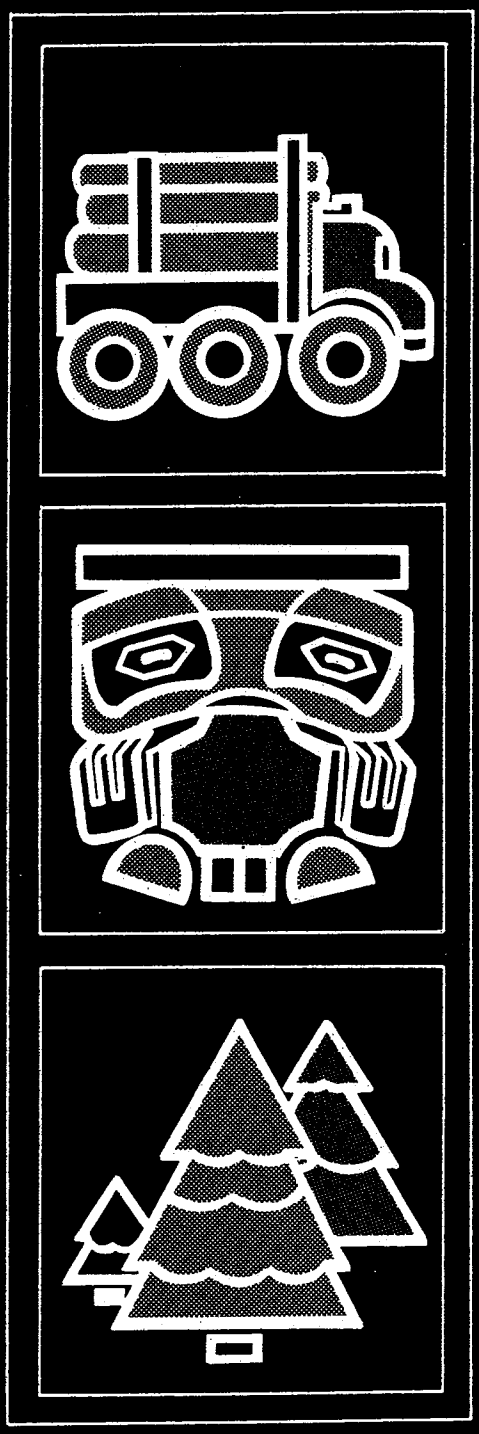
Appendix H



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INTRODUCTION

This appendix is included in the Final Environmental Impact Statement for the Forest Plan in response to decisions of the Chief of the Forest Service and the Deputy Assistant Secretary of Agriculture regarding appeal No. 1770, brought by the Northwest Forest Resource Council on September 18, 1989. The appeal centered on direction from the Regional Forester to incorporate "minimum management requirements" (MMR's) in forest plan alternatives. The appellant requested that the appropriateness of the MMR's be examined through the environmental impact statement process. The information in this appendix also responds to comments about Management Requirements (MR's) that were raised during the review of the Draft Environmental Impact Statement.

A summary of Management Requirements is provided in Chapter II, "Management Requirements" section. Additional information is in Appendix B "Development of Management Requirements." The Standards and Guidelines (or specifications) for implementation of the management requirements are found in the Forest Plan.

This appendix addresses the issue raised by the appellant: For those management requirements which cause significant reductions in allowable sale quantity (ASQ) or present net value (PNV), alternate ways of meeting the management requirements are examined and their opportunity costs (reductions in ASQ and PNV) are compared.

Appendix J of the Draft Environmental Impact Statement, "Sensitivity Analysis of Significant Forest Minimum Management Requirements" has been completely replaced by the material presented here. The Appendix J of the Draft is part of the planning record.

CHANGES BETWEEN DEIS AND FEIS

- Spotted Owl Habitat Areas were changed to meet the Record of Decision for the FSEIS to the EIS for an Amendment to the Pacific Northwest Regional Guide.

- Management requirements for mountain goats were enlarged, and the MR for deer and elk was dropped to meet regional direction, as discussed in the DEIS Appendix I.

- A new way of meeting water quality MR's was developed in response to public comment. The hydrologic cumulative effects constraint developed with public and scientific review is designed to ensure that unacceptable adverse hydrologic cumulative effects will be avoided.

BACKGROUND OF MANAGEMENT REQUIREMENTS

WHAT ARE MANAGEMENT REQUIREMENTS?

Many laws and regulations guide Forest Service activities. One law in particular, the National Forest Management Act of 1979 (NFMA), and its implementing regulations provide direction for the Forest planning process. The direction for National Forest Systems Land and Resource Management Planning, in Section 36 of the Code of Federal Regulations, Part 219 (36 CFR) specify: (1) the minimum specific management requirements to be met in

accomplishing the goals and objectives of the National Forest System (36 CFR 219.27) and (2) the minimum requirements for integrating individual forest resource planning into the Forest Plan (36 CFR 219.14 through 219.26). The term "management requirements (MR's)" will be used in this appendix to refer to these NFMA regulations instead of "minimum management requirements (MMR's)" which were used in the Draft Environmental Impact Statement and Proposed Forest Plan.

Some management requirements are procedural in nature and need not be dealt with here. Some requirements were analyzed and were available for review during the Regional Guide Environmental Impact Statement process and are not dealt with here. See Appendix B for a more complete discussion. The management requirements which have not been fully dealt with elsewhere, and which require additional analysis due to significant opportunity costs associated with implementation are:

1. Dispersion of timber harvest openings.

2. Maintenance of habitat (particularly mature and old growth habitat) to assure viable populations of wildlife.

3. Protection of riparian areas, water resources, and water quality.

These management requirements are described in greater detail in later sections of this appendix. MR's for other wildlife habitats and other requirements noted in 36 CFR 219.27 which have not been addressed in other Environmental Impact Statements do not cause significant opportunity costs when implemented.

LEGAL REQUIREMENTS VERSUS IMPLEMENTATION METHODS

The management requirements from NFMA and its implementing regulations are legal requirements. They represent "ends" which must be met during forest plan implementation. For example, the NFMA implementing regulations require that "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area." It is mandatory that, whatever implementation methods are chosen, the management requirement be met.

Specifications or standards for achievement for each management requirement are established at the national level or through analysis at the regional level for most of the management requirements. These are listed in the regulations or as Standards and Guidelines in the Regional Guide. Additional specifications identified on the Forest are listed as Standards and Guidelines in the FEIS, Appendix D, and the Land and Resource Management Plan, Chapter IV. The specification must be based on knowledge of the resources involved. For example, in meeting the management requirement for viable populations of vertebrate species it is necessary to define the type of habitat required by the species, the maximum distance between habitats which will still provide reasonable assurance of genetic interaction, and the size of habitat area needed to support a breeding pair.

Often, the pool of scientific knowledge is insufficient to provide the entire basis for defining the specific conditions or standards that will satisfy or meet a management requirement. When this happens it is necessary to rely on the field experience and the professional judgement of knowledgeable

professionals and to establish monitoring and research that will provide better information for future planning efforts.

Implementation methods are the "means" or "ways" in which the management requirements will be met. Usually there is more than one way in which a management requirement can be met. Determining the most appropriate means of meeting the specifications for each management requirement involves careful analysis at the Forest level. Considering and analyzing different means or ways of meeting a specific management requirement are particularly important if there are potentially significant reductions in present net value (PNV) or allowable sale quantity (ASQ) involved.

HOW IMPLEMENTATION METHODS TO MEET THE MANAGEMENT REQUIREMENTS ARE DEVELOPED

The selection of means sufficient to meet management requirements is based on effectiveness in meeting resource protection and on minimizing reductions to PNV or ASQ. The general process used in evaluating alternative ways of meeting the management requirements is as follows:

1. Identify the desired "end" for each management requirement.

2. Assemble existing information about the resources addressed by the management requirement.

3. Analyze the existing information to determine what conditions or specifications need to exist on-the-ground to assure meeting the "ends" of the management requirement. (See Table H-1.)

4. Develop various ways or means to meet the management requirement. (See Table H-2.)

5. Evaluate the effectiveness of the alternative means in meeting the managements. Estimate the environmental effects of each set of means.

6. For each set of means, estimate the effects on economic efficiency (as measured by changes in present net value) and the effects on timber availability (as measured by allowable sale quantity).

7. Where opportunity cost of meeting a management requirement exceed two percent of PNV or ASQ of the present net value benchmark, the analysis used to select the means are presented. Two percent was used because differences less than two percent would not be significant in terms of opportunity costs of alternative means. A higher threshold would preclude evaluation of many alternatives.

For discussion purposes, opportunity costs are reductions in present net value (PNV) and reductions in allowable sale quantity (ASQ) that result from implementing resource protection measures (means or ways) to meet the management requirements set forth in NFMA regulations. In order to meet timber harvest dispersion requirements; provide for wildlife habitat; and protect riparian areas, water resources, and water quality requirements of NFMA on Mt. Baker-Snoqualmie National Forest land, some opportunities to maximize present net value or to maximize timber production must be foregone.

Discussions are grouped by harvest dispersion, by wildlife habitat, and by riparian and water quality management requirements in separate sections. In each section, the management requirements are displayed along with relevant specifications from national and regional guidelines, and, where appropriate, alternative implementation methods (means or ways) are analyzed.

Table H-1 summarizes each of the management requirements (ends) subject to analysis of opportunity costs on the Mt. Baker-Snoqualmie National Forest and summarizes the specifications or standards of achievement for those ends. Table H-2 shows the alternative means considered for implementing each management requirement where the opportunity cost exceeded two percent.

In analyzing the effects of meeting the MR's on present net value (PNV) and allowable sale quantity (ASQ), FORPLAN runs were made with and without constraints designed to simulate meeting the management requirement. The PNV benchmark was used for this analysis. This benchmark is a FORPLAN run which identifies the mix of management activities which would result in the highest level of economic efficiency (i.e., the highest PNV) in managing Mt. Baker-Snoqualmie National Forest resources. It also identifies the ASQ associated with the most economically-efficient mix of management activities.

A benchmark was chosen to use in the with-and-without-constraint comparison, rather than an issue-based Forest Plan alternative, because management practices necessary to meet other objectives of the issue based alternatives may partially or fully meet the MR, thus clouding any analysis of opportunity costs induced by the management requirement. The true effect when measured against a fully developed alternative is significantly less because the objectives of that alternative may satisfy the management requirements to a large extent.

IMPLEMENTATION METHODS WITH HIGH OPPORTUNITY COSTS

Table H-3 displays the opportunity costs of the implementation measures selected for meeting management requirements on the Mt. Baker-Snoqualmie National Forest. Only those implementation measures with opportunity costs of two percent or larger are shown: dispersion of harvest units to meet silvicultural guidelines and NFMA vegetation management and diversity specifications; maintaining mature and old growth habitat for wildlife; protection of riparian area values; and limiting timber harvest acres to prevent unacceptable adverse hydrologic cumulative effects.

IMPLEMENTATION METHODS WITH LOW OPPORTUNITY COSTS

Management requirements for other wildlife habitat requirements for threatened and endangered species, sensitive species (except spotted owl), special habitats, and dead and defective tree habitat are not addressed in this analysis because opportunity costs of providing sufficient habitat to maintain viable populations are less than two percent.

Table H-1. Summary of Management Requirements and Associated Specifications.

Ends	Summary of Specifications
Disperse timber harvest openings	Insure timber harvest openings meet size limits and spacing requirements established by the Regional Guide.
Provide habitat to maintain viable populations of existing native and desired non-native vertebrate species	
Northern spotted owl	Maintain mature and old-growth conifer stands (for nesting and feeding) per FSEIS requirements. (see Table H-5.)
Pileated Woodpecker and Pine Marten	Maintain mature growth conifer stands (for nesting and feeding) of adequate size and distribution to permit interaction among breeding pairs of dependent species. (See Tables H-7 and H-8.)
Mountain goat	Maintain mature and old-growth conifer stands of adequate size and conditions, in critical goat use areas, to maintain viable goat populations on the Forest. (See Table H-9.)
Protect Riparian Areas and Water Quality	Allow no management practices which seriously and adversely affect water conditions or fish habitat through detrimental changes to stream temperatures or chemical composition, blockage of water courses, scouring of stream channels, or deposits of sediment. Comply with the requirements of the Clean Water Act, the Safe Drinking Water Act, and all substantive and procedural requirements of Federal, State, and local governmental bodies with respect to the provision of public water systems and the disposal of waste water.

Table H-2 Summary of Alternative Means Considered for Implementing Each Management Requirement.

Management Requirements	Alternative Means
Locate timber harvest openings to achieve desired combination of multiple-use objectives.	Harvest not more than 30% of each watershed in the first decade, 30% in the second decade, and 20% in each succeeding decade.
	No alternative means was analyzed for this MR
Provide for adequate habitat to maintain viable populations of existing native and desired non-native vertebrate species.	
Northern Spotted Owl, Pileated Woodpecker, and Pine Marten	Dedicate habitat sites for no timber harvest.
	Manage habitat sites on long rotations to provide adequate suitable habitat at all times.
Mountain Goats	Dedicate habitat sites for no timber harvest.
	Manage habitat sites on an extended rotation to provide adequate optimal thermal cover acres at all times.
Protect Riparian Areas	Allow no removal of vegetation from riparian areas.
	Allow no timber harvest in 25% of the riparian area, allow harvest using a minimum 160-year rotation on 50% of the riparian area, and manage the remaining 25% of the riparian area in the same manner as the adjacent land allocation.
Protect Water Quality	Watershed by watershed classification and evaluation of watershed conditions. Determine limits on acres harvested by decade by watershed to prevent unacceptable adverse hydrologic cumulative effects.
	Review of literature and discussions with academic and scientific community members indicates no process for assessing and mitigating hydrologic cumulative effects applicable to the Mt. Baker-Snoqualmie National Forest exists.

Table H-3. Opportunity Cost of Meeting the Management Requirements with the Selected Implementation Methods

Selected Implementation Method	First Decade ASQ MMCF/Year (MMBF/Year)	Change in ASQ 1/ Percent	PNV MM $	Change in PNV Percent
PNV Benchmark with No Protection Measures	63.9 (306)	-	2631	-
Opportunity Cost of Timber Harvest Dispersion	59.1 (283)	-8	2484	-6
Opportunity Cost of Mature and Old Growth Habitat for Northern Spotted Owl, Pileated Woodpecker, Pine Marten, and Mt. Goat	50.1 (240)	-22	2410	-8
Opportunity Cost of Riparian Protection	59.6 (285)	-7	2580	0
Opportunity Cost of Water Quality Protection	41.0 (196)	-36	2297	-13

1/ Percent change calculated on cubic foot basis

IMPLEMENTATION METHODS THAT MEET MORE THAN ONE MANAGEMENT REQUIREMENT

Implementation methods selected to meet water quality management requirements also provide fish habitat in streams and riparian habitat adjacent to streams to assure the maintenance of viable populations of species dependent on these habitats. Alternative implementation methods for meeting water quality management requirements will also meet fish habitat and riparian habitat requirements. No additional discussion or analysis is displayed in Appendix H for these management requirements.

TIMBER HARVEST DISPERSION MANAGEMENT REQUIREMENT

SOURCE OF THE TIMBER HARVEST DISPERSION MANAGEMENT REQUIREMENT

Management requirements for dispersion of timber management openings are based on NFMA which states: "Openings shall be located to achieve the desired combination of multiple-use objectives. The blocks or strips shall be shaped and blended with the natural terrain, to the extent practicable, to achieve aesthetic, wildlife habitat, or other objectives established in the Plan (36 CFR 219.27(d)(1).

Direction in the Regional Guide relating to harvest openings states, "Created openings will be separated by blocks of land that generally are not classed as created openings and that contain one or more logical harvest units. A harvested area will no longer be considered a created opening for silvicultural purposes when stocking surveys indicate prescribed tree stocking that is at least 4-1/2 feet high and free to grow."

SPECIFICATIONS FOR THE TIMBER HARVEST DISPERSION MANAGEMENT REQUIREMENT

The Forest utilized the theoretical harvest dispersion factor formula developed by the Region, which resulted in a harvest dispersion factor of 30%. This 30% represents the maximum amount of land that can be assigned to a regeneration timber harvest prescription in a 10 year period. An accessibility constraint of 30% applies to each allocation zone on the Forest for Decades 1 and 2. The accessibility constraint increases to 20% in the third and fourth decade to reflect the harvest occurring in the first two decades. After the first 4 decades, a 20% constraint is applied to the North and South portions of the Forest rather than to the allocation zones.

ALTERNATIVE WAYS OF MEETING THE MANAGEMENT REQUIREMENT FOR TIMBER HARVEST DISPERSION

No alternative means of meeting this management requirement were identified. The modeling results of the accessibility constraints were tested by plotting units scheduled for harvest in a benchmark run onto an allocation zone/analysis area map. The resulting pattern indicated that the adjacency requirements could be met in most instances, though not with a lot of leeway. This evaluation and the experiences of adjacent Forests where harvest dispersion factors ranged from 25 percent to 30 percent indicates alternative means of meeting this MR are extremely limited or do not exist.

EVALUATION OF IMPLEMENTATION METHODS TO MEET TIMBER HARVEST DISPERSION MANAGEMENT REQUIREMENT

Only a single method was developed and investigated for this management requirement.

OPPORTUNITY COSTS

The opportunity costs of the implementation method for meeting the timber harvest openings management requirement were estimated by comparing the differences in PNV and ASQ that would occur with and without the constraints that meet the requirements.

Table H-4 Displays the PNV and ASQ opportunity costs of the harvest dispersion management requirement.

Table H-4. Opportunity Cost of Meeting the Harvest Dispersion Management Requirement

Selected Implementation Method	First Decade ASQ MMCF/Year (MMBF/Year)	Change in ASQ 1/ Percent	PNV MM $	Change in PNV Percent
PNV Benchmark with No Protection Measures	63.9 (306)	-	2631	-
Opportunity Cost of Timber Harvest Dispersion	59.1 (283)	-8	2484	-6

1/ Percent change calculated on cubic foot basis

RATIONALE FOR THE SELECTED IMPLEMENTATION MEANS

The harvest dispersion constraint was developed on the assumption that harvest units would be 40 acres in size and that it would take 11 to 16 years (depending on elevation and method of reforestation) for trees to reach 4-1/2 feet in height. These assumptions may overestimate or underestimate actual conditions on the ground.

Region-wide criteria and a suggested method for calculation of a theoretical harvest dispersion constraint were available to all Forests. The calculation of the harvest dispersion constraint includes two variables, the size of the harvest unit, and length of time for reproduction to reach 4-1/2 feet in height.

Coordination with the Wenatchee, Gifford Pinchot, and Olympic National Forests indicated that there were differences between Forests that could potentially result in differences in modeling proxies for harvest dispersion. There are differences between Forests in the amount of the Douglas fir type (maximum size of harvest unit of 60 acres) and other forest types (maximum size of harvest unit of 40 acres). The length of time required for a tree to reach 4-1/2 feet also varies between Forests because of differences in species composition, growth rates and methods of reforestation.

The harvest dispersion factor selected by the four Forests varies from 25% to 30%. This difference appears reasonable based on the physical and biological differences between the Forests.

IMPLICATIONS FOR FOREST PLAN ALTERNATIVES

FEIS Chapter II and Appendix B discuss the effects of this method of meeting the harvest dispersion requirement in FEIS Alternatives. The analysis of opportunity costs of the selected means of harvest dispersion in Table H-4 shows the maximum PNV and ASQ effects. Actual Plan alternatives will have somewhat less opportunity costs as overlaps from lands withdrawn for wildlife, scenery, recreation, or other nontimber objectives will help provide dispersion of harvest units.

ROLE OF MONITORING AND RESEARCH

The Forest Monitoring Plan (Forest Plan Chapter 5) calls for monitoring of size and dispersion of harvests units to insure NFMA requirements are met. At scheduled Plan reviews, monitoring data will be evaluated to determine the effectiveness of the means selected to model the requirement for harvest dispersion.

EXISTING NATIVE VERTEBRATE SPECIES VIABLE POPULATIONS MANAGEMENT REQUIREMENT

SOURCE OF THE MANAGEMENT REQUIREMENT

The NFMA regulations require that:

"Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure continued existence in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area." (36 CFR 219. 19).

DESCRIPTION OF THE MANAGEMENT REQUIREMENT

All vertebrate species in Region Six were assessed with regard to population numbers and/or distribution that could result in either Forest or Regional extinction during the next five decades. Management requirements were developed for species whose viability would be at risk if no management actions were taken to protect their habitats.

The focus was on habitats that were likely to be limiting in the future (in short supply either in total acreage or in distribution) and on identification of particular species that could be used to represent all species dependent on those habitats. This identification was done on a subregional basis, recognizing the variability of situations within the Region. Once these species were identified, the Region defined their habitat requirements and biological characteristics. The species are included in the list of Management Indicator Species (MIS) that the Forests address in forest planning and subsequent monitoring.

Table H-5 displays current Regional management requirement direction regarding limited habitats and wildlife species by sub-regional zones. The Mt. Baker-Snoqualmie National Forest is in Zone 2.

Northern spotted owl, pileated woodpecker, pine marten, and mountain goat are the only species for which alternative ways of meeting management requirements are evaluated. Management requirements for threatened and endangered species, sensitive species (except spotted owl), special habitats, and dead and defective tree habitat are not addressed in this analysis because opportunity costs associated with providing sufficient habitat to maintain viable populations are less than two percent. The management requirements for fish

are met with the same management practices which provide the requirements for riparian area and water quality, therefore further analysis is not provided.

Table H-5. Species Matrix for Addressing Management Requirement for Wildlife and Threatened and Endangered Species.

Zone Habitat	Zone 1 North Coastal	Zone 2 Westside Cascades	Zone 3 Eastside Cascades	Zone 4 Blue Mountain
Mature and Old Growth (Seral Stages V and VI)	*Northern Spotted Owl Pine Marten Pileated Woodpecker	*Northern Spotted Owl Pine Marten Pileated Woodpecker	*Northern Spotted Owl Pileated Woodpecker Northern three-toed woodpecker	Pine Marten Pileated Woodpecker Northern three-toed woodpecker
	*The Final Supplemental Environmental Impact Statement and subsequent Record of Decision provide direction for management of spotted owl habitat in Region Six.			
Dead and Defective	Primary Cavity Excavators	Primary Cavity Excavators	Primary Cavity Excavators	Primary Cavity Excavators
Riparian	The Forest determined and documented as part of the planning records, whether it needed to address wildlife in addition to fish, and if so which wildlife species would represent the riparian habitat. Coordination of this process with adjacent Forests was necessary to determine consistency.			
Big Game		Mountain Goat	Mountain Goat (Wenatchee)	
Threatened Endangered Species	Bald Eagle Peregrine Falcon Brown Pelican Aleutian Canada Goose	Bald Eagle Peregrine Falcon	Bald Eagle Peregrine Falcon Grizzly Bear Woodland Caribou (Colville)	Bald Eagle Peregrine Falcon

HABITAT NEEDS

Once the species needing management requirements were identified, the Region defined habitat requirements and biological characteristics. These are the basis for providing habitat and also for deciding how best to represent the species' needs in the planning process and in the FORPLAN Model. Regional specifications for MR species are summarized in "A Report on Minimum Management Requirements for Forest Planning on National Forests of the Pacific Northwest Region, USDA Forest Service" (USDA Forest Service, June 1986).

Habitat needs were defined using information from existing research whenever possible (see bibliography). This information was used to define the habitat conditions, habitat dispersal, and habitat size necessary to meet the management requirement. When information was available, but did not fit exactly the management requirement context, professional judgement was used to apply the information in estimating habitat needs. When information was not available, habitat needs were developed using professional judgment of a number of more knowledgeable biologists on the subject. Information from existing research was used whenever possible (Note: Habitat needs of spotted owls are described in the Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide, USDA Forest Service 1988).

Specific information on habitat needs, specifications for meeting habitat requirements, and alternative ways of meeting the management requirements for northern spotted owls, pileated woodpecker, pine marten, and mountain goats are presented in the following sections. For each species, information is provided for these three habitat factors:

Principal Habitats Used

Information about the seral stages and Kuchler vegetation types which are used by the various species is documented in many research papers for individual species. Information as to which Kuchler type and/or seral stage are primary or secondary habitat, and the amount of dependency upon each habitat, is based mostly on professional judgment (Guenther and Kucera 1978, Phillips and others, 1981).

Dispersal Distance Between Habitats

Usually no research information is available for optimum dispersal distance between habitats. As a result, dispersal distance is often determined on the basis of observations, experience, and professional judgment. Dispersal distance is based on the ability of an individual species to travel to the next habitat often enough to prevent isolation of sub-populations. Distances are adjusted to consider the network and overlap of habitat formed by the species (e.g., Pileated woodpecker and pine marten).

Size of Habitat Areas

The size of individual habitat areas provided for each wildlife species is based on the habitat acreage needed to support the basic social or reproductive unit of the species, i.e., breeding pairs. Both home range and species density information are used to estimate the needed size of habitat area. This was supplemented with professional judgement where no data were available for the specific habitat types being managed.

SPECIFICATIONS FOR MEETING THE HABITAT REQUIREMENTS FOR NORTHERN SPOTTED OWL

Specific Regional direction for the northern spotted owl is found in the Final Supplement to the Environmental Impact Statement (FSEIS) for an Amendment to the Pacific Northwest Regional Guide released in August, 1988. In response to an appeal of the R-6 Regional Guide, the Supplement was prepared to address planning direction for spotted owl habitat management. Standards and guidelines adopted as a result the Supplement will be used by National Forests

in the Region to meet the management requirement to maintain viable populations of spotted owls.

The final SEIS was prepared after a series of public meetings and study of the nearly 42,000 comments received on the Draft Supplement issued in the summer of 1986. A summary of the analysis of public comments, substantive comments, and copies of letters received from government agencies and elected officials can be found in Appendix G of the FSEIS.

The Forest Service Preferred Alternative (F) directs that the amount of suitable habitat at each designated SOHA will vary by physiographic province. Specific criteria were followed in locating designated SOHA's on the Mt. Baker-Snoqualmie. Current distribution of owl habitat on lands unsuitable for timber production was evaluated for adequacy of distribution. SOHA's were designated on lands suitable for timber production only where necessary to meet distribution standards. Standards and Guidelines for the Forest Service preferred alternative (F) are briefly summarized in the following discussion. Chapter II of the Final Supplement should be reviewed for detailed description of the direction. These Regional Standards and Guidelines provide specifications or standards for achievement of management requirements for northern spotted owls:

1. **Amount of suitable habitat in designated habitat areas:** Designated habitat areas shall contain the following amount of suitable habitat: 2200 acres within 2.1 miles of the nest site or likely nest site if the exact nest site is unknown. Habitat shall occur as one contiguous stand if possible or, as a 300 acre stand containing the known or suspected nest site with the remaining habitat as contiguous as possible. Each stand shall be larger than 60 acres.

2. **Spacing of Designated Habitat Areas:** Designate habitat areas where: greater than six miles separates areas which occur in reserved lands or in lands unsuited for timber production, and which are capable of supporting less than three breeding pairs of spotted owls; or where greater than 12 miles separates such areas capable of supporting three or more pairs.

3. **Threatened and Endangered Species:** No spotted owl habitat management activities shall adversely effect Federally listed threatened or endangered species or their habitat.

4. **Identification of Suitable Habitat:** Suitable habitat shall be identified in Forest Plans according to the general definition in the spotted owl Final Supplement and with concurrence by the Regional Forester.

5. **Management of Habitat:** Spotted owl habitat can be provided through prescriptions using even-aged or uneven-aged silvicultural systems, or no scheduled harvest. Prescriptions to be used and where they will apply shall be specified in the Forest Plans.

6. **Location of designated Habitat Areas:** Designate habitat areas only on lands suitable for timber production as needed to meet spacing standards.

7. **Priority for Locating Designated Areas:** Priority for locating designated areas follows status of occupancy by spotted owls. The highest priority is given to locations with verified occupancy by spotted owl pairs; next highest to locations with confirmed sightings of owls; lowest priority to locations where the presence or absence of owls is unknown.

The Final Supplemental Environmental Impact Statement (FSEIS) to the Regional Guide (for spotted owl habitat management guidelines) does not include the number of designated habitat areas as part of any alternative. The number of habitat areas are not specified in the Regional Guide, but will be a consequence of applying standards and guidelines in Forest Plans.

ALTERNATIVE WAYS OF MEETING THE MANAGEMENT REQUIREMENTS FOR NORTHERN SPOTTED OWL

The Forest considered two alternative ways of providing mature and old-growth habitat for viable wildlife populations. These were the dedicated approach, where the required acres would be constrained to a no timber harvest prescription and a managed approach which provided for managing the habitat on an extended rotation basis to provide the desired structural characteristics of the stand.

ALTERNATIVE 1: Dedicated Sites

Under a dedicated habitat strategy, each acre of spotted owl habitat is withdrawn from timber production. Dedication of existing stands assures that desired structural characteristics will be available, but may risk loss of individual stands through catastrophe or decay. Recent literature on old-growth suggests this risk is much less than once thought.

ALTERNATIVE 2: Managed Sites

Management of sites assumes that existing old growth stands can be harvested as they are replaced by other stands that grow into an old-growth condition. Delay in harvesting the existing old-growth stands would occur if replacement stands fail to develop desired structural characteristics on schedule. Management of old growth on a harvest basis and replacing it removes structural characteristics important to old-growth and may hasten the decline of the residual stand (Franklin 1981). There is a risk that all habitat components are not well-enough understood to manage for the full complex of habitat characteristics needed.

EVALUATION OF IMPLEMENTATION METHODS TO MEET NORTHERN SPOTTED OWL MANAGEMENT REQUIREMENT

An efficiency analysis was conducted to compare the dedicated versus managed approach utilizing the methodology developed by the Siuslaw National Forest. This analysis indicated that a dedicated approach was more efficient than a managed strategy in terms of timber outputs. An economic evaluation was conducted for marten habitat areas, comparing the managed and dedicated strategies. This analysis confirmed that dedicated was more efficient in terms of PNV at a 4% discount rate. In addition there is uncertainty about whether the structural characteristics of mature and old growth habitat can be duplicated through management.

The minimum time required to produce mature forest habitat is 100 years. It requires at least 250 years to produce old-growth forest habitat. At both 100 and 250 years, the average replacement area would contain more volume than the original habitat area. Rotating the areas would result in less timber yield than harvesting the potential replacement area and leaving the original area to continue providing habitat. Dedicating the habitat minimizes the opportunity costs of ASQ and PNV. Thus the dedicated stand option was selected to provide for all mature and old-growth habitat management requirements.

Table H-6 compares the empirical yield table volumes after 100 and 250 years with the volumes from the intensive managed yield tables at ages 100 and 250.

Table H-6. Comparison of Stand Volumes After 100 and 250 Years.

	Stand Volumes After 100 and 250 Years (MCF/Acre)			
	100 Years		250 Years	
Site 1/	Empirical	Managed	Empirical	Managed
North				
DF High	--	12.931	--	20.463
DF Low	--	11.593	--	13.959
PSF Low	--	9.598	--	9.521
Average	6.776	--	8.527	--
South				
DF High	--	10.008	--	17.638
DF Low	--	9.196	--	11.433
PSF Low	--	9.412	--	9.368
Average	5.467	--	10.374	--

1/ DF = Douglas-fir
PSF = Pacific silver fir

OPPORTUNITY COSTS

The opportunity costs of designating the habitat areas (selected method) were not determined for spotted owls alone. Because of the interactions of habitat needs of all the mature and old growth species (Spotted owl, pileated woodpecker, pine marten, and mountain goat), opportunity costs were determined for the combination of all species requiring mature and old growth habitat. The discussion of opportunity costs for these management requirements are found at the end of this section (page H-27).

CONSEQUENCES OF THE DIFFERENT WAYS OF MEETING THE MANAGEMENT REQUIREMENT

Populations of spotted owls would not be expected to differ significantly under any of the options available to meet the management requirement. There are,

however, differences in the opportunity costs as dedicated habitat areas would have the least impact on timber outputs and therefore PNV.

RATIONALE FOR THE SELECTED METHOD

The Mt. Baker-Snoqualmie National Forest chose to provide spotted owl habitat by dedicating habitat sites. This alternative maintains necessary habitat, and has the least effect on timber outputs; it is an economically efficient way of meeting the management requirement with the least opportunity costs.

The dedicated habitat approach has the advantage that the location of the habitat site does not change over time, making implementation less complicated than continuously relocating the habitat site as the stands are harvested and replaced

IMPLICATIONS FOR FOREST PLAN ALTERNATIVES

Plan alternatives were designed to address public issues. As a result most alternatives, including the preferred, incorporate objectives for retention of old-growth and mature timber for a variety of reasons, such as wildlife, visual, and recreation. To the extent possible, spotted owl habitat areas overlap with areas selected for other purposes (such as Wilderness, unroaded recreation areas, special interest areas and other lands determined as not appropriate or unsuited for timber production), wherever these meet habitat suitability and distribution requirement.

ROLE OF MONITORING AND RESEARCH

The Forest Monitoring Plan (Forest Plan Chapter V) calls for monitoring populations and habitats of spotted owls.

The Final Supplemental Environmental Impact Statement to the Regional Guide (Appendix D) identifies specific monitoring and research needs and describes how the information will be obtained. Intensive inventory, monitoring, and research being conducted by the Spotted Owl Research, Development, and Application Program will provide new information. This should allow an opportunity to re-evaluate and possibly adjust management direction within five years.

SPECIFICATIONS FOR MEETING HABITAT REQUIREMENTS FOR PILEATED WOODPECKER AND PINE MARTEN

A number of wildlife species are known to depend on or prefer mature conifer habitat during some part of their life cycle on the Mt. Baker-Snoqualmie National Forest. By providing a dispersion of mature conifer habitat sites for the pileated woodpecker and pine marten, we are assuming that the other species preferring mature conifer habitats will have adequate habitat to maintain viable populations throughout the planning period.

Regional specifications for pileated woodpecker and pine marten are discussed in the following sections. The specifications are summarized from "A Report on Minimum Management Requirements for Forest Planning on the National Forest of the Pacific Northwest Region, USDA Forest Service" (USDA Forest Service, June 1986). In developing the report, various habitat sizes and dispersal distances

were considered. Based on that analysis, minimum habitat sizes and maximum dispersal distances were identified for each species. This information is based on the best available data. Alternatives which addressed changes to size or distribution were not considered in developing the Forest Plan for the Mt. Baker-Snoqualmie National Forest.

Habitat specifications for pileated woodpecker and pine marten are summarized in Table H-7 and H-8.

PILEATED WOODPECKER SPECIFICATIONS

Principal Habitats Used

Pileated woodpeckers need mature or old growth stands of timber for nesting and feeding. Habitats were identified in Bull and Meslow (1977), Guenther and others (1978), and Thomas (1979).

Dispersal Distance Between Habitats

An initial five-mile maximum dispersal distance between habitats from professional judgment documented in Phillips and Roberts (1985). In June of 1986, the distance between habitats was modified to one habitat area for every 12,000 to 13,000 acres (about five miles apart) to allow greater flexibility in application.

Size of Habitat Areas

The size of nesting areas in Region Six for the pileated woodpecker has been identified as a range of 100 to 540 acres. To meet the needs of pileated woodpeckers both east and west of the Cascades, 300 acres of old growth or mature timber for nesting area, plus 300 acres of feeding area was defined as a Region-wide requirement. Three hundred acres of nesting area appears to be an average for different habitats. As more data specific to westside and eastside habitats (eastside may be further subdivided) become available, the size of the nesting area may be adjusted (Bull and Meslow, 1977; Bull, 1975; Mannan, 1982; Mellen, 1986). A 1,000-acre unit was established as the minimum size territory that a pair of woodpeckers would defend. This was determined from research data. Snag size and density were taken from Thomas (1979), and acreage figures from Bull (1975), and Bull and Meslow (1977). See Table H-7 for summary of habitat specifications.

Table H-7. Pileated Woodpecker Habitat Requirements.

Principal Habitats Used Zone 2 (West Cascades) 1/	Dispersal Distance Between Habitats	Size of Area to which wildlife Prescriptions Apply	Habitat Requirements to be Used in Analyses
		All Zone	600 acres/pair Within a 1,000-acre unit:
A. Reproducing			
Seral Stages V and VI of Kuchler types K2, K5, K29, and riparian.	One habitat area for 12,000 to 13,000 acres.		Maintain 300 acres of conifers in seral stages VI and/or V, per pair for reproducing.
B. Feeding			
All seral stages of Kuchler types listed for reproducing habitat, provided snags are present.			Maintain a minimum average of two hard snags per acre greater than or equal to 12 inches dbh within the 300-acre reproductive area. Forty-five of these 600 snags should be greater than or equal to 20 inches dbh. When possible, maintain reproductive area in 300 contiguous acres. If not possible, habitat may be arranged in blocks no less than 50 acres and no more than 1/4 mile apart. Maintain a minimum average of two hard snags per acre greater than or equal to 10 inches dbh on an additional 30 acres for feeding.

1/ Mt. Baker-Snoqualmie National Forest is in Zone 2, Westside Cascades. Principal habitats used vary by zone in the Region.

PINE MARTEN SPECIFICATIONS

Principal Habitats Used

The pine marten uses seral stages III-VI--closed sapling-pole, large mature, and old growth (Thomas, 1979; Guenther and Kucera, 1978; Phillips and others, 1981). The Kuchler types used are from Guenther and Kucera (1978). The principal habitat for pine marten is seral stages V and VI (mature and old growth).

Dispersal Distance Between Habitats

Burke (1982) recommends that the maximum dispersal distance between habitat areas for pine marten should be two miles. In 1984 the Regional Forester changed the dispersal distance from two miles to three miles. This change was made because it was felt where more than one adjacent habitat is available for dispersal, the dispersal distance can be extended to three miles for pine marten. This change has been reviewed by a number of biologists within and outside the Forest Service and most agree that it would appear not to create a population viability problem for represented species. In June of 1986, the dispersal distance specification for pine marten habitat was changed to one habitat for every 4,000 to 5,000 acres (about three miles apart) to allow greater flexibility in application.

Size of Habitat Areas

In the professional judgment of the biologists listed in Phillips and Roberts (1985), a breeding female pine marten can be supported on 160 acres of quality habitat. Research is variable as to the size of area needed, but the female pine marten home range is estimated to be 160 acres (Campbell, 1979). The biologist listed in Phillips and Roberts (1985) judged that this area should be contiguous to ensure that there would be enough habitat within the home range of the female. They also judged that crown closure should equal or exceed fifty percent. Research papers indicate that areas with a low percent crown closure receive little or no use by pine marten. Therefore, to ensure an adequate crown closure, a minimum requirement of 50 percent closure was selected.

Research shows that pine marten require dead and down material for foraging, cover, and denning. Six down logs/acre (Burke, 1982) was selected as the minimum down material requirement. The number and size of snags required was selected to ensure that the amount of down material was achieved. The specifications for pine marten habitat are summarized in Table H-8.

Table H-8. Pine Marten Habitat Requirements.

Principal Habitats Used Zone 2 (West Cascades) 1/	Dispersal Distance Between Habitats	Size of Area to which wildlife Prescriptions Apply	Habitat Requirements to be Used in Analyses
	One habitat area for every 4,000 to 5,000 acres	160 acres per habitat area.	Maintain 160 contiguous acres of conifer in seral stages V or VI with a crown closure 59 percent or greater.
A. Reproducing			
Seral stages V and VI of Kuchler types K2, K5, K6, K29.		(This figure represents the territory of one female and part of the territory for a male)	Within 160-acre unit: Maintain an average of two hard snags per acres greater than or equal to 12 inches dbh.
B. Feeding			
Seral stages III-VI of Kuchler types listed for reproducing habitat.			Twenty-four of these 320 snags should be greater than or equal to 20 inches dbh. Maintain a minimum average of Six down logs per acre at least 12 inches dbh and 20 feet long.

1/ Mt. Baker-Snoqualmie National Forest is in Zone 2, Westside Cascades. Principal habitats used vary by zone in the Region.

ALTERNATIVE WAYS OF MEETING THE MANAGEMENT REQUIREMENT FOR PILEATED WOODPECKER AND PINE MARTEN

On the Mt. Baker-Snoqualmie National Forest, mature conifer habitat is defined as a stand of predominantly conifers which are over 100 years old.

Habitat areas for pine marten and pileated woodpeckers were mapped using Regional spacing, size, and habitat suitability criteria. Pine marten sites area to be located every 4,000 to 5,000 acres and pileated woodpecker sites every 12,000 to 13,000 acres.

Whenever possible sites were place within Wilderness, Wild River, RNA's other areas unsuitable for timber production, and in areas of reduced harvest levels, wherever these met habitat quality and distribution requirements.

Once the minimum number of habitat sites was determined using Regional spacing and habitat suitability specifications, the Forest considered two options for providing mature conifer habitat. One was to dedicate the required number of acres of suitable habitat in each site. These areas would not be managed for timber production and would be expected to remain in suitable habitat condition for several decades. The second option was to manage timber stands on a larger area in order to harvest timber and produce replacement stands over time.

ALTERNATIVE 1: Dedicated Sites

Under a dedicated mature conifer strategy, the required amount of mature conifer is withdrawn from timber production. Dedication of mature conifer sites has the advantage that the location of the stand does not change over time, making implementation less complicated. Dedication also assures that desired structural characteristics will be available for wildlife. There may be some risk of loss of individual stands through catastrophe.

ALTERNATIVE 2: Managed Sites

This option involves the projection of long rotations on enough acres to maintain the necessary habitat through time, with all areas being rotated. The "normal" rotation age for stands in General Forest is projected to be about 100 years. Production of mature conifer habitat is expected to take around 100 year; rotations of 140 are used to model a managed regime providing mature habitat from age 100 to 140. This means that for every acre of suitable habitat, 2-1/2 acres would be managed as replacement stands when the original acre is harvested.

Management of mature conifer sites assumes that existing stands can be harvested as other stands grow into a mature conifer condition to replace them. If replacement stands fail to develop desired structural characteristics (ie. large diameter snags and down material) as predicted mature conifer habitat would either be lost for a period of time or further delay in harvesting the existing mature conifer stands would occur.

EVALUATION OF IMPLEMENTATION METHODS TO MEET PILEATED WOODPECKER AND PINE MARTEN MANAGEMENT REQUIREMENTS

A discussion of the evaluation of alternative means of meeting all mature and old-growth habitat management requirements is included in the section on northern spotted owl.

OPPORTUNITY COSTS

The opportunity costs of designating the habitat areas (selected method) were not determined for pileated woodpecker or pine marten alone. Because of the interactions of habitat needs of all the mature and old growth species (Spotted owl, pileated woodpecker, pine marten, and mountain goat), opportunity costs were determined for the combination of all species requiring mature and old growth habitat. The discussion of opportunity costs for these management requirements are found at the end of this section (page H-27).

CONSEQUENCES OF THE DIFFERENT WAYS OF MEETING THE MANAGEMENT REQUIREMENT

Populations of pileated woodpeckers and pine marten would not be expected to differ significantly under either alternative. Both would maintain the same amount and distribution of Habitat. There are, however, differences in the opportunity costs as dedication of habitat areas would have the least impact on timber outputs and therefore PNV.

RATIONALE FOR THE SELECTED METHOD

The Mt. Baker-Snoqualmie National Forest chose to provide mature conifer habitat for pileated woodpecker and pine marten by dedicating sites where needed on tentatively suitable timber land. This alternative achieves the desired habitat with the least effect on timber outputs and is and economically efficient way of meeting the management requirement. Modeling these areas as designated for this planning period does not preclude future planners from designating replacement areas as substitution opportunities can be identified (i.e., some existing pole stands could be substituted for originally designated area by the 5th decade). Whether areas are modeled as designated or rotated, there would be little difference in implementation for the first planning period.

IMPLICATIONS FOR FOREST PLAN ALTERNATIVES

Plan alternatives were designed to address public issues. As a result most alternatives, including the preferred, incorporate objectives for retention of old-growth and mature timber for a variety of reasons, such as wildlife, visual, and recreation. To the extent possible, pileated woodpecker and pine marten habitat areas overlap with areas selected for other purposes (such as Wilderness, unroaded recreation areas, special interest areas and other lands determined as not appropriate or unsuited for timber production), wherever these meet habitat suitability and distribution requirement.

Spotted owl, pine marten, pileated woodpecker and goat areas overlap with each other in some cases, and they overlap with areas selected for other purposes (such as unroaded recreation areas and special interest areas) wherever these sites meet habitat suitability and distribution requirements. Methods

resulting in the opportunity cost shown in Table H-3 would benefit other resource uses as well.

ROLE OF MONITORING AND RESEARCH

The Forest Monitoring Plan (Forest Plan Chapter V) calls for monitoring populations and habitats of pileated woodpecker and pine marten. At scheduled plan review, monitoring data will be considered in determining the suitability and effectiveness of the selected method for meeting the management requirement for viable populations. This will be an important test of the appropriateness of the selected modeling assumptions.

Information needs for both pine marten and pileated woodpecker include:

1. Dispersal distances:

   a. How far can juveniles successfully disperse?
   b. As habitat becomes increasingly fragmented, what is the ability of dispersing individuals to locate habitat islands?
   c. What effect does the size of habitat areas have on the ability of dispersing individuals to locate these sites?

2. Size of mature conifer habitat sites:

   a. Occupancy and use of habitat sites, particularly as the sites become more isolated.
   b. Reproductive success within habitat sites.
   c. Home range size in fragmented forests.

3. Utilization and reproductive success of pine marten and pileated woodpeckers in mature conifer sites managed on a 100 year rotation (ie. are managed sites meeting habitat needs as compared to natural stands).

4. Population density, home range size and distribution of pine marten in reserved and other no-timber-harvest areas.

5. Reliable cost-effective methods of inventorying and monitoring pileated woodpecker and pine marten numbers are needed. Research is underway to improve these techniques.

SPECIFICATIONS FOR MEETING THE HABITAT REQUIREMENTS FOR MOUNTAIN GOAT

Principle Habitats Used

The mountain goat uses rock outcrops, cliffs, avalanche chutes, rim rocks, and seral stages V and VI (mature and old growth) of Kuchler types K1, K2, and K3.

Size of Habitat Areas

On the Mt. Baker-Snoqualmie, it was determined that habitat areas would be 45 acres per goat, based on the regional requirement of 10 acres per goat for each month on the winter range. Mountain goat habitat on the Forest was mappped by goat family group habitat areas, using the best available information on goat

occurrence and habitat requirements. The total number of family group areas mapped was 124: 16 in wilderness, 34 partially in wilderness, and 74 outside wilderness.

Once the family groups were established, an MR area was determined for each family group area, using the habitat specifications described in Table H-9. To the extent possible, 585 acres (45 acres per goat for an average 13 goats in the family) of MR habitat was delineated. In a number of areas, this amount of suitable cover was not present; in these cases, all of the existing suitable cover was delineated. Wilderness family groups had larger amounts of suitable cover available in a number of cases. Since these areas are what is minimally required and, therefore, very important if that is the only thermal cover left, they must be set up in areas of high use and/or critical need during winter months. The following criteria describe those needs.

PRIORITIES:

Seral Stage	Seral stages V and VI are required to fulfill the optimal cover and thermal cover needs of mountain goat. These stages correspond with the R2Map codes, S1 and S2, used to map the optimal cover/thermal cover MR's.
Aspect	Because winter range is most critical and goats concentrate primarily on south, southwest, and west-facing slopes during winter, these locations were preferred over other exposures. Wilderness cells (R2Map cell = 21.12 acres) were not chosen if they were on north-facing slopes.
Road Proximity	Mountain goats are highly sensitive to road disturbance (vehicle traffic, poaching, snowmobiles, and cross-country skiers on closed roads), therefore cells furthest from adjacent roads were selected.
Continuous Edge	Optimally, old growth cells were maintained along the flanks of rock outcrops, cliffs, etc., to provide an adequate distribution of adjoining thermal cover.
Adjacent Rock	Because mountain goats require steep ledges, cliffs, and rock outcrops, cells contiguous with this habitat were chosen first.
Wilderness Areas	Cells with wilderness designation were chosen first, if they also met the above criteria.
Tentatively Suitable Timber	Tentatively suitable timber was not chosen as part of the MR area if other cells were as appropriate for goat range.

Table H-9. Mountain Goat Requirements.

Principal Habitats Used Zone 2 (West Cascades) 1/	Dispersal Distance Between Habitats	Size of Area to which wildlife Prescriptions Apply	Habitat Requirements to be Used in Analyses
Rock outcrops, cliffs, avalanche chutes, rim rocks, and seral stages V & VI of Kuchler types K1, K2, and K3 adjacent to state landforms.	Not Established	45 acres per goat.	Forage and thermal cover within defined winter range boundaries. Maintain 50% of conifer habitat in seral stages V and VI on identified winter ranges. Allow 7-20 acres of winter range per goat per month.

1/ Mt. Baker-Snoqualmie National Forest is in Zone 2, Westside Cascades. Principal habitats used vary by zone in the Region.

ALTERNATIVE WAYS OF MEETING THE MANAGEMENT REQUIREMENT FOR MOUNTAIN GOATS

Once the family groups were established, the management requirement areas determined, and the management requirement habitat delineated, the Forest considered two options for providing adequate mountain goat habitat.

ALTERNATIVE 1: Dedicated Sites

Under a dedicated site strategy, the required amount of mature and old-growth habitat needed for thermal cover is withdrawn form timber production. Dedication of habitat has the advantage that the location of the stand does not change over time, making implementation less complicated. Dedication also assures that desired structural characteristics will be available for wildlife. There may be some risk of loss of individual stands through catastrophe.

ALTERNATIVE 2: Managed Sites

The managed sites option requires the projection of long rotations on enough acres to maintain the necessary thermal cover through time with all acres being harvest over time.

EVALUATION OF IMPLEMENTATION METHODS TO MEET MOUNTAIN GOAT MANAGEMENT REQUIREMENTS

As discussed above, it was necessary that habitat areas designated as MR areas be areas actually used by goats and containing, to the full degree possible, all of their habitat requirements. Current goat numbers are lower than expected, based on what is known about habitat requirements and available

habitat. There is a risk that their habitat requirements are not fully understood. Because of the lowered number of goats, it was determined that it was necessary to choose areas for MRs with the best indications, based on actual goat use, that they are suitable. This does not allow for managing larger areas to contain different areas of suitable habitat over time. The current literature does not support the idea that goat optimal cover and escape cover conditions can be provided through timber management.

Therefor, dedicating MR goat habitat areas of actual use and the best possible habitat conditions was selected.

OPPORTUNITY COSTS

The opportunity costs of designating the habitat areas (selected method) were not determined for mountain goat alone. Because of the interactions of habitat needs of all the mature and old growth species (Spotted owl, pileated woodpecker, pine marten, and mountain goat), opportunity costs were determined for the combination of all species requiring mature and old growth habitat. The discussion of opportunity costs for these management requirements are found at the end of this section (page H-27).

CONSEQUENCES OF THE DIFFERENT WAYS OF MEETING THE MANAGEMENT REQUIREMENT

Populations of mountain goats would not be expected to differ significantly under either alternative if each alternative would maintain equal quality of habitat. As discussed above, there is a risk that habitat requirements are not fully understood and managed sites therefore might not provide all needed habitat characteristics. Both would maintain the same amount and distribution of Habitat. In addition, there are differences in the opportunity costs as dedication of habitat areas would have the least impact on timber outputs and therefore PNV.

RATIONALE FOR THE SELECTED METHOD

The Mt. Baker-Snoqualmie National Forest chose to provide habitat for mountain goat by dedicating sites where needed on tentatively suitable timber land. This alternative achieves the desired habitat with the least effect on timber outputs and is and economically efficient way of meeting the management requirement. In addition, the managed habitat alternative was not favored because current literature does not support the idea that goat optimal cover and escape cover conditions can be provided through timber management.

IMPLICATIONS FOR FOREST PLAN ALTERNATIVES

Plan alternatives were designed to address public issues. As a result most alternatives, including the preferred, incorporate objectives for retention of old-growth and mature timber for a variety of reasons, such as wildlife, visual, and recreation. To the extent possible, mountain goat habitat areas overlap with areas selected for other purposes (such as Wilderness, unroaded recreation areas, special interest areas and other lands determined as not appropriate or unsuited for timber production), wherever these meet habitat suitability and distribution requirement.

Spotted owl, pine marten, pileated woodpecker and goat areas overlap with each other in some cases, and they overlap with areas selected for other purposes

(such as unroaded recreation areas and special interest areas) wherever these sites meet habitat suitability and distribution requirements. Methods resulting in the opportunity cost shown in Table H-3 would benefit other resource uses as well.

ROLE OF MONITORING AND RESEARCH

The Forest Monitoring Plan (Forest Plan Chapter V) calls for monitoring populations and habitats of mountain goat. At scheduled plan review, monitoring data will be considered in determining the suitability and effectiveness of the selected method for meeting the management requirement for viable populations. This will be an important test of the appropriateness of the selected modeling assumptions.

OPPORTUNITY COSTS FOR ALL MATURE AND OLD-GROWTH MANAGEMENT REQUIREMENTS

The opportunity costs of the implementation methods for meeting the habitat requirements for northern spotted owl, pileated woodpecker, pine marten, and mountain goat were estimated by comparing the differences in PNV and ASQ that would occur with and without the constraints that meet the requirements.

Table H-10 Displays the PNV and ASQ opportunity costs of the mature and old-growth habitat management requirements.

Table H-10. Opportunity Cost Meeting the Mature and Old-Growth Habitat Management Requirements.

Selected Implementation Method	First Decade ASQ MMCF/Year (MMBF/Year)	Change in ASQ 1/ Percent	PNV MM $	Change in PNV Percent
PNV Benchmark with No Protection Measures	63.9 (306)	-	2631	-
Opportunity Cost of Mature and Old Growth Habitat for Northern Spotted Owl, Pileated Woodpecker, Pine Marten, and Mt. Goat	50.1 (240)	-22	2410	-8

1/ Percent change calculated on cubic foot basis

WATER QUALITY MANAGEMENT REQUIREMENTS

SOURCE OF THE WATER QUALITY MANAGEMENTS REQUIREMENTS

Management requirements for water quality are based on NFMA which states: "Forest planning shall provide for compliance with requirements of the Clean Water Act, the Safe Drinking Water Act, and all substantive and procedural requirements of Federal, State, and local governmental bodies with respect to the provision of public water systems and the disposal of waste water." (36 CFR 219.23(d).

"Special attention shall be given to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes and other bodies of water. This area shall correspond to at least the recognizable area dominated by the riparian vegetation. No management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment shall be permitted within these areas which seriously and adversely affect water conditions or fish habitat." (36 CFR 219.27 (e).

The Clean Water Act seeks to control nonpoint sources of water pollution. To comply with Section 208 of the Act, Forest Service Region Six, the states of Oregon and Washington (which manage implementation of the Act in the respective states), and the Environmental Protection Agency agreed on a process whereby each state reviews Forest Service management practices to determine if they meet or exceed state water quality standards. Practices that are judged to meet or exceed the standards are certified as Best Management Practices (BMP's) which the Forest Service then agrees to continue.

SPECIFICATIONS FOR THE WATER QUALITY MANAGEMENT REQUIREMENTS

Requirements set forth in NFMA regulations require the Forest Service not allow management practices which seriously and adversely affect water conditions or fish habitat through detrimental changes to stream temperatures or chemical composition, blockage of water courses, or deposits of sediment. In addition direction established in the Forest Plan must comply with the requirements of the Clean Water Act, the Safe Drinking Water Act, and all substantive and procedural requirements of Federal, State, and local governmental bodies with respect to the provision of public water systems and the disposal of waste water.

On the Mt. Baker-Snoqualmie National Forest, most of the activities which affect water quality are related to timber harvesting. They include removal of trees and road construction. (For more discussion, see FEIS, Chapter IV, "Soils and Water" section).

The primary approach to maintaining water quality on Mt. Baker-Snoqualmie National Forest lands is to: 1) limit or prohibit timber harvest on certain unstable slopes (by designating such lands as unsuitable for timber production), 2) limit amount of harvesting in riparian areas to protect riparian values and fisheries habitat, and 3) limit the amount of timber harvest per decade in individual watersheds to prevent unacceptable adverse cumulative effects on water quality.

In the FEIS, the specifications established by the Forest are called Standards and Guidelines. The required watershed condition, and the standards that

indicate achievement of the water quality management requirement, are described in the Land and Resource Management Plan, Chapter IV. The following specifications are addressed in this appendix.

Water Quality and Riparian Area Standards and Guidelines:

Emphasize maintenance and/or improvement of water quality and fish habitat capability.

Retain instream woody material plus standing trees adjacent to the stream, needed for future debris recruitment plus bank and channel stability.

Maintain streamside vegetation so at least 80% of the fish habitat stream surface has shade during the summer low flows. Maintain or restore 75% of other small woody and herbaceous vegetation.

ALTERNATIVE WAYS OF MEETING THE MANAGEMENT REQUIREMENTS FOR WATER QUALITY

Alternative ways for the meeting specification shown above could be modeled in FORPLAN to simulate the required end conditions. These become alternative constraints in the model that set limits on how FORPLAN schedules timber harvest to maximize PNV. (FORPLAN constraints are discussed in the FEIS, Appendix B, "Development of Management Requirements.") The following alternatives were considered:

ALTERNATIVES CONSIDERED IN DETAIL

ALTERNATIVE 1: Schedule No Timber Harvest in Riparian Areas

This alternative is designed to minimize vegetation disturbance and schedules no timber harvest in riparian areas.

ALTERNATIVE 2: Schedule Reduced Yield Timber Harvest in Riparian Areas

This alternative allows a moderate level of removal of trees from the riparian area. No timber harvest is allowed in 25% of the riparian area, harvesting on a minimum 160-year rotation is allowed on 50% of the riparian area, and the remaining 25% of the riparian area is managed in the same manner as the adjacent land allocation.

ALTERNATIVE 3: Use Existing Watershed/Sediment Model(s) to Assess and Mitigate Unacceptable Adverse Hydrologic Cumulative Effects of Management Activities

This alternative was abandoned when review of literature and discussions with academic and scientific community members indicated that no process for assessing and mitigating hydrologic cumulative effects applicable to the Mt. Baker-Snoqualmie National Forest exists.

ALTERNATIVE 4: Develop Local Process to Prevent Unacceptable Adverse Hydrologic Cumulative Effects Forestwide

This alternative requires the development and use of a watershed by watershed classification and evaluation of watershed conditions. The process determines limits on acres harvested by decade by watershed to prevent unacceptable adverse hydrologic cumulative effects.

EVALUATION OF IMPLEMENTATION METHODS TO MEET WATER QUALITY MANAGEMENT REQUIREMENTS

Of the two alternatives that address riparian areas, Alternative #1 (No Harvest) was determined to be more restrictive than necessary to achieve the goals and objectives for protection of riparian values. Allowing the level of harvest in Alternative #2 is considered to be consistent with the requirement to protect riparian values.

Of the two alternatives that address the hydrologic cumulative effects issue, only Alternative #4 provides a means to respond to the needs to insure management activities do not result in unacceptable adverse hydrologic cumulative effects.

OPPORTUNITY COSTS

The opportunity costs of implementation meeting water quality management requirements were estimated by comparing the differences in PNV and ASQ that would occur with and without the constraints that simulate the means for accomplishing the required condition.

Table H-11. compares the PNV and ASQ opportunity costs of the implementation methods (means) for water quality protection.

Table H-11 Opportunity Cost Associated with Means for Meeting the Water Quality Management Requirements.

Selected Implementation Method	First Decade ASQ MMCF/Year (MMBF/Year)	Change in ASQ 1/ Percent	PNV MM $	Change in PNV Percent
PNV Benchmark with No Protection Measures	63.9 (306)	-	2631	-
Opportunity Cost of Riparian Protection	59.6 (285)	-7	2580	0
Opportunity Cost of Water Quality Protection	41.0 (196)	-36	2297	-13

1/ Percent change calculated on cubic foot basis

CONSEQUENCES OF ALTERNATIVE WAYS OR MEANS OF MEETING WATER QUALITY

While opportunity costs were not determined for the no harvest in riparian areas alternative, it is clear that this alternative would have a higher opportunity cost in terms of ASQ and PNV than would the alternative that allows a moderate level of harvest. The no harvest alternative would go beyond the requirements of protecting the riparian area values.

RATIONALE FOR THE SELECTED IMPLEMENTATION MEANS

The Forest chose to meet riparian area protection needs while allowing timber management activities to occur at moderate levels in the riparian areas (Alternative #2). This alternative achieves the desired condition of the riparian areas with the least effect on timber outputs and is an economically efficient way of meeting the management requirement.

The application of the hydrologic cumulative effects analysis (Alternative #4) was necessary to insure activities outside riparian areas did not contribute to unacceptable adverse hydrologic cumulative effects. At this time, the method used is the only known method of meeting the management requirement for water quality on the Mt. Baker-Snoqualmie National Forest. The MR's for water quality are in full compliance with NFMA.

IMPLICATIONS FOR FOREST PLAN ALTERNATIVES

FEIS Chapter II and Appendix B discuss the effects of the means used to meet riparian area and water quality management requirements. The analysis of opportunity costs of riparian area and water quality protection shown in Table H-11 shows the maximum PNV and ASQ effects of meeting these requirements. Actual Plan alternatives will have somewhat less opportunity costs as overlaps from lands withdrawn for other allocations or constrained for other management requirements will help meet water quality requirements.

ROLE OF MONITORING AND RESEARCH

Protection needs and methods for protecting riparian areas are well documented. The Monitoring Plan in Chapter 5 of the Forest Plan provides for continued monitoring of riparian areas and fish habitat conditions. Reviews of the results of this monitoring will be used to determine the suitability and effectiveness of the means selected to meet management requirements for protection of riparian areas.

The needs for protection of water quality and the potential unacceptable adverse effects on water quality of some management activities are well documented. However, the means for ensuring the cumulative effects of management activities will not have an unacceptable adverse effect on water quality are not well established or accepted. Again, the Monitoring Plan provides for continued monitoring of management activities and their effects on water quality. Results of this monitoring will be used to evaluate the hydrologic cumulative effects analysis process and insure its efficiency and effectiveness in meeting the water quality management requirement. If necessary, the process will be modified to correct deficiencies found during the monitoring process.

Research in the area of hydrologic cumulative effects of forest management activities is receiving considerable attention by the scientific and academic community. Any new research findings concerning hydrologic cumulative effects and forest management will be reviewed and if appropriate, incorporated into the process used by the Forest. The Forest will continue to work with the scientific and academic community to refine and further validate the hydrologic cumulative effects analysis process used in the Forest Plan.

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