintain a safe environment in designated recreation and work areas, and in transportation corridors. In addition, vegetation is removed or recycled as food by wild and domestic animals, and manipulated to provide dead and down habitat The extent, location, timing, and prescription for the vegetation cutting and/or removal determines the overall scope of the effects, but the general effects for *each piece of ground* treated do not vary among alternatives. Cutting and removing vegetation has the following direct and indirect effects on forests and plant diversity.

Changes species composition.

Changes age distribution

Changes amount and arrangement of organic debris such as logs, branches, and twigs.

Alters or kills existing vegetations including roots.

Increases growth rates of selected vegetation by repartitioning resources to targeted plants.

Eliminates the "natural" condition of plant communities in areas not previously cut

Changes the risk and incidence of tree-root disease, insects, and other diseases which affect vegetation

Alters nutrient cycling and nutrient availability to plants.

May alter microclimate and increase surface winds, which increases tree windthrow.

May alter ecosystem balance.

Changes wildlife and domestic grazing habitat which affects grass, forbs, and shrubs consumption and the risk of damage to immature trees.

Removing large trees and rearranging remaining cut vegetation disturbs soil, which affects erosion potential, compaction, and nutrient availability for plants.

May cause compaction that affects plant growth.

May alter macroclimate, possibly contributing to global warming.

Where macroclimate has already changed in the last 100 years, such as on the desert fringe areas on the east side of the forest, vegetation management activities could lead to further climatic changes altering the type of vegetation capable of growing on those sites.

Increases or decreases fire hazard and ability to control fires, which could destroy vegetation.

Descriptions and direct effects of specific types of harvests and other stand treatments involving cutting, rearranging, and removing vegetation are discussed below:

Even-aged Regeneration Harvest

Regeneration harvest is the removal of all or a portion of the tree component of the forest, for the purpose of establishing a new stand Even-aged regeneration, as practiced on the Deschutes National Forest, will mainly be seed tree, shelterwood, overstory removal, or clearcut harvest. In clearcut and some seed tree harvests, all trees to be harvested are removed in one operation. In shelterwood cutting and in some seed tree harvests, the trees to be harvested are removed in two or more operations The final removal cut takes place when reproduction is established in the understory. In overwood removal, the existing overstory trees are harvested, and advanced, natural reproduction in the understory is managed.

Regeneration cutting promotes the establishment of new stands of trees. It provides growing space, and reduces competition for sunlight, water, and nutrients. With even-aged management, regenera-

tion occurs during a relatively short period of time. Both artificial (planting) and natural regeneration practices are used Seedlings from the tree improvement (genetics) program are planted in artificially regenerated stands Stands regenerated with even-aged practices favor the establishment of sun-loving or seral species such as ponderosa pine, lodgepole pine, western white pine, and western larch. Such practices will encourage a mixture of species, to the extent possible as determined by the plant communities involved.

Even-aged stands have essentially a single canopy level The average stand diameter will be reduced from what it is today in areas outside of where extended rotations are desired Likewise, most trees within a stand will be within 20 years of age of one another. The structural diversity and age-class distribution in specific stands will be reduced by even-aged harvest, but the diversity of the Forest will often be increased by the patchwork of created even-aged stands of varying ages, successional stages, and size classes.

The shift to early successional stages following even-aged management will increase the grass, forb, and shrub components of the stands. Vegetation changes tend to be most rapid after clearcutting Because moderation of the amount of solar radiation passing through to the ground is an objective of shelterwood cutting, changes in understory vegetation can be expected to be less dramatic than for clearcuts The amount of forage and browse produced decreases as the amount of tree crown closure increases.

Impacts on forest health are found elsewhere in this Chapter under the "Forest Health" section.

The degree to which the above identified effects are exhibited is proportional to the number of even-aged regeneration harvest acres.

Uneven-Aged Regeneration

Uneven-aged regeneration is initiated by single tree or group selection harvest methods. With single tree selection, individual trees are harvested to created a desired balanced distribution of age classes In group selection, small openings (generally less than 2 acres) are made to create a balance of age classes composed of the small group openings. Uneven-aged harvests generally cover more area, and have more frequent periodic entries than even-aged harvests, with fewer trees per acre harvested during each entry.

With uneven-aged management, continuous high forest canopy is maintained when viewed from a stand basis, although small group openings can occur with group selection Regeneration is a continuing or recurring process, initiated from the seed stored on site or from residual trees There is also an opportunity to plant and take advantage of characteristics selected for by the tree improvement programs. In an uneven-aged stand there are 3 or more age or size classes, either as scattered individuals or small groups. Uneven-aged management tends to favor those species that can regenerate and grow under shaded conditions; on the Forest those would be white fir, subalpine fir, Engelmann spruce, and to some extent, Douglas-fir. The seral species in mixed conifer stands will decline and possibly over time be eliminated, unless practices are implemented to ensure their continued presence. Impacts on forest health are found elsewhere in this chapter under the "Forest Health" section

Much less forage and browse is produced in an uneven-aged stand due to the reduced light and changes in microclimate brought about by the remaining high canopy. Group selection patches will generally produce more forage and browse than single tree selection areas, but less than that produced in stands treated with even-aged management

The degree to which the above would be manifested is proportional to the number of uneven-aged regeneration harvest acres.

Intermediate Harvest

Intermediate harvests include commercial thinning as well as sanitation and salvage cuttings in all management areas where allowed.

Commercial thinning of even-aged stands has the direct effect of reducing competition for light, water, and nutrients Thinning concentrates growth potential on fewer selected trees. Thinning generally removes trees from the lower crown classes that are suppressed, weakened or genetically less fit, leaving the best trees in an enhanced growing condition. Stand density is decreased in

all cases, and within-stand diversity is often diminished. Commercial thinning will increase average stand diameter. Thinning can alter species diversity as species are selectively favored for inclusion in the residual stand Usually a mixture of species will remain after the harvest Thinning can increase the economic yield of a stand, recover mortality, and make a stand more resistant to insect and disease attacks and losses.

Salvage cutting is the harvest of dead, dying, damaged, or deteriorating trees, for the purpose of putting the wood to use before it becomes worthless as wood fiber. Sanitation cutting is the removal of the same kind of trees, as well as those susceptible to attack, but for the purpose of reducing the spread of biotic pests Sanitation and salvage harvest decrease the amount of dead and down trees and debris in the forest, thus reducing this aspect of forestland diversity.

Any intermediate cutting can damage residual stands. Poor landing locations, falling patterns, equipment selection, and requirements such as whole tree yarding can lead to damage

Mechanical Slash Treatment and Site Preparation Activities

The objectives of piling, crushing, and otherwise rearranging cut vegetation include lowering the hazard of wildfire by reducing or rearranging fuel, and encouraging or discouraging growth of specific plants.

Site preparation affects the future forest that will occupy a given site. Competition for soil moisture from residual and invading species can reduce survival and growth of young conifers The fundamental objective of site preparation is to provide an environment conducive to the establishment, survival, and growth of the new Forest. The site preparation process is the major effect. A direct result will be a reduction in the numbers and vigor of understory vegetation, and increased opportunity for survival and growth of trees, although if improperly conducted, it can lead to compacted soils, losses of nutrient capital and *reduced site productivity and tree growth.*

Manual and Mechanical Release and Precommercial Thinning

Planted seedlings and natural regeneration will occupy space vacated by understory vegetation; however, the juvenile growth rate of some plant species is faster than that of conifers, and therefore release treatments may be needed to reduce competition and ensure conifer survival. The effect of release activities will be the cutting or removing of understory vegetation, or setting back of the growth of targeted vegetation which may temporarily decrease the overall diversity of the site

As the crowns of conifer stands close, a precommercial thinning may be prescribed to meet management objectives. This will reduce competition, and concentrate growth potential on fewer selected trees, as would be accomplished in a commercial thinning. Precommercially thinned *stands will appear more evenly spaced than* unthinned stands, and possess a "tended appearance". Stand density will be decreased, but resistance to insects and disease will increase. Forage and browse will also increase as tree canopy is reduced and more light reaches the forest floor Precommercial thinning can reduce species diversity, but usually on most sites a full range of species adapted for that plant community will remain.

The magnitude of effects of precommercial thinning on forest stand structure, species, growth, and yield is also directly related to number of acres being thinned and the thinning prescription (spacing, species mix, size specifications, other desired characteristics) Selection of precommercial thinning acres is determined by management objectives for the site and the need for vigorous, insect resistant stands.

Reforestation, Revegetation, and Tree Improvement Activities

These activities introduce desired species and genotypes into areas where the vegetation has been cut or burned. The objective is usually to enhance economic, ecological, or aesthetic values, or to prevent soil erosion. General effects on *vegetation include the following:*

May change species composition

May change species diversity.

Decreases erosion potential and helps maintains long-term ability of soil to support sustainable plant growth.

Variability exists, both among and within forest tree species and other plant species, in economically important traits, as well as in traits of adaptive significance, such as cold or drought tolerance, insect and disease resistance, and growth characteristics Diversity is desirable and, to a certain extent, necessary for survival as it allows trees and other plants to grow and reproduce under the myriad of conditions and ever-changing environments encountered during a single generation and longer Diversity in tree populations is also felt to have a buffering effect against losses due to disease, insects, and climatic factors.

While the variation patterns observed in wild stands have occurred as a result of natural forces, it is also possible through proper stand culturing techniques to maintain and even increase the inherent variability of forest stands.

Tree planting can replenish or restore diversity that has been diminished as a result of catastrophic events such as wildfire, insect or disease outbreaks, or past logging practices that removed the more valuable species and/or individuals. Supplemental natural regeneration can assist in creating diverse, mixed species stands and provide locally adapted genotypes to the regenerated stand.

The mixture of species on a site is controlled to a large degree by the adaptability of a species to a specific plant community Some species such as white fir are not adapted to drier plant communities, but in the absence of natural fire, can marginally occur there, but only under much natural stress from drought, insects and disease. The regenerated mixture of species will be planned to preserve plant diversity. Forests stay healthier when species grow where they are ecologically adapted The amount of white fir, which has increased in recent decades because of fire exclusion, is expected to decrease again as stands are managed. The amounts of lodgepole pine and ponderosa pine is expected to remain the same or increase in managed stands. Supplemental planting of seral species in stands managed under uneven-aged systems may be necessary to ensure the continued presence of these species over time

Many of the effects of reforestation activities are covered above under even-aged and uneven-aged regeneration harvests Reforestation often begins with site preparation. As summarized by Cleary (1978), the methods practiced in the Pacific Northwest can be classified as mechanical, prescribed burning, chemical, and combinations of the three Mechanical methods are discussed above under Site Preparation, and the other two methods are discussed in later sections Possible ways to prevent the need for site preparation treatments will be considered in planning for all regeneration harvests

Artificial regeneration (planting) provides the most control over the timing and composition of future forested stands. With natural regeneration there is less control over species composition and stocking. On this Forest, approximately 15 years may elapse between the shelterwood or seed tree harvest and the final removal harvest in some timber stands where planting is not feasible because of rocky soil, or where heavy gopher damage is expected, or where seed crops do not develop more often The shelterwood and seed trees will not be removed until the understory is adequately stocked All clearcuts and final overstory removal harvest acres should be adequately stocked within 5 years of harvest. Managed stands that were planted instead of naturally regenerated will achieve the most uniformity in size, age, and spacing

Forest productivity can be enhanced as a result of the use of genetically diverse populations. Overall volume production from using planted, genetically improved stock in conjunction with natural regeneration leaving the best trees to provide seed is expected to be higher than without improved stock and careful selection of seed trees. Uneven-aged management with natural regeneration favors parent-to-offspring matings and matings between offspring from the same parents; even-aged management with natural regeneration reduces the frequency of matings among related individuals In coniferous species, inbreeding can have a serious impact on genetic variability and on stocking and yield in the next generations

Application of Chemicals, Trapping, Hunting, and Construction of Animal Barriers:

This includes application of chemicals such fertilizers, pesticides, repellents, and other materials; construction of mechanical barriers to prevent damage to selected plants; and selective removal of animals which damage valuable resources. The objective is to improve vegetation growth and selectively reduce plants or animals which compete with or damage desired Forest resources General effects on vegetation include the following:

- May increase growth of treated or protected species
- May damage or kill treated species.
- May damage or kill plants outside target area.

Burning Vegetation or Organic Debris:

Burning vegetation and debris involves broadcast, jackpot, and pile burning in cut-over areas, natural stands, or meadows The objectives vary, and may include any or all of the following to lower the hazard of wildfire by reducing fuel, to reduce or discourage growth of competing vegetation, to increase sunlight and nutrients for desired trees or forage species, to facilitate tree planting or establishment of natural regeneration, to reduce low-growing vegetation and logging slash, and to provide a seed bed with higher levels of available nitrogen Burning has the following general effects on vegetation.

- Encourages or discourages establishment of target plant species
- May damage or kill target or nontarget plant species.
- May allow desired species mix to persist by reducing the costs of future specified vegetation management activities.
- Changes the amount and availability of nutrients for plants.
- Alters microclimate and may alter macroclimate which affects plant survival and growth.
- Reduces risk of wild fire or the difficulty of suppressing wild fires, which can have major effects on vegetation
- Creates smoke which adds to CO_2 levels, affecting macroclimate and microclimate and plant growth and survival.

Creation of Habitat Improvement Structures and Areas:

These include water developments, protective fencing, flooding, and nesting structures. This type of activity·

- Changes microclimate, which changes species composition (i.e., flooding)
- Concentrates wildlife or domestic grazers, which increases consumption of vegetation, damage to vegetation, and nutrients available for vegetation growth.

Transportation Related Activities, Including Road, Landing, and Trail Construction and Maintenance:

These activities sometimes require heavy equipment (tractors, trucks, and earth movers) to develop stable surfaces capable of supporting log trucks, log yarding equipment, cars, horses, or people. This type of activity:

- Removes vegetation temporarily or permanently from roadways, trails, and landings
- Provides access to improve ability to manage areas for desired species composition and condition
- Provides access for visitors, which may decrease opportunity to manage vegetation visible from roads or trails with less expensive, less visually-acceptable methods
- Increases risk of man-caused fires, starts, but increases accessibility for fire control and creates fire breaks, which influences vegetation.
- Increases access for legal and illegal vegetation removal activities, such as woodcutting and Christmas-tree cutting.

Off-Highway Vehicle Use:

The magnitude of the effects depends on the season, amount of use, soil type, plant community, and size of vegetation Off-highway vehicle use:

May damage or kill young trees and other vegetation.

May increase fire risk and associated fire effects on vegetation.

Construction, Maintenance, and Use of Recreation Facilities:

Constructing recreation facilities such as parking lots, shelters, signs, campgrounds, summer homes, ski areas, and snow-play areas involves the construction of various buildings, concrete footings, sign posts, pavement, and ski runs to make the use of recreation areas more attractive to visitors Construction, maintenance and use:

Removes or damages vegetation in popular high-use areas

Changes species composition.

Concentrates people in certain areas, which may result in soil compaction and disturbance to vegetation which can affect vegetation growth and survival.

Livestock and Wildlife Grazing:

Livestock grazing can affect the amount, species composition, and condition of the natural and seeded or planted grasses, forbs, and shrubs, as well as coniferous and hardwood trees. It can act to increase, decrease, or have few effects on forest diversity Grazing generally decreases the abundance of the preferred species and leaves growing space available for increases of the less preferred species. In reforested areas and other forest sites, understory vegetation can compete with trees and can significantly reduce height growth of seedlings. Use of forage by livestock can assist in controlling competition with trees. On the other hand, livestock (and wildlife) browsing and trampling can damage trees, especially seedlings and saplings. The magnitude of impact from vegetative competition and potential damage due to grazing is generally small, site-specific, and not predicted on a Forest basis Grazing activity has the following effects·

Encourages early successional stages of vegetation.

Affects species composition.

Affects vigor of grasses and forbs.

Affects species diversity.

Provides fertilizer in high-use areas.

Damages or removes existing vegetation often leaving the roots intact.

May introduce undesirable or exotic species

Geothermal Development, Special Uses, and Mining:

This type of activity has the following effects:

Removes vegetation from areas associated with development

May alter species composition in the immediate area of the development

Designation and Management of Areas For Wilderness, Unroaded, Research Natural Areas, and Other Areas with Very Limited or No Timber Management Activities:

Wilderness management and retention of unroaded areas and other areas with little or no timber harvest have the effect of maintaining natural to near-natural forest conditions and contributing to forest diversity. In these areas, stands will tend to become older with trees larger. Tree species will tend to slowly change from "pioneer," shade-intolerant species including Ponderosa pine and larch, to more tolerant ones, such as true firs. Fire can inhibit succession to tolerant species; use of fire will be determined in the wilderness plans. All Alternatives have the same amount of wilderness which will make the same contribution to forest diversity. Alternatives differ in the amount of roadless area retained in unroaded condition and, therefore, in their contribution to forest diversity.

The management of these areas tends toward long-term, stable community structure unless the areas are influenced by fire, major windstorms, insect and disease outbreaks, or other natural disasters In the absence of major perturbations, this type of management.

Maintains the "natural" condition of plant communities.

Maintains "natural" species composition, age structure

Maintains amount and arrangement of organic debris.

Maintains genetic and species diversity

Increases risk from wildfire, and decreases ability to control fires, thus influencing the vegetation

Catastrophic events could result in major changes to species composition, age structure, and organic debris.

Increases average stand age, compared with areas managed intensively for timber production.

Managing for Big Game Hiding and Thermal Cover:

Managing for maintaining or increasing the current numbers of deer and elk decreases individual tree growth and vigor when trees are purposefully left in dense pockets or stands to provide additional hiding cover and thermal cover This tends to decrease the overall production of understory vegetation in the dense areas, and increases the susceptibility of these stands to insects and diseases

Visual Resource Management:

Visual management maintains or adds to the structural diversity of the Forest Management of the forest under various visual quality standards may provide a range of stand tree ages and sizes with natural to altered appearances. Managing to *obtain certain visual objectives can reduce future* forest growth and yields, and meeting short-term visual objectives could decrease the overall health and vigor of the stands. Without catastrophic events such as intense fires or large scale insect infestations, forest stands with retention and partial retention visual objectives will tend toward larger trees and climax successional stages Where visual objectives call for large trees, the general effect will be to broaden plant diversity on the Forest in terms of age and size distribution, while also possibly resulting in species shifts to more shade tolerant species such as white and subalpine fir, and increases in forest pests associated with these species.

Wildlife Habitat Dead Tree (Snag) Management:

Snag management involves leaving standing dead trees for wildlife habitat Snags and down trees increase forest diversity, assist in maintaining long-term site productivity, and help maintain more natural forest conditions

All areas managed for timber on the Forest will be managed to provide snag habitat at or above levels required to sustain at least minimal viable populations of dependent wildlife.

Assumptions

Assumptions used to estimate effects are:

1. For each alternative, the amount of timber planned to be sold and the amount of timber actually cut will be approximately the same for the ten years following adoption of Forest Plan

2. Harvested areas will be planted with species that either are more valuable, necessary for various wildlife habitats, or both.

3. Wildfire, disease, windthrow, and insect outbreaks will be of similar size and intensity as in the past decade

4 The stand maps and data base have been updated to adequately reflect changes in vegetation composition and age that have occurred since the Forest Inventory in 1984.

5. The law requires that the "natural forest" be used as the basis for evaluating the maintenance of diversity. However, existing condi-

tions have been so thoroughly influenced by man that "natural" references are difficult to find and apply, and what is commonly viewed in the Forest is not "natural".

6. Ecosystems are resilient and adjust to impacts such as fire, flood and other agents of change. Where lands are actively managed, early successional stages are created that are rich in a mixture of plants and animals adapted to open-structured habitat and shrub-forb dominated systems. On lands where non-consumptive or natural processes are dominant, species richness can be good or poor depending on the area's successional history and age. Forest lands allocated to these uses act as refuges for species that require latter successional stages, and closed canopied forests

7. It is debatable whether the more consumptive alternatives or the less consumptive alternatives provide the "best" diversity. In most cases, lands allocated to non-consumptive uses are dominated by natural processes that shape forest composition and structure. Natural processes when undisturbed by human activity, are generally good for diversity. However, ecologists have found that the number of plant species found on a site often decreases as the plant community moves toward climax. Species richness tends to be higher in early and mid-successional stages. Actively managed lands are not at risk of losing diversity as long as potentially detrimental activities are curbed by effective standards and guidelines.

Related ICOs

Most of the ICO's are related in some way to possible effects of management strategies and activities on forest vegetation The ones most directly related are:

How much timber should be harvested and on what schedule?

How should the Forest manage habitat for T&E species?

How should the Forest manage stands susceptible to or infested with the mountain pine beetle?

How can the forest maintain scenic beauty while providing goods and services?

What should wildlife populations be on the Forest?

How should the Forest manage its lakes, streams, and wetlands to prevent degradation?

Effects That Do Not Vary Between Alternatives

The effects of summer homes, resorts, geothermal, mining, and special uses will be localized and similar in all alternatives.

The vegetation management effects do not change the existing areas of juniper, meadows, alpine, or brush dominated communities in any alternative.

The effects of management activities on overall plant species diversity should not vary substantially by alternative. The National Forest Management Act of 1976 (NFMA) requires forest diversity be maintained or enhanced within a planning area. This has been accomplished by allocating lands to non-consumptive uses, by applying standards/ guidelines to protect diversity in managed areas, and by continued careful monitoring of habitat and species throughout the Forest.

Effects That Vary Between Alternatives

Many effects listed in the interactions section above vary according to the type of treatment or construction planned, and the extent of the activity planned in terms of number of acres treated, structures built, use days predicted, or amount of resources removed and timing and location of those removals. Many of these vary by alternative, and are listed in figure 2-50 by alternative. In many cases, the number of acres allocated to specific management areas and objectives also varies by alternative. These are also shown in figure 2-25. These tables show the relative magni-

tude of the effects listed for each activity discussed in the earlier interactions sections by displaying the relative treatment acres, outputs, or management area acres.

Since timber harvest and post-harvest strategies will have a major variable effect on vegetation in each alternative, the following discussion concentrates on the effect of specific harvest (or no-harvest) and post-harvest treatments.

Management for No Timber Harvest or Extended Rotations

As described in the effects section, there are a variety of areas managed to provide natural to near natural forest conditions while emphasizing various non-timber-production related resource values A number of these areas preclude timber management and others use timber management techniques but with extended rotations or other controls Where human-induced changes are minimized, natural to near natural conditions will continue. These areas add to the Forest structural and plant diversity, slowly moving to climax forest conditions. Typical conditions for older forests will occur in terms of density, health, vigor, age distribution, and species composition (diversity). In general, the natural to near natural conditions will be highest for Alternatives G Alternative E will be the next highest. Alternatives A and B will be lower, and NC and C will be lowest

Even-aged Regeneration Harvest

As time proceeds, the Forest will assume a patchwork structure of managed stands, with interspersed unharvested areas and areas with extended rotations, and areas of uneven-aged management As natural stands are converted by timber harvest, the diversity of tree and understory vegetation age classes will increase across the Forest, although the diversity on specific sites may decrease Alternatives A, B, and C schedule the most acres of even-aged harvests

Per acre growth will be greater on timber management acres at the end of the planning period than at the beginning. Forest-wide, no changes in species mix are expected over the planning period, although there will be major localized changes over time, especially in Alternatives NC, and C, and somewhat in Alternatives B and E. By the end of the planning period, the degree to which the above overall effects are exhibited will be proportional to the number of acres selected for even-age timber management

Uneven-aged Regeneration Harvest

In areas where single tree selection uneven-aged management is practiced, the species and age class diversity could increase as more age classes are added to stands. Shifts in species composition to shade tolerant species are likely in some plant communities where white fir and subalpine fir are present. The Forest will appear more "natural" as continuous high tree cover is present over an extensive area, although periodic entries to control stocking and achieve age and size class balance will impart a managed appearance. Alternatives G and E schedule the most and next-most acres of individual tree selection uneven-aged harvests. Alternatives NC, A, and B and C don't schedule any single tree selection during the first decade. Alternatives C and B schedule the most and the next most acres of group selection uneven-aged harvests during the first decade This would provide some horizontal diversity, with small scattered openings, generally up to two acres in size, in mixed conifer stands

Intermediate Harvest

As the planning period progresses, intermediate harvests, where practiced, will result in a more vigorous, healthier forest, from the aspect of the residual trees. Stand densities will be lower Forest-wide as the number of commercial thinning acres increases Some natural thinning will occur in stands not receiving commercial thinnings. Useable forest yields will increase Although pathogen outbreaks may cause shifts in the diversity of tree species, no shifts as a result of salvage or sanitation cuttings are planned or projected in any alternative.

Reforestation and Timber Stand Improvement

Over the planning period, as new stands are being reforested, others will be maturing, and understory vegetation that has been set back or displaced during the reforestation period will reestablish itself Different species or species proportions may occupy specific sites, because of differences between natural and managed

stocking levels, or species preferences exhibited during reforestation activities. No large shifts in plant diversity are planned or anticipated Forest-wide in any alternative.

Animal Control

The overall effect will be ongoing protection of the Forest from animal damage. It will assist in prompt reestablishment of harvested stands, and better utilization of site productivity. No species of animal will be eliminated, and population levels of the damaging animals will be influenced only in a limited geographic area where unacceptable damage is occurring or expected to occur.

Fuels Treatment

It is predicted that continued application of fire prevention, detection and suppression policies will protect much of the Forest from fire damage. Some plants removed by wildfire and fuel treatments will reestablish themselves. Others may be displaced by plants which compete best following fires, such as ceanothus, a brush species which is stimulated by fire.

The degree to which each alternative exhibits the effects discussed in the interactions section is expected to be proportional to the number of acres burned.

The following table displays the expected changes in the mix of plant successional stages over the first five decades of the Plan Primary change factors are time (stands age), and harvest activities. No attempt was made to attempt to model unplanned natural changes such as fire or windstorm impacts in this table

Figure 4-10 Table - PREDICTED VEGETATION SUCCESSIONAL STAGES

Acres of Forested Land by Successional Stage[1]

Successional Stage	Unit of Measure	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Grass-Forb/Shrub-Seeding							
Decade 1[2]	M Acres	Unknown	87 2	177.8	221.6	165 7	87.2
Decade 2		Unknown	2.7	183 4	265.6	118.4	3.2
Decade 5		Unknown	114 4	166.1	202.2	98 2	62.8
Sapling-Pole	M Acres						
Decade 1		Unknown	281.4	184 8	179 9	199.7	221.4
Decade 2		Unknown	451.3	277.0	269 3	290.5	350.6
Decade 5		Unknown	13.9	185.0	224 2	66.7	4.5
Young	M Acres						
Decade 1		Unknown	314.0	306.7	300 3	257.7	306.1
Decade 2		Unknown	62.6	60.9	63.1	62.3	51.6
Decade 5		Unknown	506.5	377.0	423.8	353.8	383.3
Mature/Old Growth[3]	M Acres						
Decade 1		Unknown	491.3	504 6	472.1	550 8	559.2
Decade 2		Unknown	657.3	652 6	575.9	702.7	768.5
Decade 5		Unknown	539.1	445.8	323.7	655 2	723.3

[1]Includes tentatively suitable land, OCRA, RNA's, Special Interest Areas, and Experimental Forest

[2]Estimates at mid-point of each decade.

[3]Includes managed multi-storied stands.

Summary of Effects of the Alternatives on Forests

All Alternatives include a broad range of management activities, from wilderness and roadless area management to clearcut harvests and intensive silvicultural regimes They differ in overall emphasis and the extent to which the various management activities influence the character of the Forest. Following is a summary of the expected overall effects of each alternative on plant diversity, the Forest ecosystem, and Forest production:

No Change Alternative

The No Change Alternative implements the current timber management plan, as amended in 1980 and 1984, but does not implement NFMA requirements, such as MRs for water quality and fish and wildlife habitat Not meeting these requirements allows faster harvesting of mature and old growth trees Since the harvest rate in this alternative is based on the old inventory and old yield tables, harvest treatment acres are higher than in any other alternative, and would be accomplished exclusively by even-aged harvest methods Outside of the wilderness, the character of the Forest will change to a roaded and intensively managed condition and the overall appearance will be that of a managed forest A mosaic of different age and size classes of stands will be created as even-aged treatments are staggered. Horizontal diversity should be increased for the next few decades although vertical diversity is likely to decline. It is questionable that species richness could be maintained. There will be a decline in presence of species associated with late successional stages Those species associated with early and mid-successional stages should increase in numbers. True fir species should decline in presence, and seral species such as Ponderosa pine and western larch should increase. Stand density will be lighter than at present due to stocking level controls. More forage should be produced in forested areas. Stand vigor and growth should be much improved over the current situation, unless standards/guidelines prove inadequate, without NFMA initiated changes, to maintain long-term site productivity with the heavy even-aged harvest schedule.

Alternative A

Alternative A would continue management of the Forest as defined by existing direction, management plans, and standards/guidelines, and, to the extent possible, produce current levels and mixes of resource outputs. Harvesting would be accomplished using even-aged systems Alternative A assumes the ability to conduct overstory removal on more than 10,000 acres during the first decade, with very low regeneration costs, a questionable assumption. Horizontal and vertical diversity would decrease across the forest Species richness should be maintained. There will be a decline in the presence of species associated with late successional stages Those species associated with early and mid-successional stages should increase. Stand density will be lighter than at present due to stocking level controls

Alternative B

Alternative B was developed to show how the current RPA program can best be implemented on the Forest It will produce moderate or relatively high levels of commodities as well as amenities, where they do not conflict Roadless areas, visual quality, and old growth will be managed at moderate levels The acres of mature stands allowed to develop through natural succession, while early and mid-successional stages will decrease. Species diversity should be rich, although those species associated with latter successional stages will decline in numbers The overall Forest will take on a roaded, intensively managed appearance. Changes will be fairly rapid and contrasts will be evident between intensively managed stands and adjacent areas reserved from timber harvest. Horizontal diversity should increase, while some reduction of vertical diversity

may occur. High amounts of group selection will be practiced in the first decade. The forest will take on a less dense appearance as more acres are placed under stocking level control. Forage production will increase Forest health and vigor will increase.

Alternative C

Alternative C emphasizes opportunities that have an established market price (timber, forage, developed recreation opportunities, and minerals). Visual and old growth resources will be managed at low levels. All roadless areas will eventually be developed for commodity production Plant and structural diversity of old growth stands will be represented at a low level. Early and mid-successional stages will predominate, while latter stages decline in frequency Plant species richness should be high, although those species associated with climax conditions will decline Much of the forest will change to a well-roaded and intensively managed timber and forage production area. Management activities will be very evident. Many young timber stands will be created and intensively managed Forest density will decrease as the highest number of acres in any alternative receive stocking level control. Forage production will increase. Forest health and growth will increase, and pest problems decline. The early successional stages will be well represented with their numerous and diverse plant species.

Alternative E (Preferred)

This Alternative was modified in response to public review of the Draft EIS and public input since that time. It is the best attempt of all involved to fine tune the preferred alternative in the DEIS to best maximize the net public benefits in an environmentally sound manner. Many sub-alternatives were developed and evaluated during the formulation of this Alternative This alternative will provide balanced outputs of commodity and non-commodity goods and services. Effects on the forest resource should result in a richness of diversity, and a long-term reduction of forest pest problems, as long as forest pest guidelines are carefully followed. Roadless areas, visual emphasis areas, and old-growth management areas will provide natural appearing environments This Alternative provides a good blend of successional stages over time, with a moderate increase in the latter stages over time and a corresponding decline in early stages. Species richness should be high Snag habitat will be provided in a range of levels sufficient to maintain self-sustaining population levels. Moderate levels of timber harvest and road development will occur. Management activities will add to forest diversity, and horizontal and vertical diversity should be enhanced Uneven-aged management will be practiced wherever it can meet long-term management objectives. The forest will appear less dense due to stocking level controls, which will be necessary to ensure continued health and growth of the understory in multi-storied stands being managed for timber production, as well as other resource management objectives Forest vigor and growth should increase.

Alternative G

Alternative G emphasizes nonmarket values and resources such as high water quality, air quality, visual quality, fish, wildlife, dispersed recreation, and other amenity values Maintenance of roadless areas and high levels of visual quality and old growth habitat and the most extensive use of uneven-aged management systems will provide many natural appearing areas Early successional stages and the species associated with them will decline, while late stages will increase Species richness may decline. True firs could begin to predominate in more mixed conifer stands, and associated forest pest problems will be magnified Forest vigor and growth will noticeably decline. Road development and vegetative manipulation will be evident, but will not predominate. Average stand density will increase Hiding cover for big game will increase at the expense of foraging areas.

Indirect Effects on Other Resources

Since Forests have a primary direct influence on all environmental components, changes in the Forest and plant diversity will have important effects on each environmental factor Principal indirect effects will be on soil, water, wildlife and big game, riparian areas and fish habitat, forest insects and diseases, fire, recreation, visual resources, and social and economic environment Further details on the effects of Forest change on environmental

components can be found in appropriate sections of Chapter 4

Cumulative Effects

Cutting of vegetation and its replacement on National Forest and adjacent lands changes the mosaic of vegetation cover. This affects ecological relationships among species and between species and their environment Included are overall changes in:

Rates of soil nitrogen fixation (from ceanothus and other nitrogen fixing plants), which alters plant growth;

Relative abundance of vegetation types, and ages;

Resistance to insects, root rot, and other diseases specific to certain species, physiological conditions, or ages of trees and other plants

Vegetation changes on lands adjacent to the Forest have been widespread. Alternatives which reduce vertical and plant species diversity on larger areas by clearcutting and burning vegetation and replacing it with fewer species, such as Alternative C and NC, have a greater cumulative effect on vegetation than those which maintain more areas with existing species and size composition, such as Alternatives B and G

The relative magnitude of these effects is indicated by

The total acreage harvested and planted over the next ten years on both Forest lands and lands of others within major basins of the eastside of the Cascade Range;

The portion of those acres that would be planted with a single or few desired species. Alternatives with the most lands planted with a limited number of species in the first decade would have the greatest cumulative effects on vegetation. Acres managed with uneven-aged management prescriptions would reduce the magnitude of these effects.

Assumptions used to predict cumulative effects are:

Changes on lands other than National Forest will continue at the same rate as in the past several years

Other land owners will not substantially contribute to the maintenance of older stands of trees.

Mitigation

A variety of species and ages of vegetation for wildlife, fish and watershed resources will be provided on the Forest at all times This would minimize the direct and cumulative effects on vegetation Snags and logs left for wildlife would provide at least minimum amounts of nutrients for recycling through the soil to replace harvested and burned vegetation Mitigation measures found to be effective on the Deschutes National Forest are included as standards/guidelines in FEIS.

The following mitigation measures for specific management activities or objectives would prevent unacceptable changes in forest vegetation Al these mitigation measures are effective on the Deschutes National Forest.

Visual Resources: Harvest scheduling and boundary layout considerations will somewhat mitigate the effects of visual management on individual tree growth. Use of uneven-aged management systems would provide greater flexibility in managing the timber resource while meeting visual quality objectives.

Wildlife Habitat: Use safety considerations in designating "leave snags" to mitigate some conflicts with state safety agencies Use animal damage control measures when necessary to prevent unacceptable impacts to forest vegetation.

Livestock Grazing: Varying the class of livestock and/or the season of use can reduce damage to seedlings.

Timber Harvest Practices: Designated skid trails, directional felling, equipment size or capability limitations, tree pulling, stage felling or logging

and other harvest practices will be used as needed to reduce physical damage or loss of desirable residual trees.

Regeneration Even-aged: Consideration in marking guidelines for initial shelterwood harvests will provide the opportunity for regeneration of new stands from parents possessing desirable economic and adaptability traits such as form, volume growth, and apparent insect and disease resistance.

Wilderness, research, roadless, visual management, riparian, and dedicated old growth areas, in addition to size and dispersion constraints for even-aged management units will maintain a diversity of age classes across the Forest Wilderness and similar areas also are dynamic reserves for genetic resources untouched by human activities

Measures are in place, in the form of standards and guidelines, to protect any understory species that are rare, threatened, or endangered.

Regeneration Uneven-aged: Uneven-aged management will be used to meet management area goals, or where the effects of even-aged management are unacceptable

Undesirable shifts in species composition could be prevented by proper marking, by the use of group selection, or by supplemental planting

Intermediate Harvest: Standard timber sale layout and sale administration practices will be used to minimize logging damage. Shifts occurring in common understory vegetation will not be mitigated.

Reforestation and Timber Stand Improvement: Measures to control competition by understory species will generally be necessary. Such measures may include chemical, mechanical, and burning site preparation, as well as chemical and mechanical release. Prompt site preparation and reforestation after logging improves the ability of conifer seedlings to survive and grow. Reforestation activities that act to enhance or maintain local variability, guided by regional and Forest policy, include:

Maintenance of natural mixtures of native tree species through mixed species plantings or through management of natural regeneration, e g., extent and timing of site preparation, selection of "leave trees" and thinning regimes.

When relying on natural regeneration prescriptions, the number and quality of individuals retained as seed trees are prescribed for the site. For example, in a shelterwood the relatedness of adjacent individuals may be reduced, resulting in an increase in the genetic variability of the regenerated stand.

For planted acres, planting stock is derived from seed that is certified and identified as to local origin; seed lots represent a broad genetic base. Tree seed zones and breeding zones have been established to guide forest managers in the use of forest reproductive material.

Natural regeneration is encouraged, even on planted areas, so that the best individuals of both types are retained.

Maximum desirable initial stocking is recommended; subsequent silvicultural operations (thinning) are conducted to retain those trees best adapted to the site

Genetically improved planting stock has been developed using methods that conserve genetic diversity.

Potential Conflicts with Plans & Policies of Other Jurisdictions

Vegetation management activities will comply with the Regional Environmental Impact Statement for Managing Competing and Unwanted Vegetation Burning of vegetation and debris will comply with the State of Oregon Smoke Management Plan.

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 unavail-

able or incomplete; additional information is needed on these topics:

The succession pattern for areas where vegetation is left in small patches for soil and water protection, and other isolated patches where vegetation is protected.

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 pruning on future growth, quality, and value.

Ecological conditions required for growth of desired species, such as conifers in riparian areas, and of unwanted species, such as brush *in plantations.*

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 a wide variety of vegetation management techniques, including fire, chemical, and manual methods.

Effects of fertilization on conifer yields, other tree species, water quality, and soils.

Growth and yield and costs of uneven-aged management

What effect does additional "edge" have on growth and yield in areas managed by group *selection or small even-aged treatment areas?* (no reduction has been assumed in this plan).

What are the long term effects of retained overstory trees and additional harvest entries, potential compaction, and disturbance on growth of understory trees in areas managed by individual tree selection?

What are the costs when uneven-aged management is implemented over many acres?

How can growth and yield and costs best be predicted and monitored?

Monitoring

Regardless of the allocation, in every Alternative, all plant and animal species are managed at viable levels, and management indicator species are monitored. Monitoring is expected to highlight any deficiencies in standards/guidelines so that timely changes can be made Although the study of biodiversity is relatively new and much remains to be learned, the structure is in place to appropriately manage and monitor biological diversity in all Alternatives, and differences in land allocations between alternatives is not expected to significantly affect diversity

Old Growth

Introduction

The inventory, preservation, and use of old growth presents a complex issue. First of all, there is no good scientifically approved definition of old growth that has been developed locally for the timber types on the Deschutes National Forest. Therefore, the Forest has used very general definitions of old growth that were contained in the Regional Guides (see old growth Ch. 2)

Secondly, there is no accurate inventory of old growth on the Forest Ranger District people using local knowledge and aerial photographs developed the old growth inventory used in the EIS and Plan *in a very compressed time frame using the Regional* Guide definitions.

Thirdly, old growth stands do not remain static, like all living organisms, they are constantly changing. Therefore, the idea of preserving a stand of trees as old growth is only a temporary situation Lodgepole pine generally die by age 150 and on numerous sites, Ponderosa pine will generally be replaced by other species unless some disturbance occurs in the stand.

Fourthly, old growth means different things to different people. To the logging industry, old growth represents the most valuable trees in the forest, many times more valuable than younger trees. Old growth is also a tree that is uniquely suited for many forest products that simply can not be produced from other trees.

Even for those people who want old growth preserved, different groups have different objectives. The Forest has identified three different and distinct reasons for preserving old growth which may not occur on the same site.

Landscape Ecology Needs: The intent here is to set aside a network of areas that will serve as benchmarks or comparisons that can fulfill a variety of research needs A minimum of three areas were selected in each geologic province for each working group (species).

Wildlife Habitat Needs: Certain wildlife species are associated with or closely associated with stands of old growth. Three management indicator species have been identified in the regional Guides for the forest types on the Deschutes National Forest. It is assumed that if the habitat needs of these species are met, the needs of all other old growth associated species with less restrictive habitat needs will also be met. The three-toed woodpecker for lodgepole pine stands, the northern goshawk for Ponderosa pine stands, and the pine martin for mixed conifer stands are the three indicator species on the Forest.

Esthetic/ Recreation or Social Old Growth Needs: Many people have a desire to see some old growth preserved from a social, esthetic or spiritual perspective.

The acres in the old growth management area will have no programmed harvest Figure 2-25 shows the number of old growth acres by alternative Alternative C has the least, followed by alternatives B, A, No Change, E, and F. Although Alternative C meets the minimum acreage amounts for the various indicator species, many of those acres did not contain old growth habitat suitable for the species. Alternative E contains more than enough acres of good habitat to meet the management requirements for the indicator species Although Alternative E contains significantly more acres than Alternative C, an effort was made to locate the acres in Alternative E in such a way as to minimize the impact on timber harvest. For example, areas were located in areas that already had reduced harvest level where possible Also some areas were located on rocky ground, steep slopes, or otherwise difficult logging or timber growing sites

Much of landscape ecology and social old growth is not included in the Old Growth Management Area They are found largely in other management areas such as Wilderness, Oregon Cascade Recreation Area, Research Natural Areas, etc. that have no programmed harvest.

Table 2-76 gives a breakdown of all the old growth on the Forest by working group by alternative Figure 2-77 shows the anticipated amount of old growth remaining at the end of the first, second, and fifth decades by alternative. Alternative C has the fewest remaining acres of old growth and Alternative E has the most.

In addition to the areas listed in Table 2-76, there will be many more areas that are being managed for their old growth character, i e social old growth, in all Alternatives, but they have not been counted in this analysis because they do not meet the Regional Guide definition of old growth This includes many thousands of acres of uneven-aged management.

Interactions

Management Requirements/Management Indicator Species: The Forest has developed a distribution plan for management indicator species that is designed to assure their distribution across the Forest. The old growth areas will fill in the gaps in this network that exists outside areas already preserved through other management allocations

Wildlife: In addition to the management indicator species old growth areas will provide suitable habitat for many game and nongame wildlife species These areas will be particularly beneficial because of their distribution across the Forest.

Threatened & Endangered Plants and Animals: Old growth management areas are in addition to the management areas established for bald eagles, osprey, and spotted owls. These species, however, will probably use the old growth areas if they are located nearby.

These areas will also provide a very valuable scientific baseline for the study of ecological succession of both plants and animals

Forest Health: Forest health may become a problem in old growth areas. Insect problems may develop in old growth areas, particularly after a catastrophic event such as a windstorm or fire.

Recreation and Scenic Quality: Many of the old growth areas will become attractions for recreationists In fact, many of the areas are already being used for recreation. As the areas become better identified this use will increase

Assumptions

The following assumptions were used in evaluating the various alternatives relating to old growth.

Landscape Ecology: The minimum number of areas is three per working group per ecological province They need to be well distributed across the Forest Additional areas are better because it will give scientists an opportunity to choose between areas and still get a good statistical comparison

Wildlife: The minimum sizes for the three indicator species are as follows.

Goshawk - 75 acres every 6 miles
Three-toed woodpecker - 75 acres every 2 miles
Pine marten - 160 acres every 3 miles

A more desirable size of area based on home range needs is as follows:

Goshawk - 160 acres every 7,000 acres
Three-toed woodpecker - 450 acres every 8,000 acres
Pine marten - 450 acres every 5,000 acres

Social: Protection of key road and visual corridors is important It is also desireable to have blocks of old growth ranging from 50 to over 1000 acres well distributed across the Forest.

Uneven-aged management contributes to the publics need for social old growth. Larger target tree size is more desirable from a social old growth perspective than a smaller size.

Related ICOs

Local and Regional Economies, lifestyles, and population levels.

Timber harvest levels and schedules.

Management of lodgepole pine and Ponderosa pine stands infested with mountain pine beetles and susceptible to infestation.

Role of uneven-aged management

Managing the scenic beauty of the Forest.

Managing the habitat of threatened, endangered, and sensitive species

How much old growth should be retained on the Forest.

Effects That Do Not Vary Between Alternatives

The old growth acreage in Spotted Owl, Wilderness, Bend Watershed, OCRA, and Wild & Scenic Rivers Management Areas do not vary between alternatives. The affect of other management activities will not change the character of old growth in these allocations.

Effects That Vary Between Alternatives

All of the Alternatives meet the needs based on the criteria which was developed and used The question then becomes subjective in terms of 1) whether one should manage for minimum level, which really does not provide options for the future, and 2) how much consideration of public needs (social) should be met Suffice it to say that we can best meet both of these needs in the Preferred Alternative and that the other Alternatives meet varying degrees of what we need for landscape ecology, wildlife, and social wants

Management activities will have an effect on available old growth (see Figure 4-11). The Preferred Alternative will leave 262,500 acres of old growth after the fifth decade. Species distribution of this 262,500 is concentrated in those species generally found at the higher elevations. Ponderosa pine in the Ponderosa pine species working group, amount to 12% of the old growth remaining after the fifth decade (Alt. E) Ponderosa pine old growth trees can also be found in association with lodgepole pine and Douglas fir, white fir, and mountain hemlock The amount of old growth remaining after the fifth decade varies from 182,200 in Alternative C to 262,500 in Alternative E. The amount of Ponderosa pine old growth after the fifth decade varies from 16,700 acres in the Alternatives No Change and A (see figure 2-77) to 32,700 in Alternative E.

Figure 4-11 Total Old Growth Acres Remaining At The End of Decades 1,2 and 5.

	Decade 1	Decade 2	Decade 5
Alt NC	322 2	296 3	245 4
Alt A(NA)	322 2	296 3	238 4
Alt B(RPA)	322 0	296 3	245 4
Alt C	309 4	270 8	182 2
Alt E Pref	326 4	304 4	262.5
Alt G	322 0	295 6	242 4

Cumulative Effects

As mentioned earlier, all Alternatives meet the minimum management requirements, however, some do not allow for future options Old growth ecosystems have really not been examined, so we do not have finite information regarding needs of all the living creatures which inhabitat this ecosystem. The effect of each altenative to another is that Alternative E provides for more future options whereas other alternatives do not, or do so to varying degree For example, uneven-aged management stands could be clearcut in the future, but if they are clearcut now that option is not available. Also, if it is determined that certain indicator species need a larger home range the area preserved today will be available

It is also recognized that because of the mountain pine beetle epidemic (which is a natural process) there will be cumulative effect (reduction in numbers) for those lodgepole dependent wildlife species.

Because of the increased acres in this allocation timber harvest levels will be reduced.

Mitigation

Once old growth is gone, whether it be through catastrophic loss such as fire, windstorm, or disease, or a man caused activity such as timber harvest, it will take 100-300 years or more to reestablish the complete old growth ecosystem. Even if there is no catastrophic or human-caused intrusion into the stand the old growth character will change or be totally lost over time. Most lodgepole pine stands, for example, die before they reach 150 years of age. Typically these stands regenerate themselves and a new stand developes. Also, Ponderosa pine stands usually are replaced by other species over time unless there is a catastrophic or human-caused change in the stand.

Some mitigation is possible by saving components of old growth such as large trees, snags, down woody debris, and multi-layered stands even though the entire old growth system is not complete. These components, if properly distributed, may meet the needs of old growth dependent or old growth associated species such as the spotted owl, various woodpeckers, pine marten and several other mammals. Some stands managed on an uneven-aged basis with several layers in the stand and a significant number of large trees may also meet some of the public's need for what has been described as "social" old growth.

Some Alternatives (see figure 2-25) contain more acres of old growth in the Old Growth Management Area than others. Also, the old growth component of other management areas is greater in some Alternatives than others (figure 2-76). Alternatives that contain the most old growth have the potential to retain it further into the future. These alternatives have the best potential to mitigate the loss of old growth.

Unavailable Information

Old growth ecosystems are not well understood or studied and as a result leaves many questions unanswered What living creatures live in this ecosystem and how can we perpetuate the ecosystem? How much old growth does the Forest have and how much growth will there be over the next 50 years? This information is not known and needs to be analyzed

Monitoring

The Forest needs to complete the old growth definitions being developed by Dr. Bill Hopkins, Forest Ecologist. Then an inventory of the Forest, using those definitions, needs to be completed to determine the actual amount of old growth. Also, the Old Growth Management Areas need to be visited and inventoried for old growth characteristics. Finally, an assessment on how well the acreage allocation is meeting the needs of the management indicator species needs to be completed

Coordination With Others

The information used for how much old growth and for what reasons to maintain old growth has been coordinated with conservationists, wildlife experts and the general public. While this has occured, not all agree on the numbers in the allocation.

Forest Health

Introduction

We are defining "Forest Health" for the purpose of this analysis as a condition where the influence of forest pests does not threaten either long or short-term resource management objectives Forest pests will be defined as insects and disease-causing agents which utilize living vegetation for all or part of their life cycle and in the process interfere with the normal growth, development, life span or form (including wood quality) of the affected plant. The analysis will focus on potential impacts of the program activity having the most effect on forest health "tree harvest activities".

Interactions and Assumptions

Insects and diseases have a significant effect on the structure, species composition and condition of the forest ecosystem of the Deschutes National Forest. Three groups of pathogens have a large impact on the forest: Dwarf Mistletoes, Root Diseases and Stem Decays. There are two groups of insects of major importance· Defoliators and Bark Beetles. The following discussion will be limited in scope to these agents and their effects in terms growth of loss, defect, and mortality, hereafter referred to as impact. Because of widely varying resource management objectives associated with the different management allocations, the impact of forest pests will provide a common basis of comparison.

We realize that not all impacts from forest pests are in conflict with management direction For example, a certain amount of mortality and defect may be desirable to provide habitat for wildlife, fish, and visual interest as character trees We also realize that acceptable levels and kinds of impact vary with management allocations, and, even within the same management unit when weighed against other resource considerations. For example, much more growth loss might be tolerated in a visual management zone than in an area where the main objective is timber production. Yet, in neither management area are hundreds of contiguous acres of dead trees acceptable.

Related ICO's

How much timber should be harvested and on what schedule?

How should the Forest manage the lodgepole pine stands which are infested with mountain pine beetles and stands which are susceptible to infestations?

How can the Forest maintain scenic beauty while providing for timber production and other goods and services?

How should the Forest protect vegetation from damage by forest pests?

Effects That Do Not Vary Between Alternatives

Every silvicultural alternative, including no treatment, affects insect and disease levels and their impact on the forest ecosystem. Vegetative manipulation can both increase or decrease insect and disease risk

Every alternative includes some stands which will be manipulated silviculturally along with other stands which remain untreated. In addition not all stands scheduled for treatment will have pest management considerations incorporated into the treatment. The following is a comparison of the no treatment with the harvest treatments where insect and disease considerations are incorporated into the prescriptions as well as the harvest treatments without regard to insect and disease considerations

Dwarf mistletoe· If left untreated without the re-introduction of a sanitizing agent like fire, dwarf mistletoe will be expected to increase greatly in the future with an associated increase in growth loss, mortality and deformities in future regeneration. This could lead to large areas which are inadequately stocked and/or stocked with small, deformed trees with no suitable seed trees to naturally regenerate the stand

Root disease and stem decays Because root disease problems are already well-established and widely distributed in the mixed conifer compo-

nent, one would expect these centers to increase in size if left untreated Some possible outcomes of this condition include stands dominated once again by pine or converted to browse and shrubs for a number of years

If left untreated, existing damage from stem decays would continue, with trees dying or toppling over before reaching the expected size or age they would have attained had they not been affected with stem decays. Increased risk associated with wounding as a result of harvesting operations would be expected to abate but wounding from falling decadent overstory trees would continue. In addition, multi-storied, dense mixed conifer stands would be the result of a cessation of all harvest operations on many sites. Stands of this type and density are at high risk of sustaining significant impacts to stem decays. Thus, the forest would sustain a higher level of damage from decays than would have been expected in the natural forest ecosystem, or under a harvest system in which seral species were favored.

Bark beetles: All of the major bark beetle species on the Forest benefit from conditions which reduce the vigor of their host plants. If left untreated, trees growing in densely stocked stands are very susceptible to depredation by bark beetles This risk is probably greatest in even-aged monospecific host stands which, if left untreated, will not only be decimated, but will have the capability of generating extremely high populations of bark beetles which may overwhelm trees in managed stands as well. In addition, the large number of snags left after an outbreak would present a serious fire hazard

Harvest activities can, in many cases, help minimize or completely avert the undesirable impacts of forest pests.

Dwarf mistletoe· The dwarf mistletoes are one of the few agents of forest disease that can be effectively controlled by harvest methods Features that make the dwarf mistletoes amenable to silvicultural control are: they are obligate parasites so they live only as long as the host does; they are species specific; they have long life cycles, frequently 4 to 6 years; the rate of spread through stands is slow; they are readily detected and cause distinctive symptoms.

Some silvicultural control strategies for dwarf mistletoe include. favoring non-host species during thinning, replacing badly infected stands with the same or an alternate species via a regeneration cut, removing an infected overstory followed by a sanitation thinning of the understory, removing all visibly infected trees from the stand followed up with a re-entry after 5 years to remove trees that were either missed or latently infected, and pruning to prolong the life of high value trees on recreation sites

Root Rots and Stem Decays. Once they are established, root rots and stem decays are most effectively controlled by clearcutting and regeneration with resistant species Unfortunately, this means regeneration is the only treatment which will ultimately reverse the levels of root disease and stem disease in a significant number of stands on the forest where it has already developed as a result of past harvesting practices and fire suppression (discussed at length in Chapter 3) In areas where problems have not yet developed, cultural practices which favor non-host species minimize stress factors, wounds and spread of innoculum will keep impacts from root disease at low levels.

Defoliators: There are several manageable variables which determine the level and severity of budworm outbreaks. Harvest activities which reduce the proportion of the host component (Douglas-fir and true firs) would also reduce the risk of budworm damage. Other activities which would have a positive effect toward reducing budworm damage include the reduction of stocking in dense host stands, changing multi-storied stands to single-story stands, improving general stand vigor, converting mature host stands to younger host (or non-host) stands, and any manipulation favoring the more vigorous seral species.

Bark beetles: Since any harvesting practice which favors individual tree growth tends to reduce the risk to bark beetles, stocking level control is the single most important tool available for managing bark beetle populations

Uneven-aged management practices, wherever they are applied, should provide for minimal bark beetle habitat and should prevent the buildup of large beetle populations.

Under certain situations, it may be necessary to adjust the timing of thinning practices to manage *Ips* bark beetles. In general, the Forest is not subjected to the high-level *Ips* outbreaks which occur on drier sites, but the potential does exist (especially in drought years) for damage to occur in young stands. Where these risks are identified as high, thinning slash should be carefully regulated to avoid buildup of these beetles.

Harvest treatments which do not give consideration to specific stand insect and disease conditions, usually result in continued, or increased, levels of impact In many cases, impacts are higher than if the stand had not been treated at all.

Dwarf mistletoe: Frequent salvage cuts in stands with dwarf mistletoe will greatly increase its spread and eventual impact For example, light partial cuts and tree selection (as have often been done in the past) or group selection in stands with mistletoe will create a multistoried structure which optimizes the spread of the mistletoe and puts at risk the maintenance of large trees on the site. The same effect can be seen when infected overstory mistletoe shelterwood or seed trees are not killed or removed in a follow-up treatment once the regeneration has become established Infected overstory trees are a source of infection to regeneration These young trees will never reach merchantable age. A cycle begins with regeneration occurring in openings left by the death of the previous stand of infected regeneration Depending on the mortality rate of the regeneration, this pattern may be repeated over and over. In the mean time, the overstory trees become more heavily infected, and their ability to produce viable seed is greatly reduced. Ultimately they will die, leaving no seed source and a stand composed of small-sized trees with various levels of mistletoe infection.

Root Disease and Stem Decays As discussed before, harvest practices which favor the mixed conifer component, especially practices which result in considerable wounding of residual trees can cause a great increase in the occurrence and impact of both stem decays and root disease. Loss in root disease infested stands, for example, has been estimated to be as high as 75% of normal growth.

Defoliators: Any practice which favors the establishment or proliferation of the tolerant climax species at the expense of the seral species will also increase the stand susceptibility to the western spruce budworm.

Bark Beetles: Any practice which leaves patches of host type in overstocked stands or which leaves low-vigor trees in a stand may be inviting damage by bark beetles These situations may arise from the need to create a diverse mosaic on the landscape (which may include dense stands or low-vigor trees), and it should be recognized that the potential risk to beetles comes with this type of activity. However, as long as these high-risk conditions are minimized or do not occur over large areas, the risk will be localized and large-scale outbreaks will probably not occur Uncontrolled generation of Ponderosa pine slash could lead to problems in certain areas during drought years. Populations of *Ips pini* could build up in this material and could cause top-kill or mortality of residual trees in the thinning areas.

Direct Effects

Dwarf mistletoe: Because dwarf mistletoe is most easily controlled with even-aged management practices, preventing or reducing the impact of dwarf mistletoe would be easiest under an alternative in which even-aged management is the predominant silvicultural system Control of mistletoe would thus be easiest in Alternatives No Change (NC) and the Alternative A, B and C. In alternatives where a significant amount of uneven-aged management is to be practiced, as in Alternatives E and G, controlling mistletoe will be more challenging In the General Forest Management Area, undesirable impacts of dwarf mistletoe can eventually be reduced to the level of the even-aged alternatives but it will take more care, planning, documentation, and monitoring Impacts would be higher, but not necessarily unacceptable, in the visual allocations where management direction does not include maximizing volume production. These areas are much larger in Alternatives E and G than in the other alternatives.

Root disease and Stem Decays: Application of silvicultural practices which favor seral species and reduce overstocking and wounding will be

effective in reducing undesirable impacts of root diseases and stem decays in all of the Alternatives. However, mitigating the impact of root disease and stem decays in Alternatives E and G where the mixed conifer component is to be managed with group selection will be more challenging than managing this component using even-aged systems with openings of 10 acres or more. Group selection methods will create more and smaller openings, thus increasing impacts over a more extensive area over time. This will result in an increased risk of root disease and stem disease as a direct result of the deleterious effects of harvest procedures like wounding, and stress related to compaction. These factors have contributed in the past to an increase in root rots and stem decays (See Chapter 3). Logging systems as well as cutting unit design will have to be sophisticated and will require considerable skill and planning. Even so, the prevalence and associated impacts of root disease and stem decays will probably be somewhat higher. In addition, impacts would be higher, but not necessarily unacceptable, in the visual allocations where management direction is not volume production These areas are much larger in Alternatives E and G than Alternatives NC, B and C

Indirect Effects

Maintaining a healthy forest condition provides positive benefits for a wide variety of resources. Long-term production of timber, maintenance and enhancement of scenic resources, wildlife habitat and others are guaranteed when the forest is maintained in this state

Planning areas which are subjected to high impacts from pests may become devoid of wildlife cover, reduced visual quality and timber productivity It may take many years to re-establish the vegetative condition necessary to enhance or even achieve minimum levels of a desired resource. In the meantime the particular resource value has been irretrievably lost

Cumulative Effects

Any alternative which reduces biodiversity over large areas runs an increased risk of sustaining damaging pest epidemics None of the Alternatives will result in a completely uniform forest However, there are relative differences between each of the alternatives. For example, in the special use zones where uneven-aged management is ultimately to be practiced under Alternatives E and G in a majority of the stands, horizontal diversity would be much lower than in alternatives which put these areas under even-aged management

Mitigation

Mitigation measures for achieving and maintaining forest health are found in the standards/guidelines (Forest-wide, and for each management area). The key to maintaining forest heath is maintaining an overall state of vigor and diversity throughout the forest ecosystem. Strategies to achieve this emphasize prevention (rather than suppression) of pest problems through silviculture (see standards/guidelines) and the development of quantifiable resource management objectives. Pest management specialists are available on the Forest to assist resource managers in pest identification, assessment, and, if necessary, control techniques and priority systems for treatment.

In addition, stand exams of proposed analysis areas with reliable stand delineation and pest information are also critical in mitigating the undesirable effects of pests on resource management objectives These exams enable the Interdisciplinary Team to more easily perform area analysis and supply quantitative pest inputs into available stand dynamics models which can then be used to compare proposed management alternatives objectively.

Unavailable Information

Models presently available do not incorporate the effects of dwarf mistletoe In addition, present models do not handle the interactions of multiple pest agents

The present amount and distribution of root disease throughout the forest has not been systematically measured, nor has the extent and severity of dwarf mistletoe in the plantations

Detailed scientific information is lacking pest behavior in stands of more complex age class structure and species composition than even-aged single species stands (eg stands with a mixture of species and/or age classes). In addition, information on response of pests to management techniques in these stands is also lacking in many cases.

Monitoring

If we are to adequately monitor Forest Health it is imperative that we know current levels of Forest insects and diseases as a basis for determining change. Past aerial surveys will provide baseline information in large-scale insect damage and damage from foliar blights. Past surveys can also provide historical levels of these agents

More chronic problems, however, including root disease, dwarf mistletoes, and insect pests of young trees (eg. seed and cone insects) are not adequately measurable by aerial survey techniques. Moreover, although Forest wide baseline information on the occurrence and severity of dwarf mistletoe was gathered in the 1986 Forest Vegetation Inventory, similar information was not gathered for the root diseases so we estimated baseline amounts.

We also must carefully monitor and document changes in these levels as we continue to manage the Forest. Aerial surveys will be used to monitor yearly fluctuations in large-scale insect damage and damage from foliar blights Chronic pest problems will be tracked through stand exams and the stand data base system along with other stand information necessary to formulate quality silvicultural prescriptions. The Forest GIS program must have the ability to aggregate and reclassify this information by project planning area, Ranger District or Forest

Pest Management specialists will periodically review a variety of project environmental documents to insure that pest considerations are incorporated into the project planning and implementation as specified in the Standards and Guidelines. A written report as a result of this review will be provided periodically to the Forest Supervisor

See the List of References for sources used by Planning Team members in preparing this and other technical documents.

Air Quality

Introduction

Forest management activities can affect air quality by adding smoke and dust to the air.

Prescribed burning activity does affect air quality and can have a significant short-term impact. It can originate on National Forest and/or on other land ownerships inside or outside the Forest boundary.

The impact of wildfires can also have a significant short-term impact on air quality. Smoke emissions are usually present through the duration of a specific fire, dissipating as a result of prevailing weather patterns. Predicting the occurrence and resulting emissions from wildfires is not possible, but a discussion of the situation is included.

It is recognized that air quality has an effect on human health The effect, due to Forest activities, is not clearly understood and is not displayed by alternative.

Interactions and Assumptions

Two by-products of management activities prescribed in the Alternatives have the potential of significantly affecting air quality, they are smoke and dust The amounts of these have indirect affects on visibility and in limited circumstances human health.

Effects That Do Not Vary Between Alternatives

Direct Effects

The existence of smoke from off-Forest prescribed burning, haze from nearby populated areas and

smoke from agricultural burning can combine with on-Forest prescribed burning to amplify air quality degradation. This most often occurs during spring and fall periods when burning takes place under more stable atmospheric conditions or when the wind has a strong easterly direction. The cumulative effect of multiple contributors of smoke and haze in the air is not expected to change significantly between alternatives. Any smoke, produced by Forest activities, would comply with the Oregon Smoke Management Plan

Dust

A potential for short-term air quality impairment from dust is created by a variety of management practices Machinery operations related to timber management often raise clouds of dust. Traffic on roads is another source of dust. Prescribed burn areas can also be a source of dust on windy days, depending on time of burn and subsequent rainfall and revegetation Road construction and maintenance machinery operations are also dust contributors both in the actual road work and in rock crushing operations. These impacts are usually of a local nature and short duration.

Anticipated levels of dust from these management activities are considered too low for detailed projections. They will be discussed further in the mitigation section

Indirect Effects

No indirect effects are known at this time

Effects That Vary Between Alternatives

Direct Effects

Smoke

Smoke and dust reduce visibility. There is a direct relationship between TSP amounts and visibility impairment. For example, the amount of visibility impairment (measured in days of smokey conditions) will be twice as much if TSP production doubles. The effects of each alternative on visibility can be seen in Figure 4-12 The reductions in TSP levels represent a similar reduction in visibility impairment

The principal smoke emissions affecting visibility are the fine particulates added to an airshed. Particulates contributed to the air by activities are measured by tons of total suspended particulates (TSP)

Smoke contributes most of the particulate material that originates from the Forest The two major sources of smoke for the area are from wildfires and prescribed burning.

The TSP production from wildfires is highly variable; estimates for the Deschutes National Forest range from 25 tons in years of infrequent wildfires to 7,000 tons in years of numerous wildfires.

The TSP production from prescribed burning will vary between the Alternatives, depending on the mix of management activities such as range improvements, timber management practices, wildlife habitat improvement, road construction, and natural residue hazard reduction. The following assumptions are made in the discussion of smoke-generated TSP's

The estimated TSP's contributed by smoke from wildfires will vary between alternatives. Alternatives with greater numbers of Forest visitors and fewer management activities could increase the number and size of wildfires. Fewer management activities would allow natural fuels to increase Greater numbers of Forest visitors could increase the number of human caused ignitions. The combined increase in fuels and ignitions could result in more and larger fires with a corresponding increase in smoke and TSP production

TSP production rate used was 25 pounds per ton of activity residue consumed and 40 pounds per ton of natural fuels consumed (personal communications with Dave Sandberg, PNW Forest Residues Lab, Seattle, WA, 1989)

Figure 4-12 depicts a decline in emissions projected for all Alternatives over time This is due to the expected gradual reduction in natural residue loadings from current levels and an increase in utilization of activity residues

This figure also displays that the Forest will meet the State's goal of a demonstrable reduction in emissions from Eastern Oregon sources (State of Oregon, 1987)

Figure 4-12 Total Suspended Particulate Emissions (Tons per year)

Decades	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
1st	2700	2700	3400	6000	1400	900
2nd	2500	2500	1700	3900	900	700
5th	1700	1700	2000	1800	1400	500

The potential for effects on the class 1 designated airsheds (i e. Three Sisters, Mt. Washington, and Mt Jefferson Wildernesses) would vary by alternative. Alternative C would have the highest risk to degrade the air quality over the Wilderness areas. Alternative G would have the least risk. The other alternatives have a risk between these two extremes and directly related to the amount of the emissions displayed in Figure 4-12.

Indirect Effects

Firewood

There is an indirect effect on winter air quality in local urban communities through the firewood provided by the Forest. This form of utilization of former waste residue helps reduce smoke emissions from the Forest but now tends to concentrate those emissions in the towns.

Human Health

The FEIS on Managing Competing and Unwanted Vegetation (U.S.D A. Forest Service, 1988) provides a detailed investigation into the effects of smoke on human health. The following is a summary of that investigation pertinent to this FEIS.

Short-term effects due to high level exposures immediately adjacent to prescribed fires or wildfires include "..eye irritation, coughing, and shortness of breath in moderate-to-heavy smoke " This type of exposure is generally experienced only by forest workers since the general public is not normally involved in such activities.

Documentation of adverse effects from long-term exposure to wildland fire smoke is virtually nonexistent. Forest workers are at some risk from low-level exposure contributing to such health effects as emphysema or lung cancer Long-term effects from even lower levels of smoke experienced by the public-at-large are less well known. Individuals with chronic lung disease or other respiratory ailments may experience additional irritation from the infrequent episodes of stagnated smokey airmasses.

There are a number of potentially toxic components known to exist in wildland smoke. However, the levels experienced under normal conditions and exposures are well below any levels known to cause harmful effects on humans. Some of the more common are carbon monoxide, carbon dioxide, carbon particles, and trace amounts of a number of chemicals that may enter the lungs on the surface of particulate matter. Close to 90 percent of the particulate matter is small enough (less than 2 5 microns diameter) to penetrate deeply into the lungs

Some of the components (polycyclic aromatic hydrocarbons) are known carcinogens under exposures much higher than those documented from wildland smoke. Other components, such as the aldehydes, are acute irritants. These are most

likely to affect forest workers who receive high exposures at burn sites

Cumulative Effects

Visibility

Because of the regional scope of visibility effects and problems, Region 6 of the Forest Service has been conducting cumulative effects analysis on TSP production through subregional analysis of emissions (for example, Eastern Oregon). The FEIS for Managing Competing and Unwanted Vegetation contains the latest information on this continuing analysis In that analysis, the Deschutes National Forest is considered as a part of the Eastern Oregon subregion This subregion is projected to reduce emissions by 23 percent under the selected alternative in the Vegetation Management Plan. The Deschutes National Forest will contribute to that reduction in all of the Alternatives in this FEIS.

Human Health

The projected reductions in emissions for all Alternatives should continue to widen the gap between probable exposures and any possible health effects chronic or acute.

Mitigation Measures

These general mitigation measures are applied to the extent commensurate with the resource goals and objectives of each project

Smoke abatement techniques provided in the Vegetation Management FEIS will be guidelines for the Forest These techniques include:

Protection of visibility in Class I areas and the overall air quality is an important objective. All prescribed burning will be done in accordance with all state and local air-quality regulations Special care will be taken to prevent smoke from affecting the visibility in Class I areas during periods of high visitor use

Prescribed burning will be planned to avoid smoke intrusion into smoke-sensitive areas identified in the Oregon Smoke Management Plan (Bend is the closest).

The "best available technology" will be used to reduce smoke, taking into account other land management practices and costs, as determined on a case-by-case basis The "best available technologies" applicable to prescribed burning on the Forest include but are not limited to

Utilization of woody material prior to disposal of excess.

Reducing felling breakage through directional felling.

Rigorous mop-up of prescribed burns where long duration smouldering of duff may be a problem.

Rapid (mass) ignition to reduce smouldering phase of combustion

Burning only during optimum conditions, including burning at the highest fuel moistures practical in order to reduce fuel consumption, timing ignitions in coordination with surrounding land managers to avoid overloading local air masses, and avoid burning during stable atmospheric conditions which decrease the probability of adequate smoke dispersion

Vegetation treated with herbicide will not be burned for at least one year

Smoke from fire wood for heating purposes can be decreased by increasing public awareness of efficient wood stove use. Proper harvesting and aging of wood, efficient wood stove operation and reduced use of wood stoves during periods of air stagnation, can reduce the detrimental effects of burning wood All wood stoves sold in Oregon must meet D.E.Q. standards for particulate emissions

Fugitive dust abatement will be aided through:

Road watering, oiling or paving as warranted by conditions.

Controls on machinery operations timing in relation to other use activities.

Dust abatement controls on stationary sources such as rock crushing operations.

Potential Conflicts With Plans & Policies of Other Jurisdictions

Smoke management plans in existence (Oregon State and Madras Seed Growers) provide a cooperative framework to minimize conflicts between prescribed fire users in scheduling burns. These will also minimize conflicts with other users of the Forest and surrounding country

Range

Interactions

The condition of rangelands is affected by the intensity of grazing management and the implementation of improvement work. The quality and quantity of forage resulting from these activities determines the capacity for livestock and wildlife grazing. The condition of riparian zones and stream channels within livestock allotments is also affected by the intensity of management.

Rangelands and their utilization by livestock and wildlife could be enhanced. Old, decadent bitterbrush dominate several acres of rangeland. Burning or crushing of these sites would foster regeneration of more palatable grasses, forbs, and younger shrubs. Water is generally in short supply on rangelands. Water development projects would disperse grazing, increase carrying capacities, and enhance the profitability of livestock grazing. On some rangelands, livestock grazing is needed to maintain quality forage. Improvements such as fencing would be needed to manage their use. Fencing may also be desirable to control livestock use in riparian areas.

The quantity of rangeland is related to the amount of timber harvest Grasses, forbs, and brush are generally abundant on sites after the coniferous overstory has been removed

The Alternatives would affect the amount of available rangeland and the quality of forage

Range management direction is included in each alternative. This direction would determine the quality of rangeland The quantity of rangeland will increase in alternatives which call for higher levels of timber harvest.

Assumptions

The following assumptions were used to evaluate the Alternatives:

Alternative evaluation is based upon predicted effects on livestock grazing capacity (AUM's). An AUM is the forage required by a mature 1,000-pound cow for one month (800 pounds). AUM's can be converted to numbers of animals by the following factors·

Livestock	*AUM Factor*
Mature cow	1.00
Mature cow with nursing calf	1.32
Yearling (9-18 months)	0.70
Bull	1.50
Mature sheep	0.20
Ewe/lamb	0 30
Horse	1.20

AUM's projections associated with each alternative are presented as a relative index of overall rangeland capacity, and are not intended to diminish the importance of these areas for other uses such as big game forage.

Livestock grazing will be managed to maintain allotments in satisfactory conditions in all alternatives. Where unsatisfactory conditions are encountered, AUM's will be reduced if needed to improve conditions.

The range direction included in each alternative will determine the potential AUM outputs. A potential grazing capacity of approximately 35,000 AUM's is associated with current management direction This capacity could be increased to about 45,000 AUM's if a greater emphasis is placed on management and improvement work such as water developments and forage enhancement. For alternatives with higher levels of investment,

an increase to as high as 60,000 AUM's is possible as projects such as fertilization are incorporated.

Increases in timber harvest could also increase potential grazing capacities. In 1988, approximately 240,000 acres within allotment boundaries were not suitable for grazing Some of these acres were unsuitable because they were forested. In alternatives with high timber harvest acres, increases in canopy removal would result in more acres of potentially useful rangeland However, for increases in grazing capacity to occur, the increase in grazing acres would need to be accompanied by an increase in management emphasis for improvements such as fencing and water sources

Reductions in grazing capacity will occur if management emphasis and timber harvest acres are reduced

Related ICO's

How should the Forest consider local and regional economies, lifestyles, and population levels in managing Forest lands?

Effects That Do Not Vary Between Alternatives

Livestock Grazing

Livestock grazing affects plant vigor and compaction. Unless managed, use levels can cause detrimental effects. Within allotments, livestock concentration points (salt licks and water sources) can become trampled and abused. Detrimental soil compaction could result

Improved and increased livestock grazing are possible with improvements in forage quality and water availability. Livestock grazing can be used as a means to maintain quality forage conditions.

Livestock grazing could also be used to achieve other resource objectives. Grazing in timber plantations may be used to reduce vegetation competition. Similarly, grazing could be used as a tool to achieve vegetative conditions desired by Forest recreationists.

Timber

Timber management will alter the structure and composition of forest plant communities Timber harvesting can increase the amount of forage available for wildlife and livestock, and improve its palatability and nutrient content.

While in the short-term, timber management may cause some soil disturbance and compaction, negative long-lasting effects in the range resource are not anticipated.

Recreation

Some reductions in commercial livestock grazing may occur in response to increased recreational use. Public dissatisfaction with the presence of livestock in popular recreation areas could require elimination of commercial livestock use.

Recreation stock may cause localized damage to range conditions near streams, meadows, and lakes.

Wilderness

Wilderness designations limit commercial livestock grazing to two allotments permitted prior to establishment of the wilderness.

Wildlife

Allocation of available forage between livestock and wildlife can cause conflicts; however, none is anticipated at projected levels of livestock grazing. Reductions in livestock use on big game winter ranges would be necessary if a conflict were to occur.

Livestock can be used to maintain quality forage conditions on wildlife ranges.

Fish and Water Quality

To achieve desired range conditions along stream channels and within riparian areas, intensive management of livestock may be needed Riparian areas and stream channels are very sensitive to physical damage such as trampling and compaction The vegetation in these areas are important components of stream bank stability, and fish and wildlife habitats. To accomplish these resource

objectives, range management could require modification of livestock grazing practices

Effects That Vary Between Alternatives

Figure 4-13 Factors with the Potential to Affect Range Quality and Carrying Capacity.

Factor	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
Timber Harvest (M acres) (% Change)	1.019 +4%	1 019 +4%	1.065 +3%	1.050 +3%	1.017 -1%	0.824 -7%
Relative Intensity of Grazing Management and Improvement Work	Low	Low	Mod.	High	Mod	Low
Recreation (MRVD's)	1 837 +32	1.837 +32	2 567 +84	3 493 +150	2.770 +99	2 045 +47
Mule Deer (M Deer)	20 3	20 3	23 3	23.3	23.3	16 7

Figure 4-14 displays estimates of the effects of each alternative on potential livestock grazing capacity

Figure 4-14 Grazing Capacity in MAUM

Dec.	No Change	Alt A	Alt B	Alt C	Alt E	Alt G
1	35	35	35	35	35	30
2	35	35	45	45	45	30
3	35	35	45	60	45	30

Alternative "No Change" and A

Existing forage conditions would be maintained. Low cost management systems and improvement projects would be incorporated to encourage uniform distribution and use of forage and to maintain plant vigor. Timber harvest would make more forage available to livestock and wildlife and improve its palatability and nutrient content. Increased recreation use would result in minimal conflicts with forage utilization by livestock No conflicts with big game forage needs would be anticipated.

Alternative B

Forage conditions would be improved through maintenance enhancement work. Use of vacant livestock allotments would be encouraged. Management systems and improvement projects would improve the distribution and use of forage Timber harvest would increase forage availability for livestock and wildlife and improve palatability and nutrient content. Increased recreation use would result in conflicts with livestock grazing on some allotments. No conflicts with big game forage needs would be anticipated.

Alternative C

Management systems and improvement work would be implemented to maximize forage for livestock and wildlife. Heavy investments in improvements such as brush disposal, fertilization, and seeding would be used to improve the quality and quantity of forage. Timber harvest would make more forage available for livestock and wildlife and improve its palatability and nutrient

content Increased recreation use would result in conflicts with livestock grazing on some allotments. Modification of grazing systems may be necessary to eliminate these conflicts. No conflict with big game forage needs would be anticipated

Alternative E (Preferred)

Forage conditions would be improved through more intensive enhancement work. Use of vacant livestock allotments would be encouraged. Management systems and improvement projects would improve the distribution and use of forage. Timber harvest would make more forage available for livestock and wildlife and improve palatability and nutrient content Increased recreation use would result in conflicts with livestock grazing on some allotments. No conflict with big game forage needs would be anticipated.

Alternative G

Range forage would experience a reduction in quantity and quality Low cost management systems and improvement work would be incorporated to encourage uniform distribution and use of forage and to maintain plant vigor. However, an overall reduction in conditions would occur at this level of investment Livestock levels would be maintained at current levels. A reduction in timber harvest levels would decrease forage available for livestock and wildlife. Increased recreation use would result in minor conflicts with forage utilization by livestock No conflicts with big game forage needs would be anticipated.

Cumulative Effects

The cumulative effect of more intensive management systems, increased improvement work, and a greater number of timber harvest areas would improve range conditions in Alternatives B and C. Range conditions would be particularly improved in Alternative C. Lower levels of timber harvest and reduced range management intensity associated with Alternative G would have a negative cumulative effect on range conditions

Mitigation Measures

Range will be managed to provide desired future conditions for livestock and wildlife grazing, to enhance long-term sustained site productivity, and to achieve riparian and water resource objectives. To assure these goals are met, several mitigation measures will be adopted.

Livestock grazing will be carefully managed Allotment Management Plans will be produced for each allotment The plans will define specific range objectives, a timetable for accomplishment, management prescriptions (i e. grazing system, stocking level, improvement needs), and a monitoring plan Practices needed to protect and enhance fish and wildlife populations will be included. Forage utilization standards will be developed based upon Forest Plan standards and guidelines. Stream bank protection will be ensured by identifying stream channel standards.

Allotment Management Plans will serve as the basis of monitoring efforts and be used to develop annual livestock operating plans. Annual plans will be prepared with permittees and will identify specific livestock management practices needed to achieve range objectives.

Range enhancement projects will also be used to mitigate or eliminate undesired conditions Forage regeneration, brush restoration, water development, and fencing are examples of projects which could be adopted to enhance forage conditions or disperse livestock and wildlife use.

Monitoring

Monitoring will be an important component of range management Forage utilization within active allotments will be sampled every two years. Range vegetation condition and trend within active allotments will be monitored once each decade. The condition of stream banks and riparian areas within allotments will be monitored every five years.

Geothermal Energy

Introduction

Geothermal energy is a "new" resource to the Forest and appears highly attractive as a source of electric generation The electrical energy surpluses of the Pacific Northwest have nearly disappeared and the search for new sources of electric generation has begun Increased exploration for and confirmation of geothermal energy will likely occur during the next ten years. During this time, the Forest will likely see development of one or two 10 to 30 MW (megawatt) power plants

On this Forest, the first geothermal leases were issued in 1982, four years after the first Forest Plan Since no geothermal development has yet occurred (as of 1990), the probable environmental interactions of this resource with other resources and activities must be drawn from those in existing geothermal developments elsewhere in the western United States and the world. For the production of electricity, geothermal development has become a mature industry worldwide during the past 15 years, and many experiences can be related to probable future development on this Forest.

Exploration and development of geothermal energy is carried out largely by private companies under the Federal leasing program. The type of activities that are involved are shown in Figure 4-15.

Figure 4-15 Types of Activities Involved in Geothermal Exploration and Development

Process Steps	Activity
Leasing	Environmental analysis and lease recommendations
Preliminary Exploration	Geologic mapping, electronic surveys, temperature gradient drilling
Exploration Drilling	Road and drill pad construction, drilling test wells, flow testing wells, abandoning (closing) unsuccessful well, and reclaiming disturbed areas
Field Development	Road and drill pad construction, drilling several wells, flow testing wells.
Plant Construction and Production	Further road and drill pad construction, drilling additional wells, constructing pipelines, generating plant, and powerlines, and revegetating disturbed areas.
Reclamation	Remove buildings, pipelines etc , abandon (close) wells, and revegetate for other resource use

Although potential for the geothermal resource appears high, there is a considerable amount of uncertainly and speculation in the exploration process. Exploration of any particular block of leases proceeds a step at a time and only enters the next step if the results are positive and justify additional expenditure for further exploration. Experience indicates that only a small percentage of the leases are drilled and an even smaller percentage make a discovery and are developed. Activity on the bulk of the leases will not proceed beyond the preliminary exploration stage

Assumptions

Within the next ten years, the Pacific Northwest will move from a surplus of electricity to a deficit as projected by the Northwest Power Planning Council in 1990 For the first time, the Northwest Power Planning Council recommends a confirmation program for geothermal energy.

One or two power plants of 10 to 30 MW each will likely be constructed on this Forest These

will likely be single or double flash systems. Emphasis will be on resource exploration and confirmation.

Development of geothermal energy on this Forest will likely be for the production of electricity, not for space heating or other non-electric uses.

All actions taken on leases, including exploration, development and production of geothermal resources, will require further environmental analysis under the National Environmental Policy Act of 1969

Lease denial, lease notices, and lease stipulations will be used to protect other resources and activities as defined in the Forest Plan.

Interactions

An accurate assessment of potential consequences and interactions of geothermal development with other resources must await a time when information is known about the character of the resource and the technology being proposed for its development. However, Chapter 3 and the brief summary of activities in Figure 3-16 give a perspective of how the geothermal resource might be developed They illustrate some typical developments in terms of the number of wells, plant size, land occupied, etc. Since the location and character of the resource are unknown, the consequences and interactions must be viewed in a broad generic way and be based on experiences in other parts of the country (mainly California) and world

Timber

Construction of drill pads, pipelines, roads, generating plants and powerlines would destroy some vegetation. At least a part of the area potentially developable is in timber stands. The resource would be used for 30 years or more during which time the timber resource will be out of production. Areas occupied by buildings, drill pads, and roads will lose all vegetation. Other areas such as pipeline and powerline rights of way and road rights of way, except the running surface, are expected to retain a grass and shrub cover.

The amount of land where vegetation will be lost varies with the type of generating facility For example, well head generators and small plants (5 to 10 megawatt) have different requirements for space than do large centralized plants (50 to 100+ megawatt) Typically, centralized plants and related developments occupy from 5 to 20 percent of the surface area of the geothermal field Field size could vary from 100 acres to several thousand acres If, for example, one assumes that there is potential to produce electrical energy in amounts ranging from 500 to 10,000 megawatts (equivalent to the production of from 1/2 to 10 Bonneville Dams), the amount of surface area affected by development could range from 750 to 15,000 acres. These acres would not be contiguous. The timber resource would be removed from all the area for the range of acres above After the the geothermal resource was depleted, the area would be reclaimed including revegetation with appropriate species.

Range

There are no significant effects on range because most potential geothermal areas are not in range areas However, if development occurs in range areas, grass and shrub cover would remain or be reestablished on about 25 to 50 percent of the disturbed area during the period electricity was being produced. Disturbed soil would be revegetated concurrent with development; and when the geothermal resource was depleted, the remaining area would be reclaimed including revegetating with appropriate species Minor amounts of forage would be created in pipeline and powerline right of ways

Wilderness and Roadless

Classified Wilderness was withdrawn from mineral entry and leasing on January 1, 1984 The Oregon Cascades Recreation Area (OCRA) prohibits leasing after January 1 1989 In keeping with the above, no leasing is planned in Wilderness or the OCRA

Development of the geothermal resource could have some indirect effect on wilderness and OCRAs if the resource were to be developed with generating plants located adjacent to these areas. Visual quality could be affected by steam plumes and visibility of some structures. Noise during well

drilling, well testing, plant construction, and odors from hydrogen sulfide are other possible indirect effects. Muffler systems are used to mitigate noise, scrubbers can remove most of the hydrogen sulfide odors, and some generating systems (binary) utilize technology that does not create a steam plume from cooling towers.

Exploration and development of the geothermal resource could also affect roadless areas The extent to which geothermal and other resource management activities could potentially affect roadless areas can be determined by viewing Appendix C and Table 2-3d These references show that acreages involved with different management strategies. Strategies which favor timber production and winter recreation/geothermal are generally compatible with geothermal exploration and development, so could affect the roadless character by creating roads. During the exploration phase some road construction may be required and, although the density of these roads would not likely be high, they would be higher than what currently exists. In current roadless areas, it may be possible to use low density roads developed for winter recreation for exploration or the reciprocal, using the roads developed for exploration for winter recreation purposes. If a resource were discovered and developed, road density would increase Roadless areas could also be affected indirectly by noise, odors, and visuals from activities on adjacent areas

Recreation

Dispersed Recreation

Unroaded· In areas where the management strategy is to provide dispersed recreation with an unroaded character, there will be no direct effects because leasing is denied The indirect effects would be noise, odors, and possible views of adjacent development.

Roaded. Geothermal exploration and development may add to the road system and create additional opportunities for dispersed recreation such as sightseeing, hunting, cross-country skiing, etc.

Developed Recreation

There would be no direct effects because leasing would be denied or limited through a No Surface Occupancy stipulation.

Leasing would be denied in developed sites such as campgrounds, ski areas, day use areas, etc. Only low-impacting exploration activities would be permitted in nearby areas. One effect of this protection would be to prohibit ski areas and resorts from utilizing the resource in their immediate area, even for direct use, since a lease must be authorized to provide for any type of geothermal resource use.

Developed recreation may be indirectly affected by noise, odors, and by the sights of adjacent activity and development.

Visual Quality

Construction of roads, drill pads, and plant development may affect the visual quality. These effects may not be pronounced during the exploration phase However, if the resource is developed, some of the facilities would likely be visible. Plant siting in highly sensitive areas such as along major highways would not be permitted. Depending on the powerplant technology used, some steam plumes from cooling towers could be visible. In the operating stage, there would be an industrialized character to the sites While proposals for development will be expected to meet visual standards, there may need to be exceptions because many of the visual areas are linear in shape and must occasionally be crossed. Some mitigation of the visual impact is possible by controlling patterns of vegetation removal and the design and color of facilities.

Wildlife Habitat

Human activity associated with exploration and development may affect patterns of wildlife habitat intermittently. Exploration activities are generally low density and short-term, ranging from a few days to a few months. If development takes place, activity would substantially increase during construction and development, but would reduce to a lower level during production. The production phase would last for 30 years or more.

The timing and location of activities in relation to key habitat and use patterns would determine the significance of displacement or disturbance Potential conflicts would be greatest in areas where wildlife concentrate and during periods of migration and reproduction

Stipulations that restrict the season of use will be used to mitigate the effects and protect sensitive wildlife habitat

Threatened and Endangered species habitat will be protected by limiting surface occupancy.

Old Growth

The old growth resource should not be significantly affected by geothermal exploration and development. This is because the acreage affected by activities will be small and dispersed.

Air

Impacts of a single geothermal facility on air quality are usually minimal when viewed from a Regional or National perspective However, they may be locally significant because of highly site specific factors. The complex geochemistry of geothermal fluids is highly variable in concentrations of noncondensable gases from field to field and even from well to well

Noncondensable gases are typically carbon dioxide with lesser amounts of ammonia, methane, hydrogen sulfide, mercury, radon, boron, and trace metals

Noncondensable gases are principally emitted by condenser gas ejection, cooling tower exhaust, power plant bypassing during shutdown, and well venting Hydrogen sulfide is the most troublesome because of its odor, even at low concentrations At higher concentrations it affects the nervous system by causing excitement and dizziness Systemic hydrogen sulfide poisoning can result in respiratory failure.

The greatest danger from hydrogen sulfide is to drilling crews during drilling. Available mitigation measures normally include detection and alarms, emergency breathing equipment, well shutdown procedures, mufflers with scrubbers, and chemical solutions that can be injected to remove hydrogen sulfide.

Concentrations causing discomfort but not posing a risk to public health or welfare occur at generating facilities Several treatment technologies have been developed for generation plants, including those that create sludge as a waste product and need proper disposal. Present evidence indicates that hydrogen sulfide will not cause severe vegetation damage. Various State and Federal agencies are proposing emission limits for hydrogen sulfide.

Boron has been determined to cause symptoms of stress and serious damage in some tree species. It is unclear whether it would be considered a serious environmental hazard at this time Boron can be removed before being vented to the atmosphere.

Noncondensable gases appear to be a minor problem when resource development uses binary generating technology or is a direct use. Binary systems use a closed system to handle geothermal fluids, thereby reducing or eliminating their exposure to the atmosphere.

Water

Water pollution could occur at any stage of geothermal exploration or development. Many regulations and operating orders are intended to prevent contamination. Surface or ground water can be contaminated by drilling mud which may contain petroleum based additives, by blowouts, in which a well casing ruptures and geothermal fluids mix with water, by rock cuttings that contain toxic chemicals; and by surface erosion during construction Most of these conditions can be prevented by isolating the surface or ground water from possible contaminants This is done by using sumps with impervious linings, properly designed wells and casing, and removal of toxic wastes to acceptable disposal sites

The most serious potential contaminant is "spent" hydrothermal fluids. Ways of disposing of the fluids include evaporation, surface spreading, and injection. The method used depends upon the quantity of waste water. Injection into the producing aquifer is the preferred method especially when fluids contain brine (salts) and other potential

pollutants. This method has the advantage of helping to maintain the long-term productivity of the field by returning fluids to the geothermal reservoir. Subsurface disposal is regulated by the Environmental Protection Agency Regulations, and by State programs developed under the Safe Drinking Water Act.

Direct geothermal applications generally contain much lower levels of dissolved compounds and the fluids are frequently disposed of at the surface after cooling

Noise

A number of significant noise sources are associated with development and utilization of the resource. These sources include sounds from large, diesel powered engines used in construction machinery, compressors and well drilling equipment, compressed air releases, turbines, gas ejection, cooling towers, and venting of geothermal steam during well testing and plant shutdowns For example, the noise level from venting an unmuffled well can reach 130 decibels (db)(about the level of a jet on takeoff) The noise levels for drilling could reach 90 db, and a cooling tower for a 100 MW power plant could reach 84 db (slightly higher than a busy street corner in a city). If sensitive receptors such as schools, residences, or recreation areas are located closer than one mile, there is likely to be some annoyance or complaints unless additional mitigation steps are taken Preliminary noise studies from The Geysers on wildlife indicate that moderately increased sound pressure levels up to 100 db do not produce any drastic changes in wildlife communities. Some evidence indicates that certain species are displaced from noisy areas but noise has not been proven to be the causal factor[1].

Noise shielding by terrain, vegetation, and equipment can mitigate noise levels Full use of demonstrated noise control technology can reduce most source noise to levels acceptable to most quiet rural communities at a distance of 1000 feet[2]

Noise levels are generally insignificant at direct use geothermal sites.

Induced Seismicity

Many of the world's hydrothermal reservoirs are located in regions with a high frequency of naturally occurring seismic events In some areas the withdrawal or injection of geothermal fluids may raise the rate of microseismic events or trigger a major earth movement.

On this Forest it seems unlikely that induce seismicity would be a potential problem for two reasons: (1) the portion of the Cascades located on the Forest exhibits a very low level of seismic activity and, (2) experience with fluid injection in a number of non-geothermal situations has demonstrated that induced seismicity can be minimized or prevented by regulating injection pressures[3] The Federal Energy Regulatory Commission concluded that "it is extremely unlikely that major seismic events could be triggered in this way "[4]

Land Subsidence

The removal of large amounts of geothermal fluids from a geologic formation may cause land surface subsidence (sinking). Permanent and non-recoverable subsidence results from long-term removal of fluids and from the compression of aquitards such as clay, silty material or shale above and below a reservoir.

Subsidence problems can be mitigated through injection of spent geothermal fluids (or other sources of water) which serve to maintain pressures within the reservoir[5 6 7], even with mitigation there could still be some localized sinking around production wells and some uplifting around injection wells.

Reinjection of spent geothermal fluids from electrical generation is the usual practice in the United States and serves to conserve the resource and serves as a preferred disposal method for the fluid. Because of the rolling topography on the Forest, it is unlikely that subsidence would be a significant problem

Water Supply

Geothermal power production typically requires large amounts of water for cooling by evaporation. The source of this water is usually the condense steam from turbines At The Geysers in California,

for example, about 80 percent of the condensed water from turbines is sent to cooling towers where it evaporates, thereby substantially raising the efficiency of the system. The remaining 20 percent is injected back into the geothermal reservoir

Binary systems (in which all geothermal fluids are reinjected) can require large volumes of water for cooling from sources other than geothermal reservoirs. These sources could be lakes, rivers, and ground water If evaporation were used to cool a 50 MW plant, hundreds to thousand of gallons per minute would be needed Water from a lake, river, or an aquifer would be evaporated and added to the atmosphere. Alternatively, surface or ground water could be used to cool a power plant Then it would be returned to its source The returned water would have been heated so that the temperature of the lake, river, or aquifer from which it came would be warmed to some extent. The amount of water needed, even though it would be returned, would be substantially greater than that needed for evaporative cooling

Surface waters above Bend, Oregon, have been withdrawn from future appropriations. However, in rare instances it may be possible to use some of these waters for geothermal cooling. It is generally believed that the ground water basins on the Forest hold a substantial supply of water, except for an area in Lake County which is associated with agricultural irrigation near Christmas Valley[8] A geothermal project proposing to use ground water would need to obtain water rights through the State of Oregon and demonstrate non-degrading effects on the ground water supply

In summary, development of the geothermal resource for power production has the potential to be a substantial user of the ground water resource However, until the type of resource and its reservoir characteristics are understood and the plant technology is determined, it is difficult to determine the effects on ground water. It should be possible to limit or mitigate the impacts because geothermal is developed in increments and need not move to the next increment unless the effects on ground water are acceptable

Social and Economic

Social effects may cause by some influx of new residents into the area. In Chapter 3, (Economics of Geothermal Development and Operation) shows estimates of the number of workers at 50 per day for about 24 months and recognizes the possibility that some 600 different individuals might be involved during the construction of a 50 MW plant If you assume 3 5 family members per worker, this could temporarily add some 175 people to the area because of the project Similarly, the operations and maintenance workforce of 10 to 20 workers would involve 35 to 70 people living in the area on a permanent basis

Assuming that 50 percent of these people come from outside the local area, such an increase would probably not affect a city the size of Bend, however, such an increase could be significant to the smaller outlying towns in the area. Such population increases may require the development of additional housing and public services, including schools. Similar impacts have been mitigated elsewhere by using contributions from the geothermal developers on a "cost-incurred" basis for the increased public service requirements Another source of funds to mitigated the impact is provided by Public Law 94-579 Section 317(c) which allows counties to borrow funds from the Federal Government against future revenues which they will receive from rentals and royalty payments made by the developers.

Depending on the scale of geothermal development, the generating plant will tend to give visitors to the Forest the impression of a low density industrial development of a type they are more accustomed to seeing near urban areas Such an impression can be minimized by proper design, coloration, vegetation management and other methods Nevertheless the installation will change the character of the Forest because of its relatively permanent nature A geothermal development could attract a significant number of visitors interested in understanding its operation and the resource being utilized.

Economic impacts of geothermal development consist of effects on employment and income to individuals. These effects are created by temporarily employing people for drilling and plant construction and permanently employing people for operating and maintaining the development. For example, a Federal Energy Commission report estimates that the construction of a 100 MW plant would create 15 permanent jobs and 150 to 175

temporary jobs. On the basis of $20,000 annual wages per worker and an employment multiplier of 2, each 100 MW plant should result in a net income increase to the area of approximately $7,000,000[9]

There is also the potential for significant revenues to the county or counties involved based on their sharing 50 percent of the rent and royalty payments from Federal land Additionally the value of the developments would contribute to the area's property tax base.

Significant revenues would flow to the county in which geothermal production occurred. At the present time, a rental fee and a 10 percent royalty from steam or electricity would be shared equally between the Federal government and the county. County taxes on the value of the development could be substantial. Annual revenue to the county from all these sources could be on the order of $1,000,000 for each increment of 15 megawatts generated.

Electric Output

No geothermal resource of commercial value has yet been discovered on this Forest as of March 1990 However, the potential for generating electricity from geothermal energy appears high. Estimates of electrical output have been made for several areas of the Forest but are acknowledged by their authors to be highly speculative. At the present time, not enough is known about the location and quality of geothermal reservoirs to relate their potential electric output to alternatives, other resources, and other activities.

Related ICOs

This Forest Plan provides for the exploration, development, and production of energy resources on the Forest while maintaining compatibility with other resource values.

Effects That Vary Between Alternatives

Geothermal reservoirs are different from place to place They have greatly different fluid chemistries, temperatures, and other characteristics. Different technologies can be used to deal with these reservoir differences. Geothermal reservoirs of commercial value probably exist on Deschutes National Forest but none have been discovered or characterized At the present time, not enough is known about potential consequences of development or about the technology being proposed for development. Therefore, effects that may vary between alternatives are not known at this time.

Direct and Indirect Effects

These effects are covered in discussions under the previous section on Interactions.

Cumulative Effects

Geothermal energy production generally removes heat from reservoirs faster than heat is replaced so that geothermal developments have a finite life time. Life times are not known but are usually 30 years or more based on existing developments in the world. There is reasonable speculation that depleted reservoirs recharge with fluids and heat after a period of time, perhaps tens to hundreds of years. When viewed over a long period of time, geothermal energy is largely renewable

Careful planning, constructing, operating, and monitoring of geothermal developments based on a large body of federal and state regulations assure that serious environmental impacts will be small or non-existent For example, the probability of a well blowout is very low, or the probability of surface or airborn contaminants such as boron or arsenic escaping to alter vegetation is also very low.

As the need for electricity increases over the next ten years in the Pacific Northwest, the number and size of geothermal developments may increase on the Forest. Certain existing roads will likely need to be improved and new roads constructed. Areas will need to be cleared and graded for well pads, pipelines, powerplants, and powerlines. Once a powerplant is constructed, new wells must be routinely drilled to replace older wells as their outputs drop.

An increasing number of powerplants that use evaporative cooling systems may increase the number of visible steam clouds generated by the cooling systems

As well pads and other facilities lose their function, surface improvements are removed and the land reclaimed for other uses through required reclamation plans and projects. Wells are abandoned according to federal and state regulations, well pads are typically reshaped and planted with appropriate vegetation; pipelines, powerplants and transmission lines are removed and their sites shaped and revegetated; and roads are either closed and reclaimed or managed for a different use.

Mitigation Measures

Vegetation

Disturbed areas would be revegetated concurrent with development except for areas specifically occupied by buildings, well pads, cooling towers, etc After depletion of the geothermal resource, the remaining area would be reclaimed including revegetating with appropriate species.

Visual Quality

Mitigation of the visual impact is possible by controlling the location of facilities, the design and color of facilities, and patterns of vegetation removal.

Wildlife Habitat

he location, timing, intensity, and types of activities in relation to wildlife habitat and use patterns would determine stipulations that would protect sensitive wildlife habitat.

Air quality

The greatest danger from hydrogen sulfide is to drilling crews during drilling. Available mitigation measures normally include detection and alarms, emergency breathing equipment, well shutdown procedures, mufflers with scrubbers, and chemical solutions that can be injected to remove hydrogen sulfide

Noise

Noise shielding by terrain, vegetation, and equipment can mitigate noise levels Full use of demonstrated noise control technology can reduce most source noise to levels acceptable to most quiet rural communities at a distance of 1000 feet[2].

Water Quality

Many regulations and operating orders are intended to prevent contamination. Subsurface disposal is regulated by the Environmental Protection Agency Regulations, and by State programs developed under the Safe Drinking Water Act. If regulations are followed and monitored, the risk of contaminating ground and surface water is small.

Water Supply

It should be possible to limit or mitigate the impacts because geothermal is developed in increments and need not move to the next increment unless the effects on ground water are acceptable.

Potential Conflicts With Plans & Policies of Other Jurisdictions

For geothermal planning and development, Deschutes National Forest must coordinate with at least the Bureau of Land Management (BLM), State of Oregon, and the county in which the resource is located The BLM is responsible for all geothermal lease activity and is responsible for NEPA compliance with the help and concurrence of the Forest Service The State of Oregon regulates drilling activities on deep geothermal wells The Forest Service should coordinate with counties in the area of Forest and county planning, and in planning and inspection of improvements on geothermal leases.

Monitoring

Authority for enforcing the various laws and regulations that pertain to operations on a Federal geothermal lease has been delegated by Secretarial Order to the Bureau of Land Management (BLM). Although monitoring is done by several Federal,

State, and local regulatory agencies, the BLM is the official contact with lessees regarding leasehold operations.

The following list is some of the laws, regulations, and guidelines that affect geothermal development of public lands. This list is not intended to be complete but rather a compilation of the more important Statutes.

Geothermal Steam Act of 1970 (Public Law 91-581, 84 Stat. 1566)

Code of Federal Regulations, Title 43, Part 3200 (Geothermal Leasing and Operating Regulations)

Geothermal Resources Operation (GRO) Orders

1. Exploratory Operations
2. Drilling, Completion, and Spacing of Geothermal Wells
3 Plugging and Abandonment of Wells
4. General Environmental Protection Requirements
5. Plans of Operation, Permits, Reports, Records, and Forms (Draft)
6. Pipelines and Surface Production Facilities
7 Production and Royalty Measurement, Equipment, and Testing Procedures

Secretarial Order 3087 - Organizational Restructuring of the Department of the Interior Minerals Management Functions (December 3, 1982)

Offer to Lease and Lease for Geothermal Resources, Form 3200-24

U.S. Department of the Interior, Geothermal Environmental Advisory Panel - Guidelines for Acquiring Environmental Baseline Data on Federal Geothermal Leases (1977) (Part of GRO Order No 5)

National Environmental Policy Act of 1969 (Public Law 91-190, 83 Stat. 852)

Code of Federal Regulations, Title 40, Part 1500-1508 (Council on Environmental Quality Regulations)

Federal Land Policy and Management Act of 1976 (Public Law 94-579, 90 Stat. 2743)

National Historic Preservation Act of 1966 (Public Law 89-665, 80 Stat 915), Code of Federal Regulations, Title 36, Part 800 (Procedure of the Advisory Council on Historic Preservation)

Endangered Species Act of 1973 (Public Law 93-205, 87 Stat 884)

Federal Water Pollution Control Act Amendment of 1972 (Public Law 92-500, 86 Stat 816)

Clean Water Act of 1977 (Public Law 95-217, 91 Stat 685)

Antiquities Act of 1906 (Public Law 59-209, 34 Stat. 225)

Archaeological Resources Protection Act of 1979 (Public Law 95-96)

The Geothermal Steam Act, leasing and operating regulations, and Geothermal Resources Operations (GRO) Orders provide the general and specific guidelines for developing geothermal resources These provisions require pre- and post-lease environmental reviews under the guidelines of the National Environmental Policy Act. The GRO Orders are specific requirements written to supplement the Geothermal Steam Act and regulations. The orders detail the technical and environmental requirements necessary to ensure safe operations and to ensure mitigation of short and long-term environmental hazards

The Federal air and water pollution control acts delegate responsibilities to maintain air and water quality standards to state and local authorities. Geothermal operators must obtain required air and water permits from these agencies before the operators begin major surface disturbing work.

The Historical Preservation, Archaeological Resources, and Endangered Species Acts are designed to preserve archaeological and historical values and protect endangered species Before operations begin, the lessee may be required by Section 6 of the Geothermal Lease to conduct archaeological or biological inventories and provide statements that these values either do not exist or will not be affected where operations are planned.

References & Footnotes

Further detail can be found in a June 1985 publication by Bonneville Power Administration, Volumes I and II, "Evaluation and Ranking of Geothermal Resources for Electrical Generation or Electrical Offset in Idaho, Montana, Oregon, and Washington," by R G Bloomquist, G L. Black, D.S. Parker, A. Sifford, S.J. Simpson, and L.V. Street.

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[2]Norris, T.R., Environmental Noise Need Not Hinder Geothermal Power Development. Geothermal Resource Council Transactions. Vol. 6, pp. 509-512, 1982

[3]O'Banion, K. and Layton, D., District Use of Hydrothermal Energy: Review of Environmental Aspects Lawrence Livermore Labs., Livermore, California, 1981.

[4]FERC, Rulemaking for Small Power Production and Cogeneration Facilities - Application to Geothermal Facilities. Western Regional Final Supplemental EIS Docket No. RM 81-2 1981

[5]FERC, 1981.

[6]O'Banion and Layton, 1981.

[7]Webb, J.W., Eddleman, G.K., and Reed, A.W., Retrospective Examination of Geothermal Environmental Assessment: Oak Ridge National Lab., Oak Ridge, Tennessee, ORNL/TM-9071.

[8]OAR 690-10-050, 3/26/84.

[9]FERC, 1981

Minerals
(Other Than Geothermal)

This section describes the effects of various program activities on mining opportunities on the Forest.

Locatable Minerals

Because the mineral potential for locatable (hardrock) minerals is low, the likelihood of development is minimal in any of the Alternatives. The acreage that would potentially be withdrawn from mineral entry varies slightly from one alternative to the next. Any environmental consequences of the Alternatives on mineral development would be directly related to the areas that would be withdrawn from mineral entry. The closing of roads for various resource activities could have an adverse impact on the access to mineral development; however the construction of roads for other resource uses could also have the opposite effect Paving of roads which might serve as mining claim access would be too costly for miners to share in maintenance fees. Minerals activities could be adversely affected by logging operations unless timing and construction stipulations protected improvements

Saleable Minerals

As the need for additional pits develops, acreage will have to be set aside for them. Any environmental consequences on development of new and existing pits would result primarily from the number of acres available for new pits, which varies slightly by alternative. The demand for additional pits will be higher in alternatives where timber harvest levels are higher Other resource activities would have a minimal impact on saleable minerals.

Recreation

Introduction

This section describes the effects that implementing each of the Alternatives would have on recreation, the size and distribution of Recreation Opportunity classes, and the quality of the recreation experience.

Discussion of the effects of the Alternatives on recreation would focus on recreation settings. Recreation settings are locations on the Forest exhibiting certain environments that people choose for different recreation experiences. The Recreation Opportunity Spectrum (ROS) describes these settings in terms of types of recreation experiences they offer. ROS is briefly described in Chapter 3 They are: Primitive; Semiprimitive Non-motorized; Semiprimitive Motorized Winter Only); Semiprimitive Motorized; Roaded Modified; Roaded Natural; Rural, and Urban.

Impacts to the recreation resource would vary through the range of alternatives. These impacts are the result of management activities that affect the quality of the recreation setting

Activities such as timber harvests, livestock grazing, mining activities, wildlife management activities and areas, construction of developed sites, roads and trails, levels of protection afforded the landscape within and adjacent to Wild and Scenic Rivers and the construction of trails in the Wilderness would all affect the recreation experience.

Interactions

Vegetation management activities can affect recreation. They can be positive or negative depending upon the type of recreation activities. Dispersed recreational activities such as hunting, nordic skiing and snowmobiling can be enhanced by these activities. However, a negative affect may be felt by hikers and horseman who's trails and scenic views are changed by such activities Vegetation management within developed sites would have an effect upon the recreational experience of the visitors and it could be negative or positive depending upon the individual and degree of change caused by the management.

Road construction and maintenance would also affect recreation. As roads are constructed, improved or eliminated recreation of one type or another would be affected. With driving for pleasure being one of the largest recreational activities any changes to our road system and the resulting views, would affect the recreational experience of our visitors (refer to Section on Scenic Quality).

Geothermal energy exploration and development would affect recreation through the development of roads and facilities and by altering vegetation. Interpretation of this energy source would provide the visitor with additional knowledge and a better understanding of the Forest as a whole. In addition new areas of the Forest may be opened as a result of exploration and development road construction

Special uses can affect recreation on the Forest. Those uses specifically associated with recreational activities would have a greater impact than those uses such as electronic and utility sites. However, where a change is made to the landscape, such as with power corridors, there would be a definite affect on recreational use and that effect can be either positive or negative depending upon the interests of the recreationist.

Mining activities and energy-extractive activities (such as geothermal and hydroelectric developments) can affect recreation. Any change in the Forest's water ways would affect the recreation that takes place on them. Mining activities can remove areas from public access. Generally there would not be a significant effect on recreation as a result of these activities.

Assumptions

Recreational demand will continue to increase on the Forest and surrounding lands.

Recreational uses and activities on the Forest are changing. The attitudes, time and tastes of the visitor are also changing

The recreating public is getting older

The Forest will be managed through the ROS program to provide a wide range of recreational opportunities.

Conflicts between user groups will continue to increase.

Recreational activities will become more specialized.

Related ICO's

Provide equal opportunity to all persons regardless of race, color, creed, sex, marital status, age, handicap, religion or national origin

Provide safe, efficient access for the movement of people and materials involved in the use of the National Forest lands.

Preserve and provide interpretations of unique geological, biological, and cultural areas for education, scientific, and public enjoyment purposes.

Provide a range of quality recreation opportunities in an undeveloped forest environment.

Provide a full range of quality outdoor recreation opportunities within a forest environment that can be modified for visitor use, visitor satisfaction, or to accommodate large numbers of visitors.

Effects That Do Not Vary Between Alternatives

Wildernesses would be preserved and managed the same in all Alternatives (see section on Wildernesses).

Even though livestock grazing use would vary from one alternative to another, the effect on recreation would basically be the same

Cultural resources would be protected in all Alternatives through the application of standards/guidelines which apply to all management activities with the potential to disturb culture resource sites (see section on Cultural Resources).

The potential for locatable minerals on the Forest is very low Any environmental consequences would be localized and be confined to soil disturbance, noise, dust and changes in visual quality. The effect on recreation should be the same in all Alternatives.

Geothermal development would affect recreation predominantly through changes in the visual quality and interpretation. Even though the area for development would vary by alternative, the effect on recreation management would basically be the same regardless of alternative.

Special uses can affect recreation, however, direction for management is given in the standards/guidelines and should be the same for all Alternatives.

Effects That Do Vary Between Alternatives

Figure 4-16 Potential Recreational Use and Development (Based on Decade 2 figures)

	Alt A	Alt B	Alt C	Alt E	Alt G
Developed Rec (MRVD)	652	1725	1812	1727	1662
Dispersed Rec. (MRVD)	1415	1920	1857	1918	1308

Figure 4-16 Potential Recreational Use and Development (Based on Decade 2 figures) (continued)

	Alt A	Alt B	Alt C	Alt E	Alt G
Campground Construction	Some	Meet Demand	Meet Demand	Meet Demand	None

Direct Effects

No Change Alternative/Alternative A

As far as recreation is concerned these two alternatives are the same. The base for recreational planning is set with the data shown in Figure 4-16. Developed recreation at 652 MRVD and dispersed recreation at 1,415 MRVD of use per year.

Under this alternative all fee campgrounds would receive maintenance and services that reflect the fees collected. Nonfee campgrounds and those day use sites not associated with fee sites would receive minimum service and maintenance. This will result in the further deterioration of these facilities which will lessen the recreation experience of the visitor.

Some existing developed sites and heavily used portions of the Forest would show signs of overuse, such as loss of vegetation As a result, the forest scene that users have come to love and enjoy will no longer be present and the users experience will be reduced if not changed completely.

Vegetation Management

Timber harvesting is scheduled on a nondeclining yield basis under this alternative. It would affect recreation in varying degrees with the major effect being on dispersed recreation. As areas are harvested and open up there would be a shifting of recreational experience associated with the Roaded Natural to the Roaded Modified This would result directly in an increase in some recreational activities such as snowmobiling and indirectly in a decrease in other activities such as driving for pleasure and viewing scenery Those recreationists that enjoy the more natural appearance of the forest will be disappointed and feel a reduction in their recreational experience while thise that enjoy the modified appearance will be content with this alternative

Transportation

Forest roads and vegetation management are related The roads are generally a result of timber harvesting practices. As areas are harvested they are opened to recreationists. This often results in a shifting of recreational use. The recreationist that prefers the Roaded Modified experience would be drawn to these areas while the recreationist that prefers the more natural end of the spectrum would be disappointed by the change to the landscape

Data from Figure 2-50 Average Quantifiable Resource Outputs and Environmental Effects by Alternative shows that there is a potential reduction in total Forest mileage There would be both construction of new roads and closing of old roads Those roads closed may provide the opportunity for development of motorcycle, off-highway vehicle (OHV) and mountain bike trails which this alternative calls for. Those users that prefer the more primitive experiences will find this increase in mechanical use objectionable

Opportunity for semi-primitive dispersed motorized trail use would be lost on those unroaded areas that become developed

Construction of Facilities

Construction of facilities would probably affect recreation in our developed sites the most Under this alternative some new campgrounds and day use facilities would be built. But overuse will occur. Crowded conditions will change the recreation

experience and in some cases lessen it. Overuse will result in facility deterioration and the users may have difficulty in finding camping sites.

Alternative B

Using the figures in Figure 4-16, developed recreation would be at 1725 MRVD or an increase of 165 percent and dispersed recreation would be at 1920 MRVD or an increase of 36 percent for this alternative

Under this alternative fee campgrounds would receive maintenance and services that reflect the fees collected. Nonfee campgrounds and day use sites not associated with fee campgrounds would receive minimum service and maintenance. This will result in a lessening of experiences similar to Alternative A.

Under this alternative the demand for outdoor recreation would continue to increase, some existing developed sites and heavily used portions of the Forest would show signs of overuse, such as loss of vegetation. This will result in crowded conditions and a decrease in the users recreational experience.

Vegetation Management

Timber harvesting continues to increase under this alternative. There would be a shifting from the Roaded Natural recreation experience to the Roaded Modified setting The scenic quality of the Forest would change over the next few decades which would affect recreation This alternative calls for 66 percent of the harvesting, in the first decade, to be in clear cuts or shelterwoods This would open additional areas for some forms of dispersed recreation Those users that object to this type of harvesting will not be pleased with the resulting forest. Their recreational experience will be greatly reduced by it.

Transportation

The increased harvesting would result in some road construction, but there would also be a closing of many roads. Data from Figure 2-50 shows the potential change in the Forest road system. Many of the low standard and closed roads can be converted into mountain bike, motorcycle and OHV trails, which are scheduled to be developed under this alternative. This will enhance the experience of those users which enjoy this type of recreation.

Opportunity for semi-primitive dispersed motorized trail use would be lost on those unroaded areas that become developed, thus decreasing the experience of those that enjoy that type of experience.

Construction of Facilities

Under this alternative direction is given to construct campgrounds and day use facilities as demand arises. This would affect the developed recreation of the Forest. It is possible, under this alternative, to see a shift from the Roaded Natural to the Rural setting depending upon the level of construction that takes place on the sites. This should continue to provide enjoyable recreational experiences for users which enjoy the more developed type of recreation.

Alternative C

Using the information in Figure 4-16, developed recreation is planned for at 1812 MRVD or an increase of 178 percent and dispersed recreation at 1857 MRVD or an increase of 31 percent for this alternative.

Under this alternative fee campgrounds would receive maintenance and services that are reflected in the fees collected Nonfee campgrounds and day use sites not associated with fee campgrounds would receive minimum services and maintenance This will create a similar reduction in the recreation experiences of those that use these nonfee sites, similar to Alternatives A & B

Under this alternative the demand for outdoor recreation would continue to increase, some existing developed sites and heavily used portions of the Forest would show signs of overuse, thus reducing the quality of experiences the recreationist will obtain

Vegetation Management

Timber harvesting is at its highest under this alternative. There would be a major shifting from

the Roaded Natural to the Roaded Modified setting. The visual appearance of the Forest would change and for many this would be a negative experience. This alternative calls for 66 percent of the harvesting, in the first decade, to be in clear cuts or shelterwoods. This would open additional areas for dispersed recreation Those visitors searching after the more natural experience will be disappointed and probably shift their visits to someplace else.

Transportation

Along with the increase in timber harvesting, there would be an increase in road construction which would result in the opportunity for increased recreation. Figure 2-50 shows the largest potential mileage for this alternative Mountain bike, motorcycle and OHV trail systems are to be expanded with most of the low standard road system (those not maintained for passenger cars) to be open to off-road vehicles (refer to Chapter 2) Users that enjoy mechanized travel will find an increase in pleasure with this alternative while the users which object to it will have their recreational experience reduced

Construction of Facilities

Under this alternative direction is given to construct campgrounds and day use facilities as demand arises. This would affect the developed recreation of the Forest. It is possible, under this alternative, to see a shift from Roaded Natural to the Rural setting depending upon the level of construction that takes place on the sites. Under this alternative those visitors which enjoy the more developed type of camping will find their visit enjoyable, while those preferring the more primitive type of experience will be disappointed.

Alternative E (Preferred)

Using the figures in Figure 4-16, developed recreation would be at 1727 MRVD or an increase of 165 percent and dispersed recreation would be a 1918 MRVD or an increase of 36 percent for this alternative.

Under this alternative fee campgrounds would receive maintenance and services reflected in the fees collected. Nonfee campgrounds and day use sites not associated with fee campgrounds would receive minimum service and maintenance, which will result in a lessening of the recreational experience for those lesser maintained sites along with a deterioration of their facilities.

Under this alternative the demand for outdoor recreation would continue to increase, some existing developed sites and heavily used portions of the Forest would show signs of overuse, and will result in a reduction in the quality of the users experience

Vegetation Management

The percent of harvesting done the first decade by clear cuts and shelterwoods is at 63 percent. As with previous alternatives the increased opening of the Forest would lean towards the Roaded Modified setting. Some forms of dispersed recreation would be favored in this type of management Those users that object to this type of harvesting will not be pleased with the quality of the resulting forest. Those that enjoy the roaded modified setting will find that their recreational experiences may be enhanced by this alternative.

Transportation

This alternative does call for some new road construction which would result in the opportunity for increased dispersed recreation It also directs that most of the Forest's low standard roads be open to off-highway vehicles. The development and expansion or mountain bike, motorcycle and OHV trails are endorsed by this alternative Those users who enjoy the mechanical type of recreation have the quality of their experience enhanced, however, those that enjoy the more primitive setting will find this activity objectional.

Construction of Facilities

Under this alternative direction is to construct campgrounds to meet increasing demands. Day use facilities would also be constructed, but at a reduced level not meeting projected demand. This would have a direct effect upon developed recreation of the Forest. It is possible to see a shift from Roaded Natural to Rural setting depending upon the level of construction that takes place on the sites in developed areas. Those users desiring the easy accessibility of the more devel-

oped sites will enjoy this alternative. However, those users who search for the more primitive *experience will be disappointed.*

Alternative G

Using the information in Figure 4-16, developed recreation is planned at 1662 MRVD or an increase of 155 percent and dispersed recreation is planned at 1308 MRVD or an decrease of 8 percent for this alternative

Under this alternative all fee campgrounds would receive minimum service and maintenance. All nonfee campgrounds would be closed. All day use sites would receive minimum standards of maintenance. Many significant user groups would be extremely unhappy There would be a drastic reduction in recreational experiences in the developed sites. We would see a rapid deterioration of facilities along with increased vandalism

Under this alternative the demand for outdoor recreation would continue to increase, existing fee campgrounds and heavily used portions of the Forest would show signs of overuse with severe site deterioration taking place There would be more motorized restrictions in habitat areas. In general the forest recreationist will be disappointed with their recreation experience Due to crowded *conditions, they may have difficulty in finding* camping spots.

Vegetation Management

Timber harvesting is down in this alternative and the area available for timber production would be reduced Only 44 percent of the harvesting done in the first decade would be by clear cuts and shelterwoods Emphasis is more on the Roaded Natural setting and the scenic quality of areas receiving high amounts of recreational use This will enhance the experience of those who enjoy driving for pleasure or viewing scenery.

Transportation

There is a reduction in the miles of Forest roads with this alternative (see Figure 2-50). Although some new roads would be constructed more would be closed. Likewise the motorized trail system would be de-emphasized in this alternative. *Those roads closed may be considered for part* of the mountain bicycle trail system. The recreationist enjoying motorized activities will find their experience greatly reduced under this alternative, while those enjoying the more natural experience will find their experiences enhanced.

Construction of Facilities

There would be no construction of campgrounds under this alternative. The emphasis is being placed on the nonmotorized and dispersed recreation. With recreation continuing to increase and the closing of nonfee campgrounds the remaining fee campgrounds and the heavily used areas in the Forest would receive more pressure and would quickly show signs of severe overuse and site deterioration. The recreational experiences at developed sites would be greatly reduced by this altenative. Visitors would have difficulty finding places to camp and those sites would not provide the setting that they wanted.

Additional Effects

The effects of aforementioned alternatives on the Recreation Opportunity Spectrum of the Forest is outlined below:

Primitive

The only Primitive ROS setting on the Forest are found in the five wildernesses. None of the alternatives affect the Primitive recreation setting.

Semiprimitive, Non-motorized (SPNM)

The existing Roadless Areas on the Forest include Mt Jefferson, Metolius Breaks, Three Sisters, West/South Bachelor, Bearwallows, Bend Watershed, Waldo, Charlton, North Paulina, South Paulina and Maiden Peak. While these areas would generally be classified under the Semiprimitive, Non-motorized (SPNM) ROS settings, some would allow over-the-snow vehicular traffic during the winter season or a special Semiprimitive, Motorized (Winter Only) ROS setting. Each alternative would affect these settings in different degrees.

Alternatives A, B, C, and E would all see varying degrees of reduction in the SPNM setting Alternative G would see some increase in this setting

Semiprimitive, Motorized (Winter Only)

This ROS setting is between the SPNM and the Semiprimitive, Motorized (SPM). These areas would be managed as SPNM during most of the year and when sufficient snow is present, management would shift to SPM, allowing for over-the-snow vehicular use.

Alternatives A, B, C, and E would all expand this setting Alternative G would de-emphasize motorized use and would reduce this setting's area.

Roaded Recreation

The Roaded recreation ROS settings are a very important part of recreation on the Forest The ROS settings included in this grouping are SPM, Roaded Modified (RM), Roaded Natural (RN), Rural(R), and Urban (U) The majority of recreation use, on the Forest, takes place in these settings Most of the developed recreation occurs in the RN and R setting. ORV activities generally occur in the SPM setting Each alternative would affect these settings in different degrees

Off-highway, Motorcycle, and All Terrain Vehicles: Alternatives A, B, C, and E would all promote expansion of these types of activities which could result in and increase of the SPM setting. Alternative G de-emphasizes motorized use and would reduce this setting's area

Roaded Modified: This ROS setting lends itself to dispersed recreation use. It is greatly affected by other management activities. Alternative G would reduce the area allocated to this setting. All other alternatives would result in an increase to this setting in various degrees

Roaded Natural The majority of developed recreation takes place in this ROS setting. All alternatives show potential for increases in recreation. The level of increase is dependant upon the directions of the various alternatives, but it should not affect the size of this setting unless such development takes place in one of the other settings.

Rural: The increase of this ROS setting would depend upon the level of recreational development that takes place as new sites are developed or existing sites are redeveloped Alternatives A, B, C, and E all have the potential to increase this setting. Alternative G would have no affect on this setting.

Urban: Only the Lava Lands Visitor Center and Mt Bachelor Ski Area fall into this ROS setting. All Alternatives agree to leave this in a status quo situation

Cumulative Effects

All Alternatives recognize the increasing demand for recreational opportunities on the Forest The cumulative effects of this increasing use will show itself upon the developed sites Alternatives A, B, C, and E would require maintenance and services reflective of the fees collected in the fee sites and minimum maintenance and services in the nonfee sites Alternative G would require minimum maintenance and services on the fee sites and nonfee day use sites and would close all nonfee campgrounds. In all Alternatives some of the developed sites would tend to show signs of over use The cumulative effects of this over use may result in site deterioration and an actual loss of users. This condition would be magnified in Alternative G

The combined effects of timber harvesting and road construction would have cumulative effects upon the quality and quantity of recreation. Alternatives A, B, C, and E would all tend to shift to the more developed or modified end of the spectrum, while Alternative G shifts to the undeveloped or natural end.

Mitigation Measures

Potential conflicts between users would be mitigated by working with affected user groups Visitor control measures such as signs, permits, and activity restrictions would be used where necessary In some situations separation of activities may be required but would be used only as a last resort

Expansion of existing sites or the construction on new sites would be programmed to meet demand

for developed recreation opportunities in all Alternatives except Alternative G

Losses of trail systems as a result of timber harvest can be offset by alternate ways of locating and scheduling road construction and the cutting of harvest units In some areas, there is the potential for relocating trail, rehabilitating older, non-maintained trails, or rehabilitating trails in place after timber harvesting is complete to supplement access

Monitoring

Monitoring serves as a check on the effectiveness of mitigation measures It identifies necessary adjustments in the level and type of mitigations required to meet management objectives.

The Forest's trail system would be looked at annually to determine if it is meeting the needs of the users, being adequately maintained and meeting the scheduled outputs of miles constructed as directed by the Forest Plan.

The Forest's semi-primitive (dispersed) recreation would be looked at annually, or on a scheduled basis, to determine if it is supplying opportunities consistent with planned direction, meeting ROS objectives, meeting standards/guidelines for dispersed recreation, and identifying and providing for the changing needs of the Forest visitor.

The Forest's developed recreation would be looked at annually, or on a scheduled basis, to determine if, development is keeping pace with demand and resource capabilities, recreational special uses are providing quality services, vegetation and scenic qualities of developed sites is being managed to maintain or enhance users recreation experience, and are the changing needs of the users being considered.

Potential Conflicts With Plans & Policies of Other Jurisdictions

State and local planners, and members of the private sector, recognize the importance of the recreational settings to both the tourist industry and the local economy. Several communities adjacent to the Forest are currently engaged in recreational promotions to increase tourism and thereby stimulate the local economy Some of these plans are dependent on National Forest recreational opportunities as an attraction to visitors

Consultation will be made with other agencies such as neighboring National Forests, Oregon State Parks, the US Department of Fish and Wildlife, Oregon State Department of Fish and Wildlife and the State Historic Preservation Office regarding the management of existing or potential recreational settings. While the effects of implementing any of the Alternatives are not expected to conflict with the majority of the objectives identified by these constituencies, a high level of public contact and coordination between the Forest Service and others will be maintained.

Roadless Areas

Interactions

Roadless areas inventoried for potential during the Roadless Area Reviews and Evaluations (RARE I AND RARE II) are discussed in this section Though some of the area now in a roadless condition contains land suitable for timber management or geothermal development much of it is not and will remain undeveloped

The areas on the Forest which are still in a roadless condition generally have not been developed because they contain low value timber or other commodities. Further, rough ground and natural obstacles have made construction of roads into these areas economically impractical to date for the extraction of these commodities

Generally, environmental impacts will run in direct proportion to the amount of acreage which is converted from roadless to a roaded condition This conversion from a roadless condition would most likely result from expanding timber harvest, developing geothermal potential, increasing the number of miles of road in the Forest's transportation system, and increasing off-highway vehicle riding opportunities. Effects of these activities may

be beneficial and/or detrimental. Each of the previously mentioned activities may have a variety of water quality, wildlife habitat, scenic quality, soil, or other environmental impacts. They would also decrease the acres of certain recreational settings and for dispersed and the more primitive recreation opportunities.

The reduction of roadless acres would also have an effect of future consideration of these acres for designation as Wilderness or other special classification dependent on limited development of the area and relatively natural conditions.

In the current planning cycle, these roadless lands are available for a range of multiple resource uses including those of timber production, fish and wildlife habitat, research, recreation, and in one instance Wilderness The timber on roadless lands has a commodity value and has the potential to contribute to both the economic and social pattern of local communities Roadless lands also have the potential to provide settings for recreation, and opportunities to interweave the physical environment with particular social factors such as isolation, remoteness, and personal challenge

An important consequence of the alternatives is whether or not these lands will remain in an unroaded condition. Allocation of roadless areas to some uses requires development. These uses include timber harvest, road construction, and special uses such as expansion of existing ski areas and exploration/development of mineral resources. Development activities may affect how people perceive environmental qualities such as naturalness and isolation.

Assumptions

As a very general assumption the more acres eliminated from a roadless condition the greater the potential impacts on several components of the environment. The greater the surface disturbance in currently existing roadless areas the more impact would be expected in water quality, changes in wildlife habitat and recreational settings.

Related ICO's

How much timber should be harvested and on what schedule?

How should the Deschutes, Fremont and Winema National Forests manage the lodgepole pine stands infested with mountain pine beetles and the stands susceptible to these infestations.

How should the Forest meet expanding needs for dispersed recreation?

How should roadless areas be managed?

Effects That Do Not Vary Between Alternatives

There is no development of geothermal resources planned However, this activity is driven by volatile energy market economics and its timing will be the hardest to predict. Some geothermal exploration and development is expected and these roadless areas would be available for this activity. The Bearwallow and the North Paulina Areas appear to have the greatest potential for geothermal development

Effects That Vary Between Alternatives

Direct Effects

As a consequence of implementing any of the proposed alternatives, there would be effects to roadless lands in the Forest. In all alternatives some roadless areas would become developed through road construction, timber harvest, or mineral exploration and development, while other areas would remain in an undeveloped condition. The extent of development or maintenance of an undeveloped condition of roadless lands is determined by the type of use to which areas are allocated.

Figure 4-17 Total Roadless Area Acres Remaining At The End Of Decade 1,2 & 5 By Alternative

	Decade 1	Decade 2	Decade 5
Alt NC	145,142	145,142	132,708
Alt A(NA)	145,142	145,142	132,708
Alt B(RPA)	138,060	126,713	114,983
Alt C	138,060	112,750	75,212
Alt E Pref	145,142	144,887	138,595
Alt G	145,142	144,745	135,880

Alternatives that favor development of roadless areas (Altenatives B and C) would diminish the Forest's capacity to satisfy future demand for uses dependent on roadless conditions

In addition, the option to evaluate roadless lands for Wilderness in the next cycle of Forest planning would be reduced The allocation of roadless lands to development activities typically results in alternation of the landscape, vegetation patterns, and size and shape of individual areas Changes of this nature limit the potential of an area to provide isolation, solitude, and primitive recreation experiences and hence its suitability for future Wilderness evaluation.

Although development of roadless areas would preclude future Wilderness evaluation and other recreation uses, it would provide for other values and benefits Development of roadless areas would support maintenance of historic harvest levels, employment of wood products workers, and community stability. In addition, development activities would provide increased forage for big-game animals and habitat for other species

In alternatives that maintain significant portions of most roadless areas (particularly Alternatives NC, A, E and G), it is likely that greater amounts of future demand for uses dependent on roadless conditions such as semiprimitive recreation could be satisfied. In these alternatives, and to a lesser extent in Alternatives B and C, the Wilderness evaluation option would still be retained for the next cycle of Forest planning Opportunities for isolation, solitude, and primitive recreation would be maintained in some inventoried roadless areas.

The allocation of roadless areas to uses that do not permit extraction or removal of priced commodities, such as wood products and minerals, may affect the economic base and social patterns of dependent communities. Employment levels of wood products workers would likely be affected However, habitats for some wildlife species would be favored, such as species utilizing mature and old growth timber habitat.

The location and magnitude of these effects are relative to the amount of total roadless land allocated to development as indicated by Figure 4-18 which displays how percentages of land developed and no longer in a roadless condition vary by alternative and planning decade.

Figure 4-18 Rates of Entry Over Time (percentages of roadless lands developed by alternative)

	Decade 1	Decade 2	Decade 5
Alt NC	0	0	9.4
Alt A(NA)	0	0	9.4
Alt B(RPA)	4 8	12 6	20.7
Alt C	4.9	22.3	48 1
Alt E Pref	0	0.1	4 5
Alt G	0	0 1	6.4

Appendix C displays total acres, acres harvested, miles of road constructed and other roadless area data under each alternative

Cumulative Effects

The cumulative effect on roadless lands is relative to the extent of their development in the alternatives from both the activities on the Forest and those of adjacent land owners Each alternative proposes different levels of development for different amounts of the inventoried roadless areas. The proposed development of areas, whether full orlimited would alter the roadless condition of each area gradually through time. As roads are constructed and timber sale units are harvested, roadless areas would be altered in size and shape In addition roadless areas adjacent to other land ownerships are subject ot the external influences of their management. These effects would alter the potential of individual areas to provide wilderness quality experiences and opportunities in the future

Areas of 5,000 acres or larger, maintained in an undeveloped condition, would be available for consideration as Wilderness in the next cycle of land management planning.

Mitigation Measures

When viewed as potential Wilderness, as habitat for certain types of wildlife, or as a setting for primitive recreation opportunities there are no mitigating measures for the loss of the roadless condition.

On roadless land where development is limited, there will be a slower rate of change than on intensively managed lands, and impacts can be managed to shorten the time of recovery to natural conditions. Where roadless lands have been allocated to scenic uses or winter recreation, timber harvest is reduced. Cutting units will be designed to reflect the vegetative patterns of the characteristic landscape. Three major methods of mitigating effects to roadless lands are: the allocation of lands to non-development uses, the use of aerial harvest systems without the construction of roads; and a general development strategy that limits harvest access and activities to the perimeter of individual areas where feasible.
A variety of mitigation measures for activities which may occur in later decades can be found in the standards/guidelines for riparian areas, Front Country, General Forest, Undeveloped Recreation, and Winter Recreation.

Monitoring

Monitoring should be on-going and should include evaluation of annual action plans, especially for timber management.

Scenic Quality

This section describes the effects that implementing each of the Alternatives would have on Scenic Quality.

Introduction

Portions of the Forest landscape may appear as natural and unchanged, but the visual evidence of human activities does exist, to varying degrees, on most lands outside of wilderness areas Activities such as timber harvests, road construction and minerals extraction may be either not apparent to the casual forest visitor, or may be visible enough to create an altered landscape.

Visual Quality Standards are measurable standards for the visual resource management of all National Forest system lands. They are based on **National Forest Visual Management, Vol.2, Agriculture Handbook Number 462.**

The condition of Scenic Quality is measured in degrees of acceptable change from the natural-appearing landscape, according to established Visual Quality Standards The Visual Quality Standards are briefly described in Chapter 3.

Because a relatively small alteration on a landscape may have a visual effect on adjacent portions of that same landscape, degrees of acceptable change are measured within the context of the landscape unit viewed from a particular travel route, recreation use area or other significant viewer location. These landscape units are called **viewsheds.** Viewsheds may be linear, along travel corridors for example, or related to geographic features, such as lake basins, buttes and other landforms.

For the various alternatives, viewsheds are treated differently based on the emphasis of each alternative. Likewise, the number of acres that would result in the different degrees of acceptable change from the natural-appearing landscape varies between alternatives. In some of the alternatives where commodity production receives the highest emphasis, some of the viewsheds on the Deschutes National Forest would change toward a visual condition that is less natural than they presently are. In other alternatives, the natural-appearance of these same viewsheds is maintained

* Preservation and Retention standards would result in **Naturally Appearing** viewshed conditions

* Partial Retention indicates a **Slightly Altered** viewshed condition

* Modification and Maximum Modification would result in **Moderately to Heavily Altered** viewshed conditions

The visual resource would vary by alternative based on the number of acres allocated to each of the Visual Quality Standards, and the resultant degrees of alteration from the natural visual condition. Alternatives emphasizing amenity values would retain the most acres of viewsheds in a natural appearing or slightly altered appearance.

Interactions

Vegetation management activities affect scenic quality in virtually all phases, including timber harvesting, slash treatment, site preparation, pre-commercial thinnings and wildlife habitat improvement. The degree of visual change produced by any of these activities is relative to the shape and size of the area treated, the type of treatment (regeneration vs a partial-cut, broadcast burning vs hauling slash to a disposal site, etc) and variables such as the season within which the activity takes place, the distance from sensitive viewer locations, the slope and aspect of the terrain, and the duration of view.

Road construction and maintenance affects scenic quality in foregrounds, middlegrounds and backgrounds. In most cases, the Forest visitor as well as the driver hauling products on Forest roads accepts the fact that the road being driven upon tends to be an unnatural visual feature. It is accepted as the means by which the viewer is able to see the Forest landscape, rather than as a foreign element on the landscape When seen on a hillside or as a linear opening through a forested canopy at middleground and background viewing distances, however, roads generally appear as discordant features. The more roads that are visible from middleground and background viewer locations, the less natural these landscapes generally appear.

Intensive recreation, including off-highway vehicle use, can affect scenic quality and can also be affected by scenic quality. Facilities necessary for developed recreation sites, such as roads, bridges, *ski lifts, parking lots and buildings, can often create* landscapes that are less natural in appearance A natural appearing landscape can provide a substantially different recreational experience than a heavily modified landscape Also, intensive recreation use can increase soil compaction, leading to a loss of vegetation, and eventually resulting in a notably altered landscape within areas of concentrated recreation use.

Livestock grazing can result in the removal of vegetation and soil compaction in visually sensitive foregrounds Such a change in vegetation can create a less-natural appearing landscape, especially when it occurs along streams or other water elements in the Forest's landscapes The presence of grazing animals can also have a positive effect on scenic quality by adding visual interest and creating desirable pastoral landscapes.

Geothermal energy exploration and development would affect scenic views through the construction of roads, drill pads, power plants and transmission line corridors. The industrialized nature of geothermal developments makes them difficult to blend with the elements normally found in the natural appearing landscapes of the Forest. When viewed from a position within, or immediately adjacent to, a geothermal development, the development would visually dominate the natural landscape When viewed as middleground or background, geothermal developments may be evident to the casual forest visitor, but the natural character of the landscape would dominate the scene Special uses, such as electronic sites, utility sites and corridors, and other structures with their associated facilities, affect scenic quality on the Forest. They introduce an industrial-appearance in areas where they can be seen in foregrounds and normally remain subordinate to the overall visual strength of the forest landscape when viewed in middleground and background distance zones

Mining activities and energy-extractive activities (such as geothermal and hydroelectric developments) often create a less-natural appearance on the immediate area in which they are sited. When viewed from middleground and background distances, however, they generally do not result in a significant reduction in scenic quality.

Assumptions

* Except when they are within a developed recreation site or facility, recreationists expect to see a natural-appearing landscape when they view the Deschutes National Forest.

* The greater the degree of change from the natural landscape, the greater the loss of visual quality

* Degrees of change from the natural landscape can be classified and are measurable

* Old growth characteristics, such as large trees and deeply-fissured bark, are visually desirable, especially in landscapes composed primarily of Ponderosa pine.

* Changes in scenic quality are measured as seen from significant viewer locations.

Related ICO's

Provide old-growth tree stands for (1) preservation of natural genetic pools, (2) habitat for plants and wildlife species associated with over-mature tree stands, (3) contributions to the diversity spectrum, and (4) aesthetic appeal

Provide Forest visitors with visually appealing scenery

Effects That Do Not Vary Between Alternatives

Direct Effects

Many timber stands in sensitive visual areas have dwarf mistletoe, root disease and other pest and diseases. Because management activities in these areas are not focused on maximizing timber growth, many acres would either not be treated or would be treated to maintain or enhance the visual resource (i.e type conversion to non-commercial species, pruning large yellow-bark trees to prolong their life, etc.). For this reason, there would be some gradual changes in species composition and diversity that would be virtually the same for all Alternatives However, these gradual changes would appear similar to natural changes that could occur. Treatments may be prescribed when the desired visual condition is threatened by undesirable natural occurrences.

Wildernesses would be preserved in their present visual condition in all Alternatives. Effects on the remaining acres would vary, depending on the resource emphasis of each alternative Forest visitors can expect to see a Forest setting unaltered by man, often exhibiting mature and old-growth character in Wildernesses.

Road corridors along all State and County roads, and along all Forest Service roads that are heavily used by the recreating public would be managed to result in natural appearing or slightly altered landscapes. Roads on the more prominent buttes and other landforms that are visually important would also be managed to provide natural appearing or slightly altered landscapes.

Off-highway vehicle (OHV) and mountain bike use would not have a significant effect on the visual resource because OHV use in visually important areas would be limited to designated roads and trails.

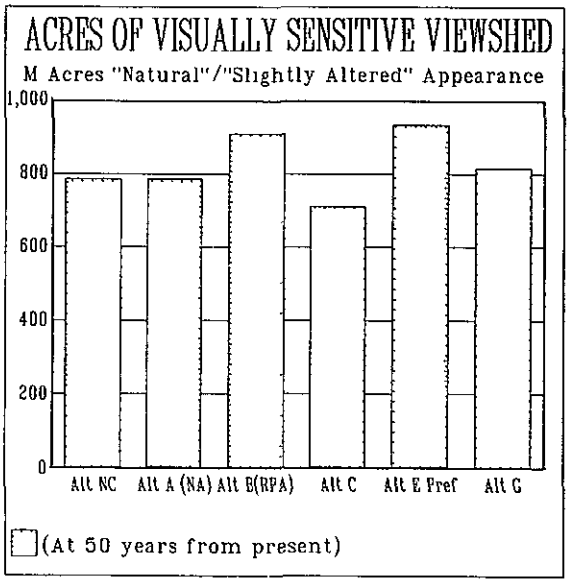
Even though the amount of use may vary from one alternative to another, livestock grazing would essentially have the same generally beneficial effect on scenic views for all alternatives considered.

The number of cinder pits and other mining activities on the Forest may vary from one alternative to another. However, the effect of these activities on scenic views is generally degrading for all Alternatives.

Indirect Effects

Changes in the visual quality of forest landscapes can affect the quality of the recreation experience. If visual quality is lowered, the recreation experience and degree of user enjoyment derived is also likely to be lowered Those landscapes dominated by timber management activities and road construction, for example, would normally be classified in the Roaded Modified recreation setting Because

all Forest lands are viewed, even though some lands are only seen from aerial viewer locations, those alternatives with higher harvest levels reduces visual quality overall, even though the most visually sensitive viewsheds have high visual quality standards The general public impression of the Forest could become one of substantially modified landscapes under the commodity-oriented alternatives. A long term effect of the Forest landscapes becoming substantially-modified is a reduction in recreation and tourism in Central Oregon.



Effects That Vary Between Alternatives

Direct Effects

The visual resource would vary by alternative based on the number of acres allocated to each of the Visual Quality Standards, and the resultant degrees of alteration from the natural visual condition. Alternatives emphasizing amenity values would retain the most acres of viewsheds in a natural appearing or slightly altered appearance. Alternatives emphasizing commodity production would result in the most acres in a moderately or heavily altered condition.

Figure 4-19 indicates the predicted overall acres of visually sensitive viewshed in a "natural or "slightly altered" appearance 50 years from now. This is a prediction of future visual conditions for these viewsheds, based upon an analysis of potential visual effects of applying the standards/guidelines for each management area, discussions with District Landscape Architects and other district staff, and more than 11 years of personal observation of viewsheds on the Forest.

Figure 4-19 (Bar Graph) Acres of Visually Sensitive Viewshed

No Change Alternative

Under this alternative, the road corridors along all State and County roads, and along all Forest Service roads that are heavily used by the recreating public would be managed to result in natural-appearing landscapes. This alternative would result in 48 percent of the Forest in a natural appearing or slightly altered appearance and 52 percent in a moderately or heavily altered condition.

In addition, the more prominent buttes and other landforms that are visually important would be managed to provide natural-appearing landscapes.

Because timber harvesting is scheduled on a nondeclining yield basis under this alternative, many of the mature and overmature large trees in visually sensitive areas would be removed over the next 50 years. Some visually sensitive middle-ground buttes, road corridors and steeper slopes on the Forest would change from coarsely-textured, continuous canopies to smoother textures, as the larger trees are removed, and broken canopies, as openings are created

Foreground landscapes would also change through time as larger trees continue to be

removed. Even though foreground management activities would not result in large, artificial openings in timbered areas, the gradual decline in the number of large trees would result in shifting the viewer's attention from individual trees to the overall texture created by numerous smaller trees. There would always be a few large trees visible in these foreground landscapes, but they would become single "features" on the landscape, rather than the dominant element

Many of the Forest's dispersed recreation areas would change from a predominately natural landscape appearance to a more heavily managed appearance. The evidence of human activities would be hidden to the extent that the casual forest visitor would not notice disturbed areas from a vehicle or developed recreation site or facility during the first few decades. But, as the undisturbed areas between vegetation management activity areas decrease, these same viewsheds would begin to take on a more modified look

Management Areas with a high commodity production emphasis would continue to change toward a more modified appearance. The evidence of management alterations on these landscapes would become increasingly more apparent, especially when flying over these Forest landscapes, or when viewing them from the tops of buttes or higher elevations. Views of the Forest from wilderness areas would appear substantially modified, even those high commodity output areas viewed as middleground and background.

As the demand for outdoor recreation continues to increase, existing developed sites and heavily used portions of the Forest would show signs of overuse, such as loss of vegetation. Scenic quality would change in the popular recreational areas of the Forest under this alternative.

Alternative A (No Action)

Alternative A would result in 48 percent of the Forest in a natural appearing or slightly altered appearance and 52 percent in a moderately or heavily altered condition

Vegetation Management

Some of the mature and overmature large trees in visually sensitive areas would be removed over the next 50 years, but enough large trees would be left to maintain them as a prominent element in the landscape Some visually sensitive middleground buttes, road corridors and steeper slopes on the Forest would change from coarsely-textured, continuous canopies to smoother textures, as some trees are removed Broken canopies would begin to replace continuous canopies as openings are created on some of these landscapes.

As larger trees are removed, foreground viewsheds would change through time. A gradual decline in the number of large trees would result in shifting the viewer's attention from individual trees themselves to the overall texture created by numerous smaller trees. There would be a few large trees visible in these foreground viewsheds, but they would become single "features" on the landscape, rather than the dominant visual element.

Transportation

Road density would be reduced from its current level in this alternative by 18 percent over the next 50 years as a result of road closures and obliteration of existing roads. This may have a slightly beneficial visual effect, since some of the roads to be obliterated or closed are within sensitive visual areas. However, most of these roads are most likely to be located in areas not viewed from sensitive viewer locations

Recreation

The scenic quality in popular dispersed as well as intensive recreation areas would change visually during the next few decades As the demand for outdoor recreation continues to increase, existing developed sites and heavily used portions of the Forest would show signs of overuse, such as loss of vegetation.

Alternative B (RPA)

Alternative B would result in 37 percent of the Forest in a natural appearing or slightly altered appearance and 63 percent in a moderately or heavily altered condition.

Vegetation Management

Timber harvesting on landscapes that are predominately Ponderosa pine and mixed conifer types would become less natural appearing as some of the mature and overmature large trees in visually sensitive areas would be removed Enough large trees would be left to maintain them as a prominent element in the landscape. Some visually sensitive middleground buttes, road corridors and steeper slopes on the Forest would become slightly altered as some trees are removed. Broken canopies would begin to replace continuous canopies as openings are created on some of these landscapes.

As larger trees are removed, foreground landscapes would change through this alternative. A gradual decline in the number of large Ponderosa pine, Douglas and true fir would result in shifting the viewer's attention from individual trees to the overall texture created by numerous smaller trees There would be a few large trees visible in these foreground landscapes, but they would become single "features" on the landscape, rather than the dominant visual element. This would result in the overall appearance of a slightly altered landscape in many foreground areas.

Landscapes that are predominately lodgepole pine would change in the short term to moderately or heavily altered under this alternative as the scheduled harvest of this species is accelerated. Once the mountain pine beetle epidemic is under control, many of the lodgepole pine landscapes would begin to appear as a mosaic of textured patches of younger trees. The overall appearance of these landscapes would remain moderately altered in the future.

Transportation

Road density would be reduced from its current level in this alternative by 18 percent over the next 50 years as a result of road closures and obliteration of existing roads. This may have a slightly beneficial visual effect, since some of the roads to be obliterated or closed are within sensitive visual areas However, most of these roads are most likely to be located in areas not viewed from sensitive viewer locations

Recreation

The scenic quality in popular dispersed as well as intensive recreation areas would change visually during the next few decades. As the demand for outdoor recreation continues to increase, existing developed sites and heavily used portions of the Forest would show signs of overuse, such as loss of vegetation.

Indirect Effects

Changes in the visual quality of forest landscapes can affect the quality of the recreation experience. If visual quality is lowered, the recreation experience and degree of user enjoyment derived is also likely to be lowered. Those landscapes dominated by timber management activities and road construction, for example, would normally be classified in the Roaded Modified recreation setting. Because all Forest lands are viewed, even though some lands are only seen from aerial viewer locations, those alternatives with higher harvest levels tend to lower visual quality overall, even though the most visually sensitive viewsheds have high visual quality standards The general public impression of the Forest could become one of substantially modified landscapes under the commodity-oriented alternatives. A long term effect of the Forest landscapes becoming substantially-modified is a reduction in recreation and tourism in Central Oregon.

Alternative C

Alternative C would result in 44 percent of the Forest in a natural appearing or slightly altered appearance and 56 percent in a moderately or heavily altered condition.

Vegetation Management

Timber harvesting is highest under this alternative. Landscapes that are predominately Ponderosa pine and mixed conifer types would become less natural appearing as trees from all age groups are removed. Eventually, many of the mature and overmature large trees in visually sensitive areas would be removed, but enough large trees would be left in foregrounds to maintain them as a prominent element in the landscape. Some visually sensitive middleground buttes, road corridors and

steeper slopes on the Forest would become slightly altered as trees are removed. Broken canopies would replace continuous canopies as openings are created on some of these landscapes Even though these openings would be free-form, natural shapes, there would be more of them in this alternative than in any other alternative, leaving fewer acres in a dense, unmanaged condition

As with other alternatives, foreground landscapes would change through this alternative as larger trees are removed There would be a gradual decline in the number of large Ponderosa pine, Douglas and true fir There would be a few large trees visible in these foreground landscapes, but they would become single "features" on the landscape, rather than the dominant visual element. This would result in the overall appearance of a slightly altered landscape in many foreground areas.

Landscapes that are predominately lodgepole pine would change in the short-term to moderately or heavily altered Many lodgepole pine landscapes would begin to appear as large areas of younger trees, thereby eliminating size-class diversity in some areas The overall appearance of these landscapes would remain moderately to heavily altered in the future.

Transportation

Road density would be reduced from its current level in this alternative by 6 percent over the next 50 years as a result of road closures and obliteration of existing roads. This may have a very slight beneficial visual effect, since a few of the roads to be obliterated or closed are within sensitive visual areas However, most of these roads are most likely to be located in areas not viewed from sensitive viewer locations

Recreation

Scenic quality in intensive recreation areas would change as new recreation sites are developed Those areas within and adjacent to recreation developments would tend to shift from natural appearing or slightly altered landscapes to "moderately altered" or "heavily altered" visual conditions. Some portions of the Forest would show signs of overuse, such as loss of vegetation, as recreation use increases

Alternative E (Preferred)

Alternative E would result in 58 percent of the Forest in a natural appearing or slightly altered appearance and 42 percent in a moderately or heavily altered condition. This alternative would result in natural appearing landscapes on most lands seen from significant viewer locations

Vegetation Management

Timber harvesting promotes uneven-aged management under this alternative, resulting in viewsheds which maintain the desired species and size-class mixtures that compose the characteristic landscapes. General Forest areas that are not ordinarily seen from significant viewer locations would also be managed to maintain and achieve uneven-aged management objectives. For this reason, many General Forest management areas would tend to be more natural appearing than in other alternatives.

Landscapes that are predominately lodgepole pine would become less natural appearing as trees are removed in response to forest pest problems. In some viewsheds, many of the dead or dying, mature and overmature lodgepole pine would be removed, eventually to be replaced with areas of healthier, young trees. Where feasible, some larger lodgepole pines would be left in these viewsheds to maintain them as a prominent element in the landscape.

Some visually sensitive middleground buttes, road corridors and steeper slopes on the Forest would become slightly altered as trees are removed, but these alterations would be short-term, and would not substantially change the characteristic landscape of these viewsheds in the long-term. Broken canopies would replace continuous canopies as openings are created in some of these viewsheds

Some foreground viewsheds would change through this alternative as some of the larger trees are eventually removed. There would be a gradual decline in the number of large Ponderosa pine, Douglas and true fir, yet large trees in these foreground landscapes would remain a dominant visual element. The overall appearance would be a slightly altered landscape in many foreground areas.

Transportation

Road density would be reduced from its current level in this alternative by 18 percent over the next 50 years as a result of road closures and obliteration of existing roads. This may have a slightly beneficial visual effect, since some of the roads to be obliterated or closed are within sensitive visual areas. However, most of these roads are most likely to be located in areas not viewed from sensitive viewer locations.

Recreation

Scenic quality in intensive recreation areas would change as new recreation sites are developed. Those areas within and adjacent to recreation developments would tend to shift from natural appearing or slightly altered landscapes to "moderately altered" or "heavily altered" visual conditions.

Some portions of the Forest would show signs of overuse, such as loss of vegetation, as recreation use increases

Alternative G

Alternative G would result in 50 percent of the Forest in a natural appearing or slightly altered appearance. The other half of the Forest would be managed to result in a moderately or heavily altered condition However, virtually all of the altered acres would be in portions of the Forest not seen from significant viewer locations.

Vegetation Management

Landscapes that are predominately Ponderosa pine and mixed conifer types would become less natural appearing as trees from all age groups are removed Eventually, many of the mature and overmature large trees in visually sensitive areas would be removed, but enough large trees would be left in foregrounds to maintain them as a prominent element in the landscape. Some visually sensitive middleground buttes, road corridors and steeper slopes on the Forest would become slightly altered as trees are removed. Broken canopies would replace continuous canopies as small openings are created on some of these landscapes.

As with other alternatives, foreground landscapes would change through this alternative as larger trees are removed There would be a gradual decline in the number of large Ponderosa pine, Douglas and true fir, yet large trees in these foreground landscapes would remain a dominant visual element The overall appearance would be a slightly altered landscape in many foreground areas

Landscapes that are predominately lodgepole pine would change in the short-term to moderately or heavily altered. Many lodgepole pine landscapes would begin to appear as large areas of younger trees, thereby eliminating size-class diversity in some areas. The overall appearance of these landscapes would remain moderately to heavily altered in the future.

Transportation

Road density would be reduced from its current level in this alternative by 29 percent over the next 50 years as a result of road closures and obliteration of existing roads This may have a substantial beneficial visual effect, since many of the roads to be obliterated or closed are within sensitive visual areas.

Recreation

This alternative would change scenic quality in intensive recreation areas as new recreation sites are developed. Both developed and dispersed recreation would increase by 11 percent, yet all non-fee campgrounds would close and day use sites would receive only minimum maintenance. Heavily used portions of the Forest would continue to show signs of overuse New construction of recreation facilities would alter portions of visually sensitive viewsheds

Areas within and adjacent to recreation developments would tend to shift from natural appearing or slightly altered landscapes to "moderately altered" or "heavily altered" visual conditions.

Cumulative Effects

The previous discussion, comparison charts and predictions of future visual conditions refers only

to National Forest lands. Some viewsheds seen from sensitive viewer locations are within a mixture of land ownerships Timber management and other resource management activities on private lands, or on lands administered by other governmental agencies, may not meet the visual quality standards recommended by the Visual Management System For example, there may be heavily altered areas that are privately owned within viewsheds where the Forest Service objective is to maintain or achieve a natural appearance. Where this occurs, the cumulative effect on the visual condition of the viewshed as a single visual unit would be the creation of a more heavily-altered appearance than what was predicted in Figure 4-19. Careful design and scheduling of treatment areas can mitigate some of the negative visual effects of cutting on private lands by eliminating straight edges and geometric shapes, thereby creating a cumulative effect which is less detrimental than the effect of private land management activities without these mitigation practices.

Mitigation Measures

Mitigation measures for achieving and maintaining established visual quality standards are provided in several published visual resource handbooks that are kept in the Forest Supervisor's Office and the District Offices The Standards/Guidelines in the Forest Plan also provide methods for achieving a desired visual condition and maintaining that condition through time

Vegetation management would be handled in small units in all Scenic Views Management Areas. Except in those areas where openings in the tree canopy are a component of the natural landscape, clear-cut openings would normally not be introduced in Scenic Views Management Areas. Where untimbered openings are a part of the natural landscape, and in other management areas (including General Forest), timber harvest "blocks or strip cuts shall be shaped and blended with the natural terrain to the extent practicable"(36CFR 219.27(d))

Uneven-aged timber management techniques are the standard in most viewsheds. These techniques result in essentially continuous vegetative cover and visual diversity provided by a range of vegetative species and sizes

Viewshed analyses and planning will be done to guide management activities so that the desired visual condition of a particular viewshed can be achieved and perpetuated.

Recreational settings, in particular, are managed to meet visual quality standards reflecting the concerns of recreationists Developed sites have the potential to contrast dramatically with their surroundings. Constructing roads, buildings and recreational facilities on highly sensitive landscapes can create high degrees of change from natural-appearing landscapes. Professional site planning, landscape design and the use of natural-appearing colors and materials may reduce the degree of change on most sites. Most winter sports facilities can be sited to blend with natural landforms, colors, and textures to reduce visual contrasts on the landscape.

Visual quality mitigation measures are also found in the standards/guidelines pertinent to management activities necessary for wildlife, range, minerals, special uses, transportation and other resources.

Monitoring

For all Alternatives, changes in the visual resource will be monitored by the Forest Landscape Architect and Forest Staff to determine whether or not a particular viewshed is remaining at, or moving closer towards, the desired visual condition Individual projects will be assessed to determine whether they meet the established visual quality standards, but will be considered within the context of the viewshed. All Level 1 viewsheds on the Forest will be evaluated every two years. Level 1 viewsheds are those viewsheds that are road corridors, recreation use areas, water bodies and landform features that were determined to be primary viewsheds in the 1976 Deschutes National Forest Visual Resource Inventory Monitoring will determine where deviations from the S&Gs have occurred, and when changes and clarification of these S&Gs are necessary

Potential Conflicts With Plans & Policies of Other Jurisdictions

Conflicts regarding visual quality and other agencies' plans and policies may occur where a particular viewshed is composed of both National Forest and privately-owned lands or lands that are administered by other governmental agencies. For example, vegetation within State Highway rights of way is often managed by the Oregon Department of Transportation (ODOT) for motorist safety. ODOT's vegetative management plans may, in some instances, conflict with the Forest's long-term management objectives for scenic quality along these same highways.

Social and Economic

Introduction

This section describes the effect each of the alternatives would have on the socio-economic setting as described in the FEIS, Chapter 3 Caution should be exercised when interpreting the results of socio-economic analysis Changes in employment and income levels were estimated with the use of IMPLAN, an input/output model which is described more fully in the the social and economic section of FEIS, Appendix B. Projections from IMPLAN are directly related to assumptions.

Assumptions

The major assumptions used in making employment level projections were

The basis for the local economy will remain static for the next ten years. This assumption means, among other things, that there will be no technological changes, no new industries; no industries ceasing to exist; and no changes in the patterns in which industries purchase from one another The industries may change in size only, not in makeup

The location in which timber and other outputs are processed will remain static. For the purposes of this analysis, it was decided that only 50% of the timber volume harvested off the Forest will be milled within the Forest Influence Area This descision was based on the trend toward increasing competition for Deschutes National Forest timber from mills outside the Influence Area and the likelihood of even more competition due to forces, e.g the Northern Spotted Owl Recovery Plan, which will further reduce potential harvest levels from this Forest and surrounding public lands

Changes resulting from the outputs and practices of the Deschutes National Forest are reflected. Other factors external to the actions of the Forest are held constant

The area's economic health is greatly influenced by national forces. Inflation, interest rates, conditions in the housing market, and individual preferences for recreational opportunities and living environment have more of an influence on local jobs and incomes than the Deschutes National Forest However, the projected outcomes are useful for evaluating relative differences between alternatives.

Four social parameters are used to assess the impacts of the alternatives. They are 1) changes in employment levels, 2) lifestyles, i.e. how people use and perceive the quality of their environment in terms of recreational and subsistence, 3) community stability and cohesion, i.e. the health of the social institutions (stability) and the degree of unity and cooperation evident in a community as it defines and resolves problems (cohesion), and 4) attitudes, beliefs, and values, i e the feelings, preferences, and expectations people have for forests and the management and use of particular areas. See FEIS, Appendix B, Section V for a more detailed description of these social considerations

Four community types with distinct types of employment, lifestyles, and social organization are identified (see FEIS, Chapter 3 and FEIS, Appendix B) Communities such as Gilchrist and Crescent have been categorized as "Rural Industrial" communities These communities are closely bonded to the Forest in work, subsistence, and play Towns such as Sisters and LaPine, on the other hand, are categorized as "Rural Recreation and Residential" communities and are dependent

on forest-based recreational activities and recreation based residences for their livelihoods. Bend is categorized as the "Central Oregon urban center", having both a large industrial sector based on wood products and a large service sector tied to recreation and tourism Cities such as Portland and Eugene represent the "Westside" communities Although the Forest does exert some influence, both economically (primarily wood products) and through recreational opportunities, the main impact is on broader levels of concern over such issues as the fate of the Northern Spotted Owl, old growth, roadless areas, Regional timber supply, etc.

Each alternative was analyzed with respect to the relationship between the Forest and the four *community types, i.e. the changes in raw materials* for industry and the jobs it provides and the recreational and scenic environment the Forest offers to visitors and residents. The effects will be measured in terms of the four social parameters identified earlier.

The potential effects of Alternative NC on the socio-economic setting were not analyzed in detail since the available data was insufficient to predict these effects It was also felt that since the harvest level under the NC Alternative was based on outdated resource inventory data and antiquated modeling techniques, it would not provide any insight into the differences in environmental effects or even past management of the Forest. If effects were estimated based on the outputs displayed in FEIS, figure 2-50, a response would be expected similar to Alternative A's recreation related employment and leisure lifestyles but with much higher timber related employment. In fact, Alternative NC would be the only alternative with positive timber related employment Some have suggested comparing the other alternatives with the NC Alternative. In this case all the Alternatives would show slightly less positive recreation related employment figures and more negative timber related figures than displayed in Figure 4-20.

Figure 4-20 Economic Indicators

Alternatives	Activities	Personal Income (M$)	Jobs	Payment to Counties (M$)Decade 1
Alt. A	Timber	- 7.681	- 442	
	Recreation	7.148	690	
	Total	- 0 534	248	4.5
Alt. B	Timber	-10.753	- 631	
	Recreation	10.285	969	
	Total	- 0.468	338	3.9
Alt. C	Timber	- 6.324	- 381	
	Recreation	11.017	1048	
	Total	4.693	667	5.0
Alt. E	Timber	-12 868	- 739	
	Recreation	10 193	958	
	Total	- 2 674	219	2 2
Alt. G	Timber	-14.299	- 819	
	Recreation	9.175	860	
	Total	- 5.124	41	2.2

Effects of the Alternatives on Jobs

In general, commodity (timber and developed recreation) oriented alternatives tend to do better in maintaining the economic aspects of the social structure in the area Increased supplies of timber in particular, provide the means for the local wood processing industry to respond to regional and national markets, which in turn means more, relatively higher paying jobs for Central Oregonians. To the extent that some communities are more dependent upon the wood products industry than others, they will benefit In addition, more timber means more revenues to counties. This is also an asset when it comes to implementing and maintaining public projects in the local communities, whether they be timber dependent or not.

The recreation use levels will not change dramatically in the short-term from one alternative to another. Therefore it is the amount of timber that each alternative proposes to sell which most heavily influences the jobs and income levels during the first decade Over the long run (20 to 50 years), the differences between the alternatives in recreation output levels increase, and therefore become an important factor accounting for the variation in potential for long-term economic growth opportunities (See FEIS, Figure 4-2)

Another interaction, which is not apparent by reviewing FEIS, Figure 4-2, is that providing opportunities such as dispersed or unroaded recreation will have a positive effect on service and related economic sectors, but may have a negative effect on timber related employment as well. This relationship is possible due to their potential to reduce the harvest level. There are many compatible relationships between timber management and recreation or amenity management. There are also many circumstances where providing for one will have a negative impact on the other. As a result,alternatives which provide a high level of certain recreation opportunities limit timber related employment. The opposite is also true, alternatives with high harvest levels and high timber related employment limit recreational opportunities and therefore recreation induced employment. For example, an alternative which provides for a high level of unroaded recreation will create employment based on that opportunity but at the same time limit the amount of land available for timber harvesting, potentially limiting employment based on timber harvest Timber management on the other hand, may limit certain recreation opportunities (unroaded recreation) which will reduce recreation induced employment.It may also impact the quality of certain recreational experiences through less visual quality, higher noise level, etc , which is unquantified in terms of employment opportunities Alternatives which manage for high levels of amenity oriented resources (visual quality, old growth, etc) generate no additional recreation related employment but limit the amount of timber related employment.

It should be noted that wood product jobs produce more income than service sector jobs created through recreation opportunities This is shown in FEIS, Figure 4-20, e g all Alternatives show a net gain in employment, due to recreation, but a net loss in income.

FEIS, Figure 4-20 indicates that all Alternatives may lose timber related jobs and gain recreational jobs. The universal loss in timber related jobs is associated with a number of factors. The time period (1986-1989) used to compare the alternatives was characterized as having a relatively strong market for lumber Secondly, all alternatives have a lower supply potential, due to more conservative volume and growth predictions and legal requirements, than in the past Finally, it is assumed in the future more of Deschutes National Forest timber will be processed outside the Forest Influence Area due to increasing competition for its timber

The universal increase in recreation related employment in all Alternatives is directly related to population trends and to the continuing diversification of the Influence Area service sectors This has led to a doubling of the jobs created per Recreation Visitor Day over the last decade.

Based on the relationships described above, the direct effects of changing outputs on employment, income, 25% monies, and Forest related budget expenditures may have different impacts on the four community types

The fact that all the Alternatives predict a loss of timber related employment and an increase in recreation employment indicates that Rural Industrial communities will see the highest loss in employment opportunities. This is a result of their economy

being more dependent on timber harvest and at the same time being less capable of taking advantage of increased recreation use on the Forest As a result, these communities will suffer a disproportionate share of the loss of employment without the mitigating increase in recreation employment. Of all the Alternatives, Alternatives A and C will have the least impact on employment due to the former's relatively high Ponderosa pine harvest and the latter's relatively high total volume. Alternative B followed by Alternatives E and finally G, will provide decreasing amounts of protection against employment losses

Conversely, the effects all the alternatives will have on employment in Rural Recreation and Residential communities will be the opposite of these on the Rural Industrial The loss in potential timber related employment will have little impact because these communities' economies are not based on timber related employment. On the other hand, they will benefit by the increase in recreation induced employment. In fact, alternatives with higher timber emphasis (Alternatives A, B, and C) may exert a negative pressure on employment opportunities in the long run This would be due to timber management activities influencing the availability and quality of recreational opportunities. Alternative C, a high timber alternative, and Alternative G, an amenity oriented alternative, may have offsetting effects from those described above Alternative C has the highest developed recreation site potential and Alternative G the lowest. This fact would offset negative impacts the harvest level may cause in Alternative C, and cause some negative impacts due to fewer opportunities in Alternative G Although these community types are not dependent on employment from wood products, alternatives with high timber harvest levels have a positive impact on these community types through payment to counties (97% of these funds are generated from timber harvest) The higher level of payments to counties in Alternatives C, A, and B would provide more benefits than Alternatives E and G.

The Urban Center, Bend, has such a well-developed economic base it will feel both the negative effects (loss in timber related employment) and positive effects (increase in recreation employment). In the short-term the overall effects would be negative even though there is a total increase in jobs The increase in jobs is related to recreation induced employment, and recreation related employment produces less income and payment to counties than timber related employment.

The direct effects on Westside communities would be minor at best. The lower offered timber volume in all Alternatives, compared with volume in the recent past, may have negative impacts on timber related employment and a slightly positive effect due to the increasing recreation opportunities. Because of the size and number of these communities, any impacts are expected to be dispersed, lessening their impacts on any given geographical area.

In summary, all Alternatives will have a negative effect in the short-term on the employment base in all community types except Rural Recreation and Residential Since the demand for recreational opportunities is predicted to continually rise, employment based on recreation opportunities will offset employment losses in all community types except the more dependent Rural Industrial communities such as Crescent and Gilchrist. The increase in recreation employment through time will be greatest in Alternatives E and G, and timber related employment will be greatest in Alternative C followed by Alternatives B and A.

Effects of Alternatives on Leisure Lifestyles

Rural Industrial communities should not experience any effects on leisure lifestyles due to implementation of any of the five Alternatives All the Alternatives provide similar amounts of leisure activities generally associated with these community types. Alternative C, with more dispersed recreation opportunities, including vehicle access, probably has the highest positive effect. Conversely, Alternative G, with the lowest access, has the worst effect. However, Alternative G provides the highest amount of firewood of any alternative which should offset the negative access restrictions

In the short-run, Rural Recreation and Residential communities should experience positive effects from implementation of any of the Alternatives. In the long-run, Alternatives A, B, and C, due to loss of visual quality and more primitive recreation activities, may result in negative impacts on these community types.

The impact of forest related leisure opportunities, from implementing any of the five Alternatives, on the Urban (Bend) and Westside communities should be similar to those of the Rural Recreation and Residential The lesser amount of visual quality objectives and lower emphasis on maintenance of existing unroaded areas outside Wilderness may be more strongly opposed by these communities than by Rural Recreation and Residential. Alternative C's higher developed and dispersed recreation opportunities, on the other hand, may offset any major negative impacts potentially found in the Rural Recreation and Residential community because of the more diverse recreational tastes in these two community types.

The Effect of Alternatives on Community Stability and Cohesion (Social Organization)

This social parameter considers both the effect on the social institution (i.e. schools, churches, etc), and community cohesion, which is an estimation of unification or polarization within a community

It is predicted that implementation of any of the Alternatives will exert some downward pressure on the ability of social institutions to function properly within Rural Industrial communities. This will be caused by decreased timber revenues and income associated with timber dependent employment necessary to support these institutions On the other hand, community cohesion will be strengthened as people with the same basic views band together against what will be perceived as "outsiders" destroying their way of life.

The alternatives with higher timber emphasis (Alternative C, followed by Alternatives A and B) will maintain the social institutions at a higher level than Alternative E and especially Alternative G As far as community cohesion is concerned, effects of the alternatives would be the reverse from the impact on institutions, i e. Alternative C would result in the least community cohesion because of the least change from existing conditions.

Within the Rural Recreation and Residential communities, the reduction in available timber volume in all Alternatives is not predicted to have a major destabilizing effect on social institutions due to the loss of timber related employment and personal income. Reduction in payment to counties and the Forest's budget, on the other hand, may have some negative impacts, especially in Alternative G and to a lesser extent Alternative E The increase in recreational related employment will offset any erosion of the financial base necessary to support social institutions which might occur under certain alternatives Community cohesion, on the other hand, is likely to increase only in Alternatives C and A, and to a lessening extent Alternative B, due to the perception that the timber production is out of balance with their perceived needs

Due to the size and diversity of the Bend economy, the negative and positive effects of less timber and more recreation will balance out in terms of impacts on social structures. If effects were to occur, they would tend to be negative Potentially, the most negative would be from Alternative G, followed by Alternatives E, B, A, and then C

Community cohesion, on the other hand, will be lessened in all Alternatives because of the diverse, polarized interests found within the community. Alternatives B and E can be expected to affect the least internal conflict due to the perception that they are more properly balanced

Westside communities will feel no destabilizing effects on their social institutions due to implementation of any of the Alternatives. Cohesion will be lessened more in the timber emphasis alternatives (Alternative C, A, and B) because westside residents would feel the loss of recreational opportunities more directly than diffused timber related impacts

Many communities, especially Bend, and the Rural Recreation and Residential types have been experiencing very rapid growth. This growth is being spurred by the increase in tourism, Bend's evolution into a regional service center, and an influx of people moving into the area. Although the Forest is not entirely responsible for these changes, it is certainly a contributing factor As a result of this growth the social institutions and community cohesion are showing signs of stress For many, affordable housing is rapidly becoming unattainable, especially for those tied to the lower paying, service related sectors. All Alternatives, but in particular the more amenity oriented alternatives, may exacerbate this condition. Alterna-