United States
Department of
Agriculture

Forest
Service

April 2009

Preliminary Environmental Analysis

Wildcat Thin Timber Sale

Gifford Pinchot National Forest
Mount St. Helens National Volcanic Monument
Skamania County, Washington

T8N, R6E, Willamette Meridian

For Information Contact: Ruth Tracy, Wildcat Interdisciplinary Team Leader
10600 N.E. 51st Circle, Vancouver, WA 98682
(360) 891-5112, rtracy@fs.fed.us

Table of Contents

Table of Figures

SUMMARY

The Gifford Pinchot National Forest proposes to commercially thin approximately 2,800 acres of timber stands on the Mount St. Helens National Volcanic Monument (outside of the legislated Monument) in Washington State.

The Wildcat Thin Timber Sale planning area comprises four subwatersheds, including Muddy River, Clear Creek, Clearwater Creek and Elk Creek, which are located within the Muddy River Watershed and one subwatershed, Pine Creek, of the Swift Reservoir Watershed.

The purpose of this action is to restore and improve/accelerate timber growth and yield of even-aged, stagnated stands that were artificially regenerated following clear-cut timber harvest in the 1960s and 1970s. It is also to restore late-successional ecosystems in stands in Late-Successional Reserves and in Riparian Reserves, and to manage the stands within the lands designated as Matrix in the Northwest Forest Plan for the continued production and utilization of forest resources, principally timber, water, dispersed recreation, and wildlife.

Specifically, the proposal would commercially thin 2,740 acres of forest plantations, commercially salvage on 11 acres of plantations affected by blowdown, and treat 17 acres of non-commercial stands. Small tree thinning would also occur within the clearing limits for Road 2500.

Danger tree removal would occur along the haul routes within the timber sale. Use of old existing logging roads within the units (9.4 miles) limited the construction of new temporary roads to 1.6 miles to access various units in the proposed action.

Following internal and public scoping, the Forest Service identified no potentially significant issues that would lead to the development of an alternative other than the proposed action (Alternative B). Alternative A is the No Action alternative and is the baseline for consideration of effects from other alternatives.

Based upon the effects of the alternatives, the responsible official will decide which alternative best meets the overall purpose of and need for action or whether there would be any significant effects to the human environment, which would call for the preparation of an Environmental Impact Statement.

CHAPTER 1. PURPOSE AND NEED FOR ACTION

Background

This proposal would commercially thin approximately 2,800 acres on the Mt. St. Helens Ranger District, Gifford Pinchot National Forest. Elevation for the planning area ranges from approximately 1,600 – 3,200 feet (Figure 1).

The Wildcat Thin Timber Sale planning area comprises four subwatersheds, including Muddy River, Clear Creek, Clearwater Creek and Elk Creek, which are located within the Muddy River Watershed and one subwatershed, Pine Creek, of the Swift Reservoir Watershed. The Muddy River Watershed and Pine Creek Subwatershed have been designated a Tier 1 Key Watershed under the Northwest Forest Plan (NWFP).

The western third of the planning area is characterized by stands that were harvested during the late 1950s to early 1970s and are located between the major tributaries of Pine Creek. The middle third of the planning area is characterized by stands that were harvest during the same decades and are located on the west side of the Muddy River. The eastern third of the planning area is characterized by stands that were harvested in the late 60s and early 70s and are located close to Forest Road 2500. Stands proposed for treatment include a few immature stands, as well as some stands previously harvested by private landowners before these stands became National Forest Lands through land exchanges. The stands are located within Matrix, Late-Successional Reserve, and Riparian Reserve land allocations.

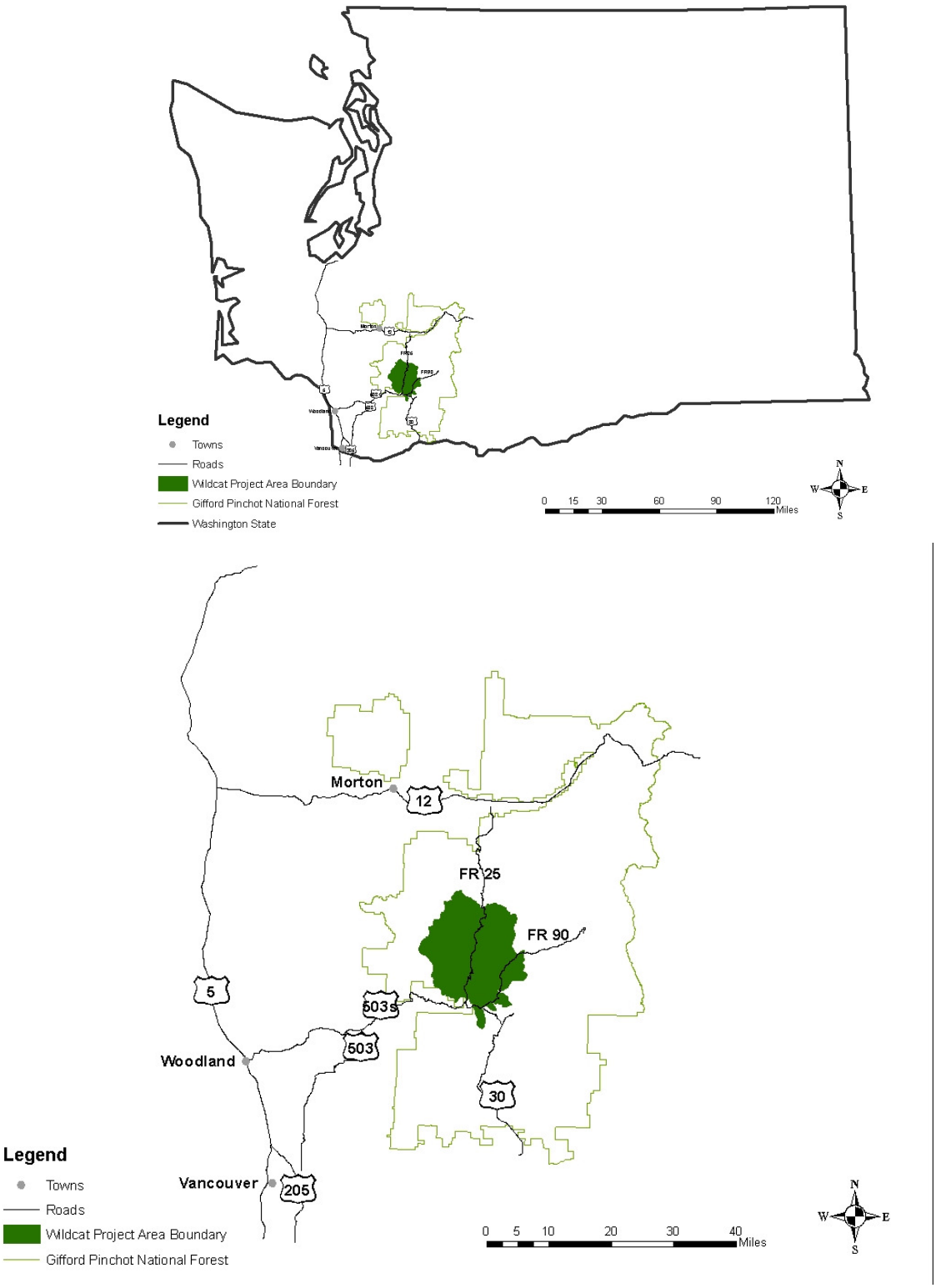


Figure 1. Wildcat Timber Sale Planning Area Vicinity Map

Purpose of and Need for Action

Timber harvesting in this watershed began in the early 1950s and continued throughout the next four decades. All of the timber stands in the proposed action originated from artificial plantations as a result of clear-cut timber harvests in the 1960s and 1970s. These young stands are dense, even-aged stands comprised of mostly Douglas-fir, with a component of western hemlock. These stands are also currently experiencing individual tree mortality from inter-tree competition, reduced diameter growth and reduced tree canopies from high tree densities.

The purpose of this watershed scale project is to restore and accelerate timber growth. while also accomplishing restoration objectives for related resources. The need to restore and accelerate timber growth and yield in even-aged, dense stands exists in the Muddy River and Swift Reservoir watersheds that were artificially regenerated following timber harvest predominately in the 1960s and 1970s. Specific needs include the continued production and utilization of forest resources within the Matrix allocation and restoration of late-successional components (large multi-species trees, variable tree densities, snags and downed coarse wood) in Late-Successional Reserves and Riparian Reserves. The need to concurrently implement restoration for other resources is for logistical and economic efficiency. The restoration of other resources include reducing fragmentation, developing optimal thermal cover, increasing deer and elk forage, and decommissioning one road posing risks to wildlife and aquatic life.

Additionally, the need to maintain scenic viewsheds seen by many people from major roads exists. The desired future condition of visual emphasis areas includes providing a continuing opportunity to appreciate scenic worth. Management of the visual attributes of the corridor include opening views to features such as distant peaks, unique rock forms and unusual vegetation. The proposed action includes maintaining vista opportunities along Forest Road 2500 while being consistent with Late-Successional Reserve objectives.

Desired Condition: The proposed treatment units are located within Matrix and Late-Successional Reserve allocations, and some contain Riparian Reserves. The desired condition for the General Forest management area within Matrix is that the lands are managed for the continued production and utilization of forest resources, principally timber, water, dispersed recreation, and wildlife. The desired future condition for Deer and Elk Winter Range within Matrix is that tree species and sizes are varied and well distributed, and that at least 44 percent of the biological winter range is in optimal thermal cover. The desired condition for Riparian Reserves is that these lands support late-successional forest stands providing riparian function benefiting fish and riparian-dependent non-fish species along streams, rivers and other waterbodies, as well as connectivity of late-successional forest habitat across the Forest.

Late-Successional Reserves are to provide habitat for late-successional and old-growth related species. The Forest's Late-Successional Reserve Assessment (1997) recognized a need for commercial thinning in stands less than 80 years old with the objectives of accelerating growth, increasing plant species diversity, increasing structural diversity, and to provide a mechanism to create snags and down wood where needed.

Existing Condition: Overall tree growth in the proposed treatment units is slowing due to overcrowded conditions. Thinning can provide faster attainment of large-diameter individual trees than what would be otherwise possible. Also, structural and species diversity can be enhanced by thinning in areas that are relatively uniform in stocking, species composition, and tree size by applying variable thinning prescriptions.

Dense stands that are never thinned generally reach maximum density by age 25. At maximum density, stand and individual tree growth stagnates. Stagnated stands are slow to differentiate and provide the characteristics of late-successional forest.

Management Direction

Management direction on the Gifford Pinchot National Forest comes from the *Gifford Pinchot National Forest Land and Resource Management Plan* (Forest Plan, 1990), as amended by the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (Northwest Forest Plan, 1994). These two documents guide planning on the forest by land allocation, have stated desired future conditions and contain standards and guidelines that must be adhered to. Land allocations that occur in the project area are explained in detail below. Where land allocations overlap between the Forest Plan and Northwest Forest Plan, the more restrictive standards and guidelines apply, unless otherwise noted.

About half the treatment units are located within lands allocated as Matrix/General Forest and half are located within Late-Successional Reserve allocations as described in the Forest Plan and Northwest Forest Plan (Figure 2). Units 1 and 2 are within Visual Emphasis GPNF Forest Plan Allocation and Late Successional Reserve NW Forest Plan Allocation (not shown). Other management areas described in the Forest Plan that occur to a lesser degree in the project area include Visual Emphasis, General Forest/Timber Production, Deer and Elk Winter Range. The project is expected to meet Forest-wide standards and guidelines and Management Area direction for these allocations, as well as meet the objectives and intent of the Northwest Forest Plan.

Gifford Pinchot Forest Plan Land Allocations:

Visual Emphasis (VM/VL): About half of the proposed units are located in a Visual Emphasis management allocation. The goal of this allocation is to provide a natural or near-natural landscape as viewed from the designated travel route. The desired future condition for this allocation is to accommodate a variety of activities, which to the casual observer, are either not evident or are visually subordinate to the characteristic landscape. Timber harvest activities may be permitted in compliance with assigned Visual Quality Objectives. The Visual Quality Objective for some of the units is partial retention (VM) which requires that the activities remain visually subordinate to the natural landscape while others are retention (VL) which requires that management activities should not be evident to the casual Forest visitor. Wildcat stands near Forest Road 8300 and 8322 have a Visual Quality Objective of VM or VL designation, depending on proximity to the road.

General Forest/Timber Production (TS): About half of the units lie within the general forest/ timber production land allocation. The objective for these lands is to restore and accelerate the timber growth and yield of even-aged stagnated stands and to manage for the continued production and utilization of forest resources, principally timber, water, fish, dispersed recreation, and wildlife. The desired future condition is for all tree sizes and mixture of native species from seedlings to mature saw timber well distributed on the landscape. The full range of recreation opportunities is available in this land allocation (Forest Plan Amendment 11 p. 6-25).

Deer and Elk Winter Range (EM): A portion of the proposed units are located in deer and elk winter range where wider thinning spacings is proposed for creation of foraging opportunities. The goal is to maintain habitat in conjunction with all other allocations within the biological winter range to provide a mix of forage and cover that, over time, maintains the current (1990) carrying capacity (within 10%) of 5,200 elk, and provides a 10 percent increase over the current carrying capacity of 21,000 deer. Scheduled timber harvest is permitted.

Wildcat stands are below 3,000 feet elevation, and many are below 2,200 feet elevation and used by deer and elk during average winters.

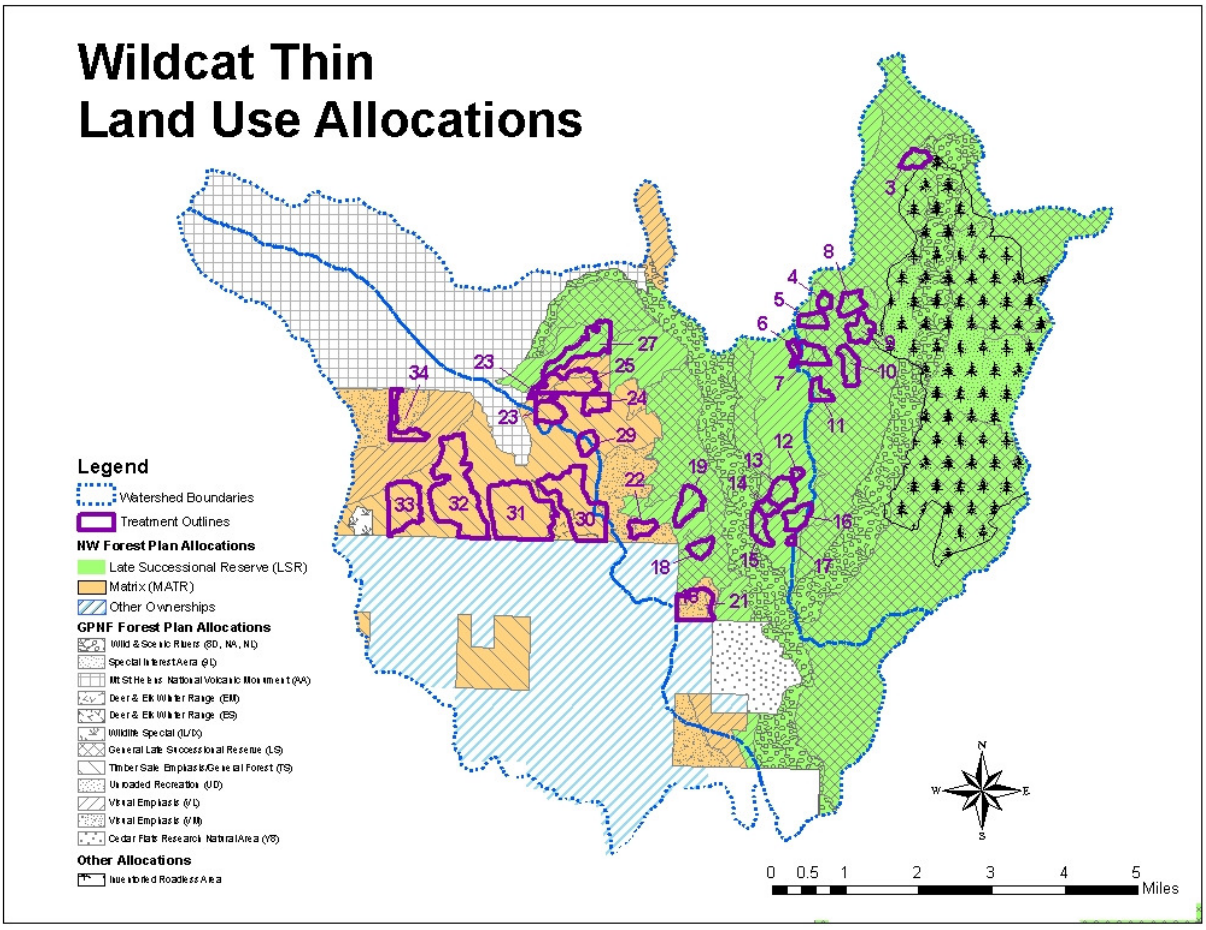


Figure 2. Gifford Pinchot National Forest Plan management areas within the Wildcat Timber Sale planning area.

Northwest Forest Plan Land Allocations:

Matrix: About half of the units occur within the Matrix land allocation. The objective for lands within the Matrix allocation is to promote the continued production and utilization of forest resources; principally, timber, water, fish, dispersed recreation, and wildlife. Matrix lands are those outside designated reserves (such as late-successional and riparian reserves) where most vegetation management will occur (Forest Plan, Amendment 11, p. 6-1).

Late-Successional Reserves (LS/VL): About half of the units occur within Late-Successional Reserves. The objective for these lands is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old growth related species, including the northern spotted owl. Desired late-successional and old-growth characteristics that are created as younger stands change through successional development include: 1) multi-species and multi-layered assemblages of trees, 2) moderate to high accumulations of large logs and snags, 3) moderate to high canopy closure, 4) imperfections such as accumulations of large cavities, broken tops, and large deformed limbs, and 5) moderate to high accumulations of fungi, lichen, and bryophytes (Forest Plan, Amendment 11 p. 5-4).

Allocations coded VL have an additional goal of providing a visually natural or near-natural landscape as viewed from the designated travel route or use area, meeting a retention visual quality objective. Approximately half of the Wildcat stands lie within the Lewis LSR. Those stands located near Forest Roads 2500 and 8322 have the additional visual quality objectives (VL).

Riparian Reserves: Some of the units have portions dedicated to riparian reserve management. Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. The objective for treating the Riparian Reserve portions of these stands is to encourage the growth of larger conifers, including increased tree diameter and wide vigorous crowns, increase species diversity, and augment future sources of coarse wood for the riparian forest floor and in streams.

Key Watersheds: The Muddy River Watershed and Pine Creek Subwatershed have been designated a Tier 1 Key Watershed under the Northwest Forest Plan. The Muddy River Watershed and Pine Creek Subwatershed provides habitat for Bull Trout, which are listed as Threatened under the Endangered Species Act. Key Watersheds are one of four components making up the Aquatic Conservation Strategy under the Northwest Forest Plan. Tier 1 Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also are considered a high priority for watershed restoration. On-going riparian and in-stream restoration work is occurring along portions of Clear Creek, Pine Creek, and the Muddy River in addition to road decommissions and fish passage culvert road improvements throughout the Muddy River Watershed.

Other Management Direction and Landscape Analysis:

Vegetation Treatment Requirements: The proposed silvicultural treatment methods within the proposed stands meets all the requirements, conditions, and constraints for vegetation manipulation as specified in title 36 CFR 219.27 (b) and Appendix F of the Forest Plan. The vegetative treatment analysis also meets the requirements of the Mediated Agreement and the 1988 Record of Decision for Managing Competing and Unwanted Vegetation.

Watershed Analyses:
Watershed Analysis recommendations that are pertinent to this project include the following:

- Silvicultural treatments to accelerate development of riparian sapling/pole and small trees stands… priority sub-basins to evaluate include ...6 [middle Pine Creek] (Lower Lewis WA, p. VI-7).
- Thinning operations should be designed to increase growth and provide species and structural diversity (Lower Lewis WA, p. VI-29).
- Silvicultural treatments to accelerate development of riparian sapling/pole and small trees stands… The highest priority sub-basins to evaluate for treatment are 1, 2, 4 (Muddy River sub-basins. These sub-basins have had high riparian harvest, are highly fragmented, and have streams with both poor LWD and poor pool ratings. Other priority sub-basins to evaluate include …18 (Clearwater Creek sub-basins) (Muddy River WA, p. VI-6).

Late-Successional Reserve Assessment:
An assessment of all Late-Successional Reserves (LSR) on the Gifford Pinchot National Forest, including the Lewis LSR, was completed in 1997. Pertinent comments and specific recommendations follow:

- The Lewis LSR has relatively large expanses of younger habitat in the middle of the LSR. Most of this habitat is in the small-tree structural stage and should develop into late-successional habitat in the next 50 years or longer. Silvicultural treatment that accelerates the development of late-successional habitat would be beneficial in these areas. Page 4-49 LSRA.
- Over 20,000 acres in this LSR consists of deer and elk winter biological winter range. As an objective secondary to those of the LSR, treatments should consider opportunities to provide forage for deer and elk". Page 3-17 LRSA
- Connectivity between the LSRs in the north part of the Forest is weak. The Riparian Reserves between Lewis, Quartz, and Woods LSRs, and between Woods and Packwood, contain only 18 percent late-successional habitat. Page 4-28 LSRA
- Currently Riparian Reserves are highly fragmented and thus are not providing the connectivity function for which they were designed. Mid seral (small conifer) habitat comprises between 27 to 40 percent of Riparian Reserves between LSRs. Thus the connectivity function of Riparian Reserves should improve in the next 40 years as the mid-seral stands develop late-seral characteristics. Page 4-28 LSRA

Proposed Action

To meet the purpose and need, the Forest Service proposes to commercially thin approximately 2,800 acres on the Mt. St. Helens Ranger District, Gifford Pinchot National Forest. The Wildcat Thin Timber Sale planning area comprises four subwatersheds, including Muddy River, Clear Creek, Clearwater Creek and Elk Creek, which are located within the Muddy River Watershed and one subwatershed, Pine Creek, of the Swift Reservoir Watershed. Elevation for the planning area ranges from approximately 1600-3200 feet.

Specific actions associated with this project include: commercial thinning of conifers using tractor and cable logging systems, construction of temporary roads and landings, maintenance of system roads needed for haul, culvert replacements, possible road reconstruction on Forest Service roads 2560, 2573, 2575, 2586, 2588, 8318, 8320, 8322 and associated system spur roads, machine piling and burning of landing slash, and inter-planting with conifers. All new temporary roads and landings would be obliterated after the sale was complete. Old abandoned roads that are reused for this project would also be obliterated after the sale.

A complete description of the proposed action is found in Chapter 2 of this document.

Decision Framework

The responsible official (Mount St. Helens Monument Manager) will review the proposed action and the no action alternative to determine which of them best meets the purpose of and need for action. When making the decision, the responsible official will also take into consideration the specific objective of developing an economically feasible timber sale as well as the issues that have been raised by the interdisciplinary team and from comments received from the public, other agencies, and tribes in response to this analysis.

The final decision would be to either:

- select the action alternative for implementation, or
- defer action at this time, or
- conclude that significant impacts would result from the proposed action which would warrant the preparation of an environmental impact statement.

Public Involvement

The proposal was listed in the Schedule of Proposed Actions beginning in January 2009. A description of the proposal was sent to the Forest mailing list including interested individuals, organizations, agencies, and tribes for comment during scoping which was initiated on December 11, 2008.

During the initial scoping period, the Forest Service received seven comment letters in response to the proposed action. Using these comments the interdisciplinary team developed the final proposed action and a list of issues that would be addressed in this analysis. A field trip occured on October 24, 2008 to inform and discuss the proposed project with interested entities.

Issues

The issues were developed through public as well as internal scoping. Each of the significant issues raised were either used to refine the proposed action through the incorporation of specific design features, or addressed through application of standards and guidelines or best management practices from the Gifford Pinchot Land and Resource Management Plan.

The following issues were identified:

Sediment Delivery

- Road reconstruction, temporary road and landing construction, and log haul within the Wildcat Timber Sale may deliver sediment to streams which may negatively affect water quality and aquatic habitat.

Measure: Miles of temporary road construction, and acres of ground disturbance
This issue was addressed through project design requirements and best management practices including decommissioning all temporary roads after use and locating landings at previous landing sites. Discussion of this issue can be found in the project design features and mitigation measure section in Chapter 2, and the Hydrology section in Chapter 3.

Soil Stability

- Soil disturbance activities in steep or unstable areas within the Wildcat Timber Sale project area could cause soil erosion.

Measure: Steep or unstable areas within units avoided or with specific management recommendations for thinning activities.
The interdisciplinary team has mapped and intentionally avoided unstable slopes within the project area. Discussion of this issue can be found in the project design features and mitigation section in Chapter 2 and the Soils section in Chapter 3.

CHAPTER 2. ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes and compares the alternatives considered for the Wildcat Timber Sale project. It includes a description and map of the action alternative considered. None of the issues raised during scoping was considered to be a significant issue, thus the issues raised did not drive development of action alternative other than the Proposed Action.

Alternatives

Alternative A—No Action

Alternative A is the no action alternative. This alternative is included in accordance with the National Environmental Policy Act, (CFR 1502.14 (d)) and provides a baseline to evaluate the action alternatives. This alternative assumes that none of the proposed activities would occur, including: thinning treatments, construction and use of temporary roads, slash treatments and restoration. Forest Road 8322-560 and Forest Road 2586-170 would not be decommissioned, and the restoration of old logging roads within the units would not be implemented.

The opportunity to restore and accelerate timber growth and yield in even-aged, dense stands, and to restore late-successional ecosystems in stands in Late-Successional Reserves and in Riparian Reserves, and for the continued production and utilization of forest resources within the Matrix allocation would be forgone at this time.

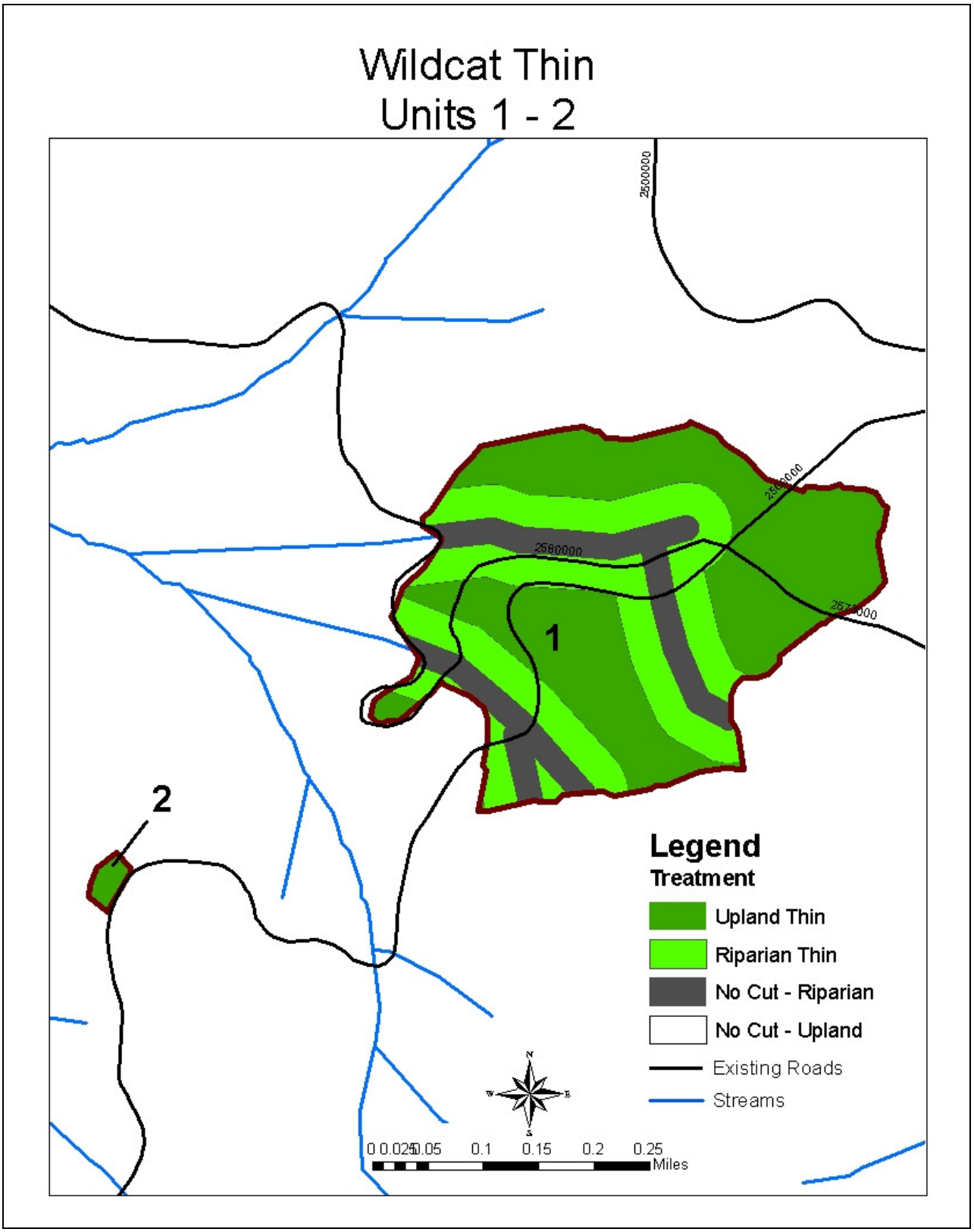
Under no action, stands would be left to develop without any direct human manipulation, except for the suppression of wildfires.

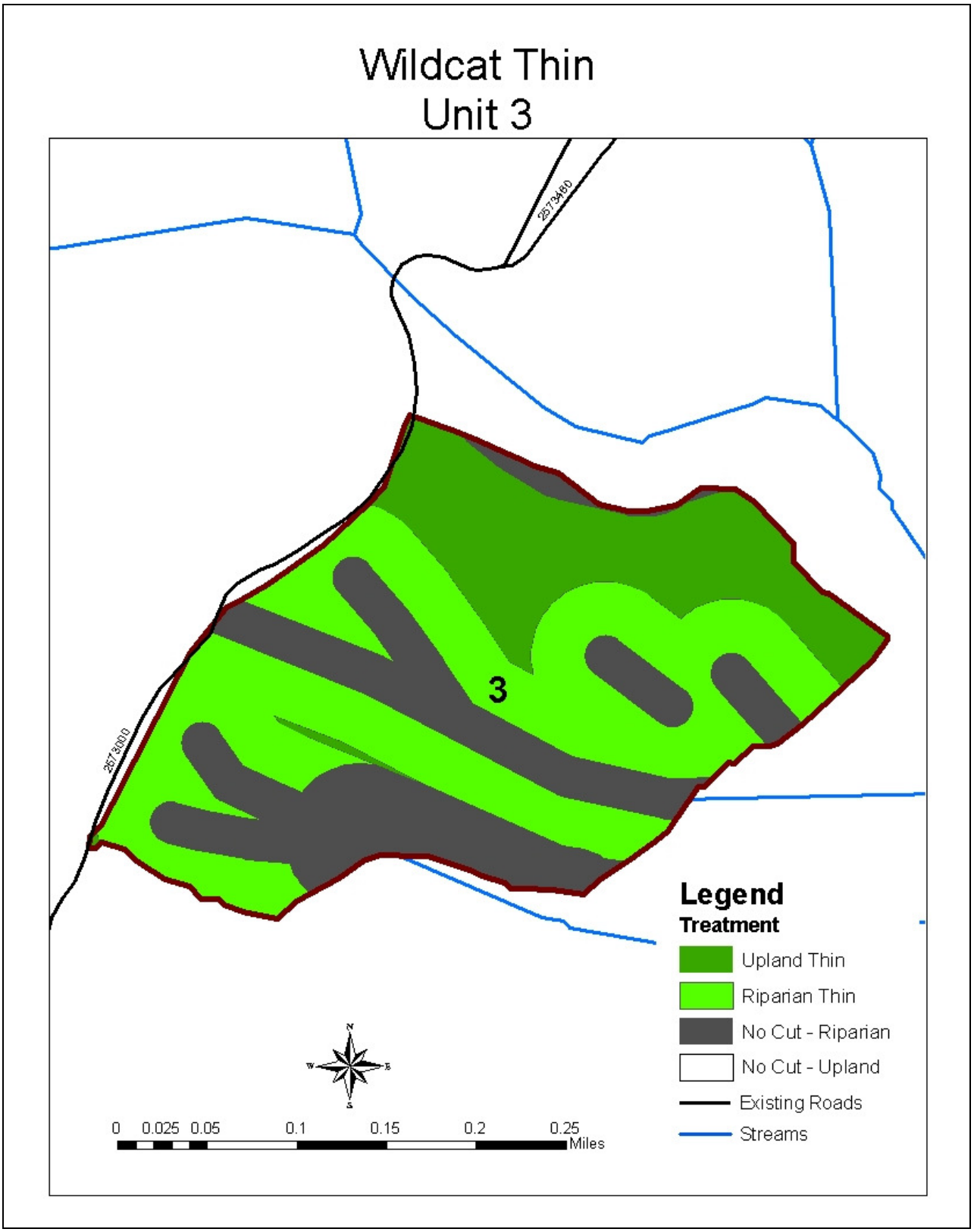
Alternative B—The Proposed Action

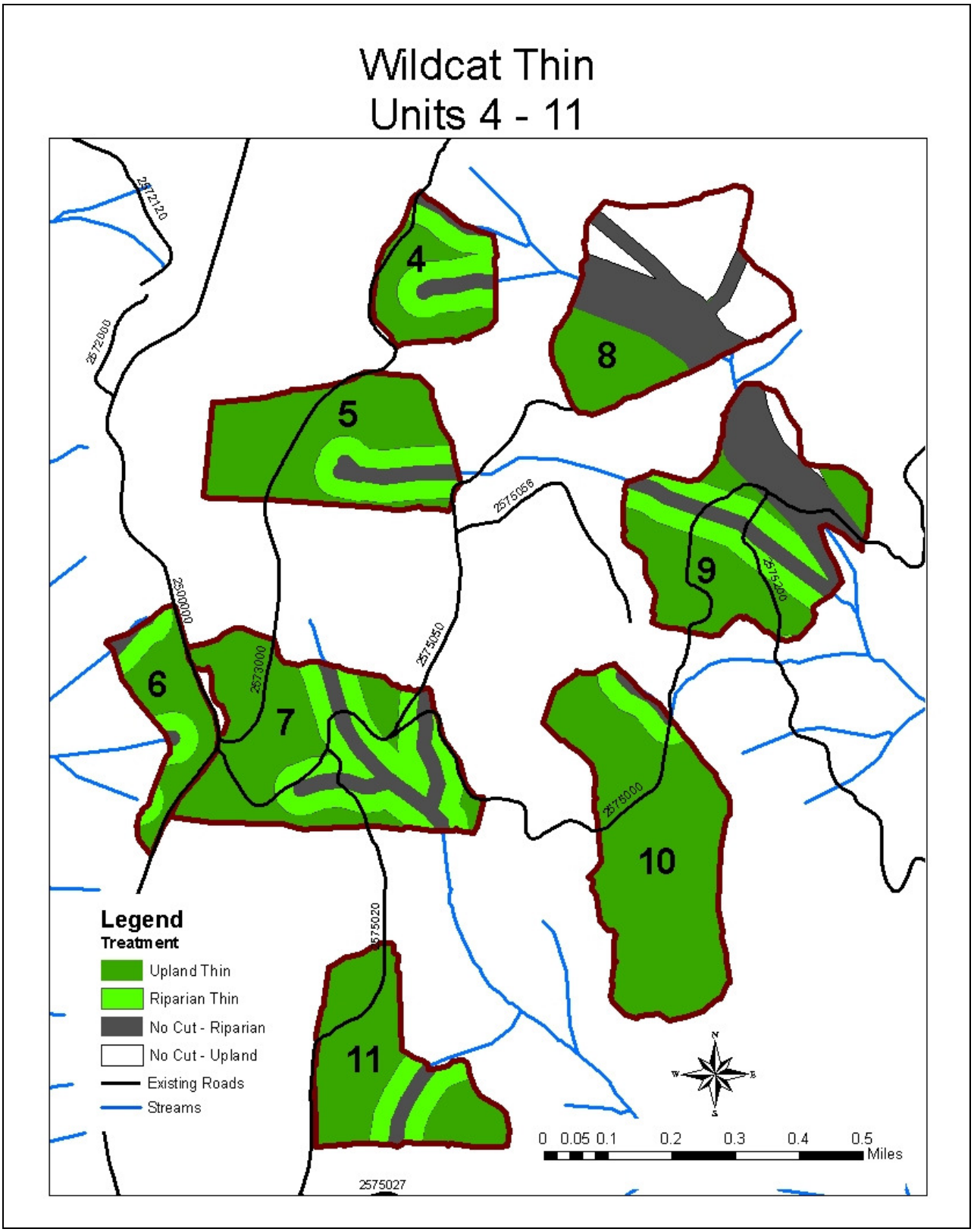
A single action alternative is proposed for Wildcat to meet the overall objectives for the project as established by the Monument Manager. It includes: commercial thinning on 2,740 acres of mid-seral forest plantations; commercial salvage on 11 acres of mid-seral forest plantations; non-commercial, small tree thinning on 17 acres of mid-seral forest plantations; and, non-commercial, small tree thinning within the clearing limits for Road 2500.

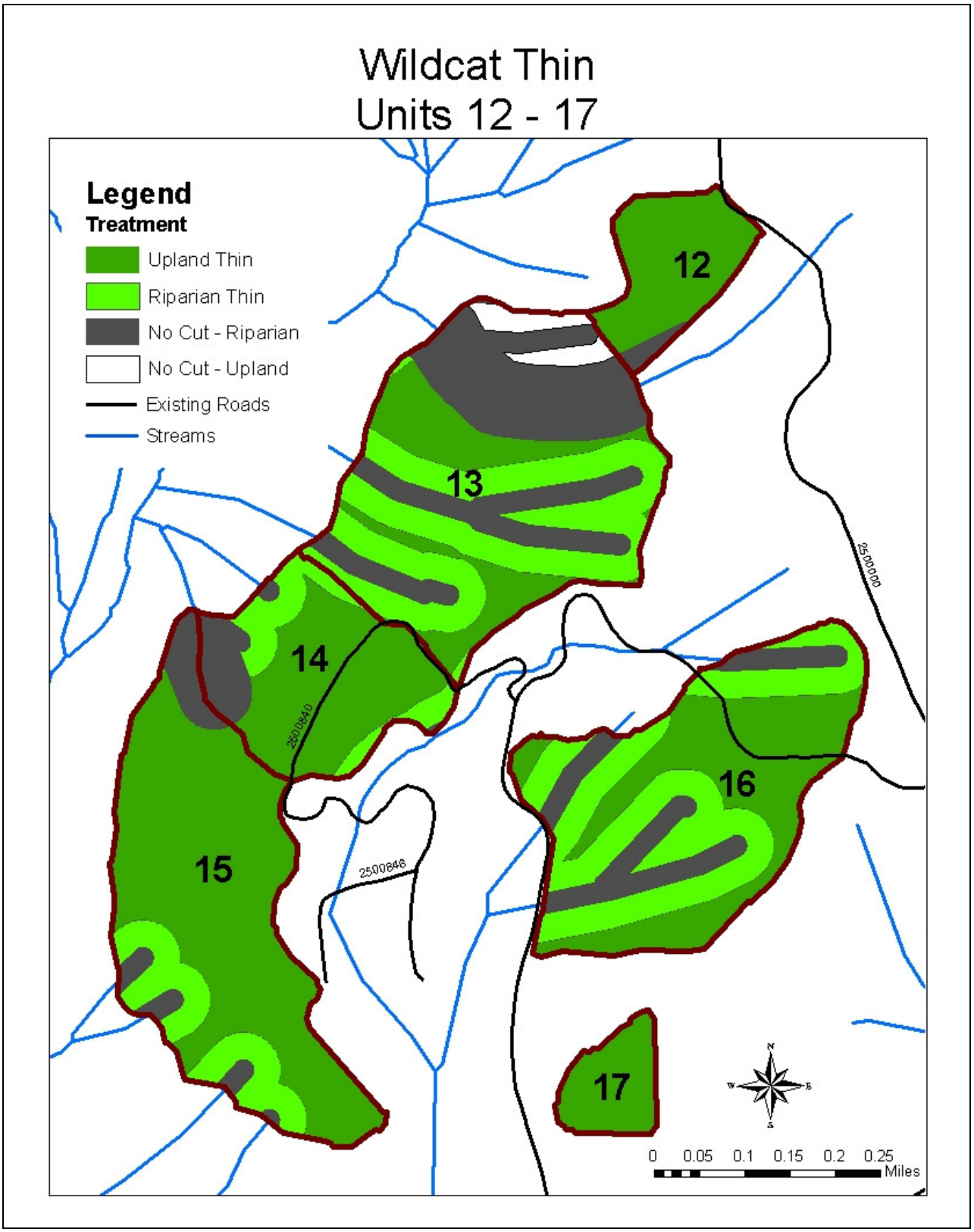
Thinning of commercial size trees will occur within thirty units (Figure 3). A combination of skyline and ground-based logging would be used for 30 units. Slash would be treated.

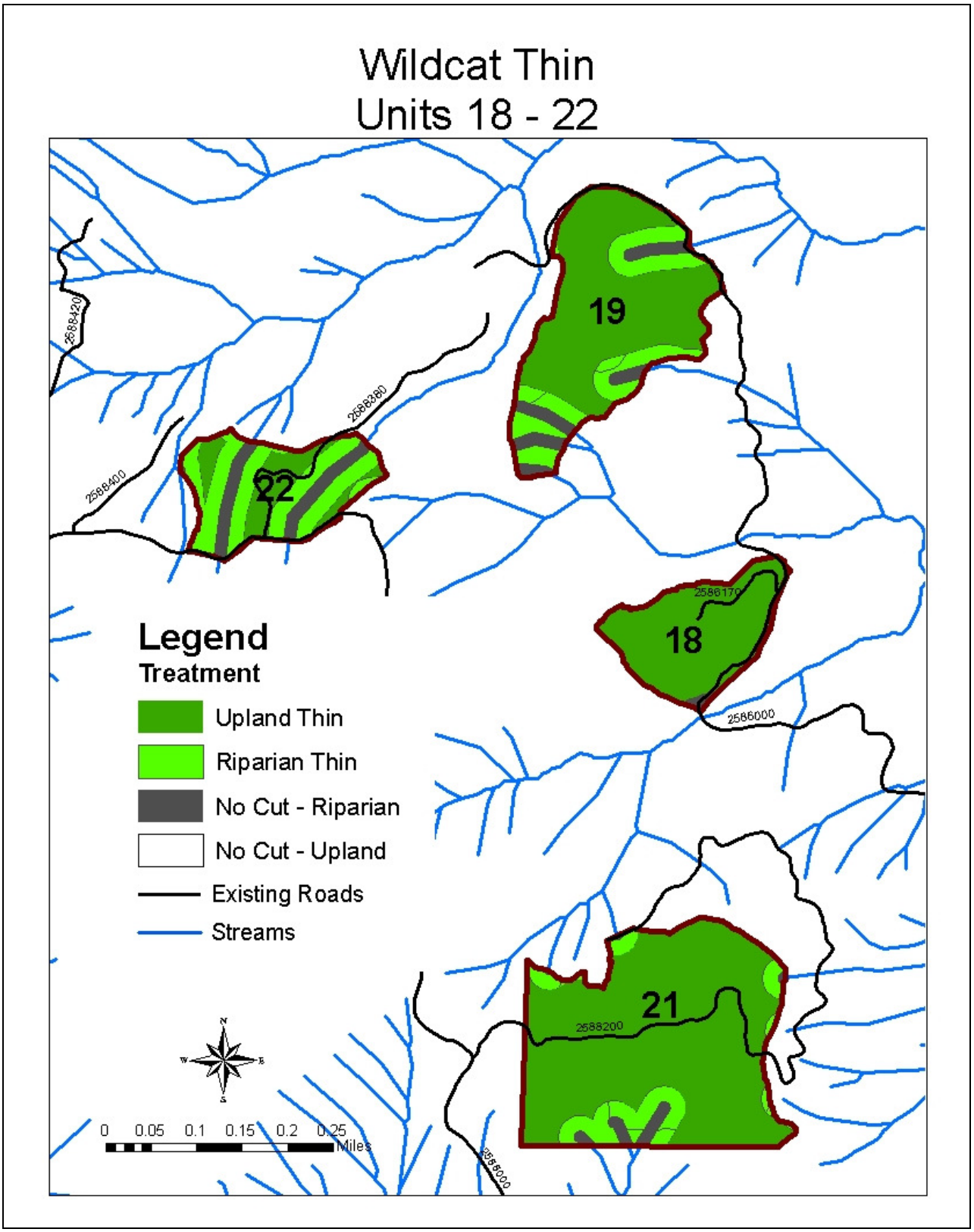
Details of the prescriptions for each of the units are described below.

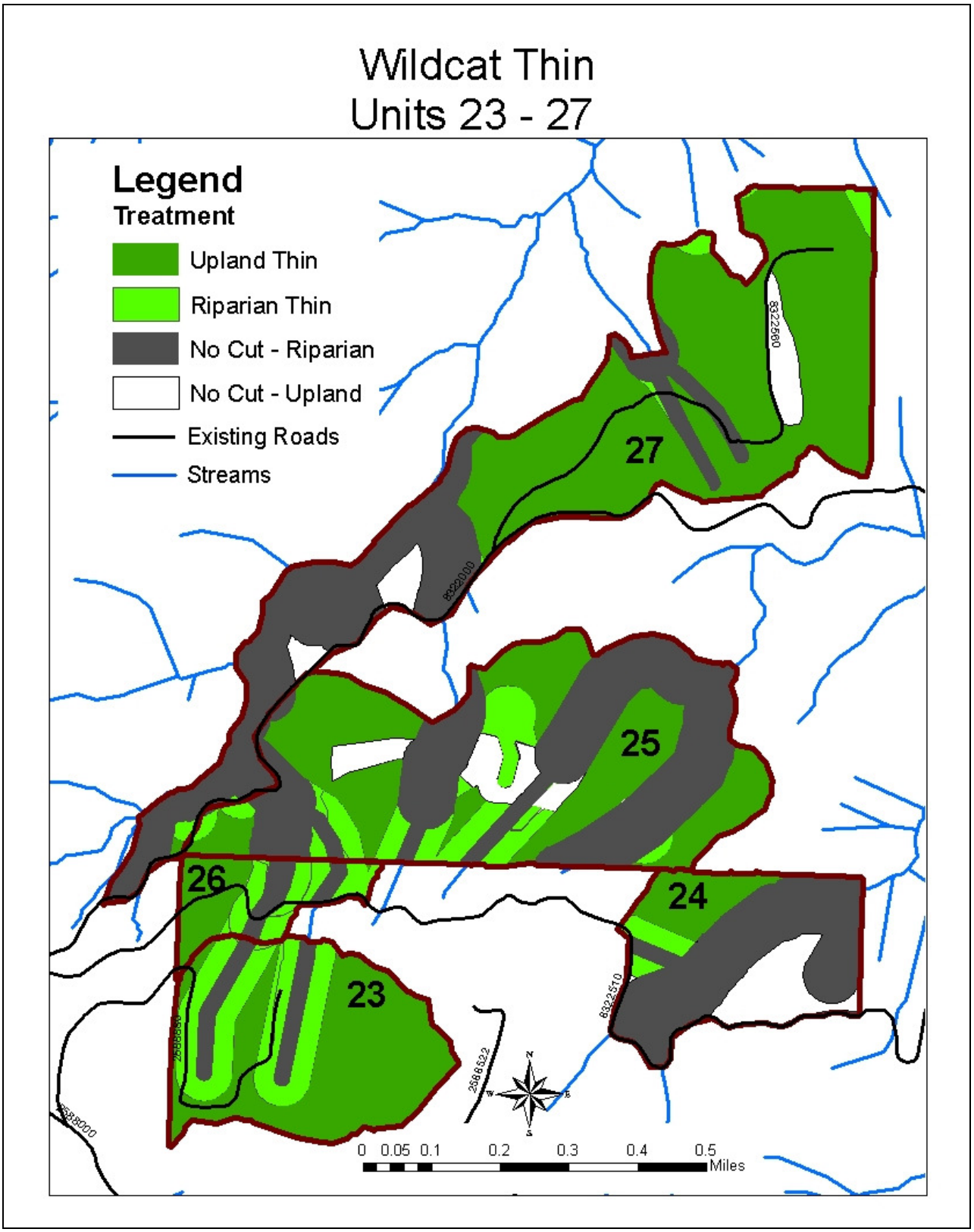

Wildcat Thin
Units 1 - 2
2600000
2580000
2560000
1
2
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
N
W
E
S
0 0.025 0.05 0.1 0.15 0.2 0.25
Miles

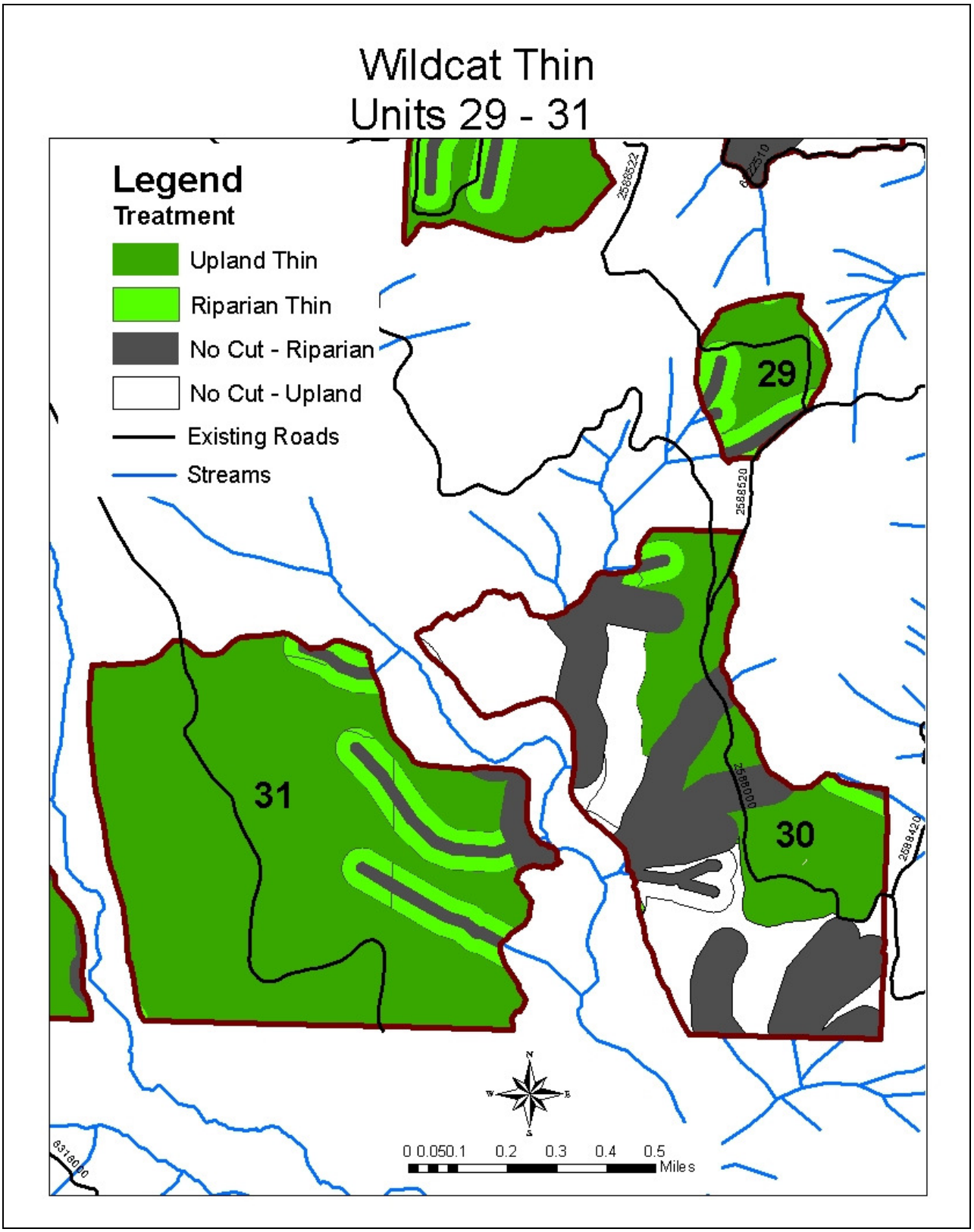

Wildcat Thin
Unit 3
2573460
2573000
3
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
N
W
E
S
0 0.025 0.05 0.1 0.15 0.2 0.25
Miles


Wildcat Thin
Units 4 - 11
4
5
6
7
8
9
10
11
2572120
2572000
2575056
2575200
2575040
2573000
2575000
2575020
2575027
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
N
W
E
S
0 0.05 0.1 0.2 0.3 0.4 0.5
Miles


Wildcat Thin
Units 12 - 17
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
12
13
14
15
16
17
2500840
2500846
2500000
N
W
E
S
0 0.05 0.1 0.15 0.2 0.25
Miles


Wildcat Thin
Units 18 - 22
19
22
18
21
2588420
2588380
2588400
2586170
2586000
2588200
2585000
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
N
W
E
S
0 0.05 0.1 0.15 0.2 0.25
Miles


Wildcat Thin
Units 23 - 27
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
27
25
26
24
23
8322560
8322000
8322510
2588522
2588000
0 0.05 0.1 0.2 0.3 0.4 0.5
Miles


Wildcat Thin
Units 29 - 31
Legend
Treatment
Upland Thin
Riparian Thin
No Cut - Riparian
No Cut - Upland
Existing Roads
Streams
29
30
31
2588522
2588520
2588000
2588420
N
W
E
S
0 0.050.1 0.2 0.3 0.4 0.5
Miles

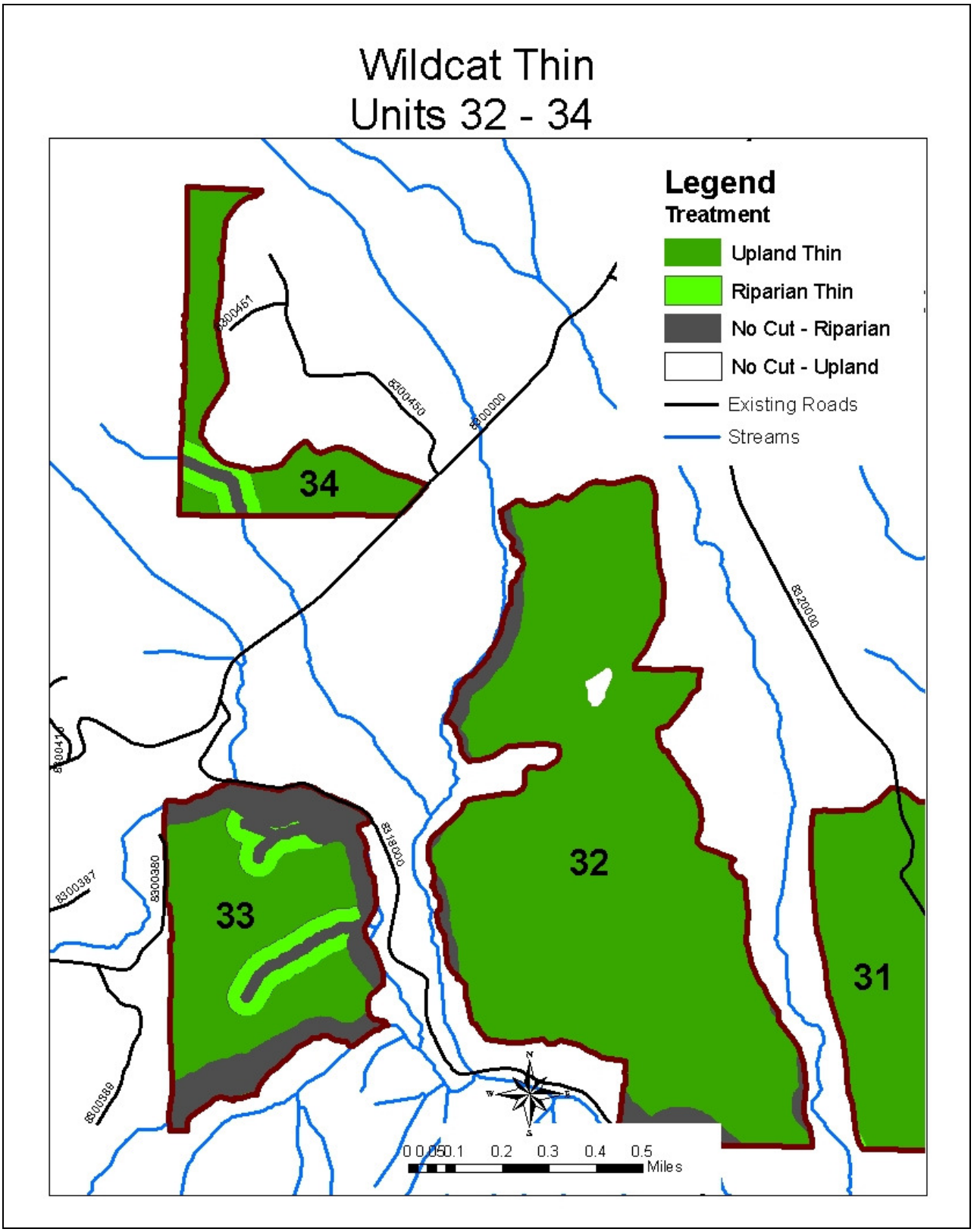


Figure 3. Thinning Units within Alternative B – The Proposed Action

Forest Road 2500, together with other minor roads, would be the main haul route used in the proposed action. Approximately 25 miles of existing roads will need to be treated prior to haul, and there will be approximately 25 sites needing culvert, ditchline, and/or failed fill repair/replacement, some within Riparian Reserves, that will require heavy reconstruction. Heavy reconstruction will improve access to units, replace culverts, and improve road-drainage by rebuilding ditch lines.

Danger tree removal would also occur along the haul routes used for the timber sale. This would include the removal of approximately 10 trees per linear mile. Trees would be identified by a Forest Service employee certified in danger tree identification.

The construction and use of approximately 11 miles of temporary roads would occur to access various units in the proposed action. The majority of use (9.4 miles) would occur on previously-constructed temporary roads whose footprint is still evident on the ground. Only 1.6 miles of temporary road would be newly constructed. Temporary roads, if in use more than one season, would be weatherized prior to the onset of wet weather in the fall. All temporary roads would be rehabilitated by providing drainage where necessary, scarified and re-seeded with the exception of Units 31 and 32, where scarification will not be conducted.

General landing locations have been identified for the project area, most of which would be entirely within the applicable unit. Some earthwork would be required to clear and establish a site that is suitable for landing logs and to provide access for log trucks. Landings would be rehabilitated by providing drainage where necessary, scarification and application of seed and/or mulch as described in project design features.

Commercial Thinning

LSR Units 1, 3-5, 7-12, 14-20, and 27

The LSR units would be commercially thinned and the proposed action would employ variable density thinning techniques to reduce the density of the predominant species (in most units Douglas-fir). Thinning would be from below, leaving the largest trees in the stand. All trees $\geq$18 inches diameter at breast height would be left except for landings and skyline corridors and temporary road locations. Thinning would seek to reduce their present relative densities by 40-60%. This would leave 80 to 120 trees per acre. This is characterized as a light to moderate thinning intensity.

Minor species components, including western redcedar, Pacific yew, black cottonwood, and red alder will be maintained to promote diversity within stands. Minor tree species would be left regardless of condition. These trees would provide future stand differentiation in tree size, tree spacing, and canopy layering. It would promote overall variation. The few disturbance agents that are present would be utilized to improve variation and structure. Trees with laminated root rot and mistletoe would be favored for leave.

To further enhance diversity, 3-10% of the stand would be in gaps that are 1/10 to ¼ acre in size. All of the predominant species between 6-18 inches diameter at breast height would be removed within gaps. These gaps would maximize the development of minor species left within them. If

needed, these gaps may be planted with western red cedar, western hemlock, and/or Pacific silver fir seedlings at low density (100 trees per acre).

Ten percent or more of the stand left unthinned to allow natural suppression mortality and variation. Unthinned areas would include the inner portions (closest to the stream) of Riparian Reserves. Other areas of observed biodiversity would not be thinned.

All existing large downed logs (≥20 inches large end) and snags (≥15inches dbh) would be left. Additional downed logs would be left in the cut portions of thinned units at a density of 10 trees per acre that are at least 10 inches diameter large end. No additional snags would need to be created due to the small size of excess trees.

Matrix Units 21-26, and 29-34

The prescription in the Matrix units is similar to the LSR commercial thinning, especially in the units with a high proportion of Riparian Reserve thinning (Units 22, 24, and 25), however, greater considerations are made for immediate and future timber yields. Thinning will be from below leaving the largest trees in the stands. The predominant species will be targeted for removal, typically Douglas-fir, western hemlock, and/or Pacific silver fir. Thinning will seek to reduce their present relative densities by 40-60%. This will leave 60 to 120 trees per acre. This is characterized as light to heavy thinning intensities. All trees >18 inches diameter at breast height would be left in units 22, 24, and 25 due to the high proportion of riparian reserve thinning which has similar objectives to thinning within the LSR. In the other Matrix units, all trees >24 inches diameter at breast height would be left where practical.

As with LSR units, minor species components, including western redcedar, Pacific yew, black cottonwood, and red alder will be maintained to promote diversity within stands and would be left regardless of condition. These trees would provide future stand differentiation in tree size, tree spacing, and canopy layering. It would promote overall variation.

In contrast to the LSR units, Western hemlock and Pacific silver fir with severe dwarf mistletoe infections (Hawksworth ratings of 4-6) and Douglas-fir within laminated root rot infection centers would be favored for removal in all Matrix stands.

To further enhance diversity, ¼ acre gaps would be created where all of the predominant species between 6-18 inches dbh would be removed. It is anticipated that minor species will fill these gaps, but if needed, they would be planted with western red cedar, western hemlock, and/or Pacific silver fir seedlings.

Other area would be left unthinned to allow natural suppression mortality and variation. Unthinned areas will include the inner portions Riparian Reserves, closest to streams. Other areas of noted biodiversity would not be thinned.
All existing large downed logs (≥20 inches large end) and snags (≥15inches dbh) would be left. Within units with high proportion of riparian thinning (Units 22, 24, 25), additional downed logs would be left in the cut portions of thinned units at a density of 5 trees per acre that are at least 10 inches diameter large end. Other matrix units need no additional downed logs. No additional snags need be created due to the small size of excess trees.

A heavy thinning intensity is prescribed for Units 24, 25 and 26 to promote and maintain greater levels of understory forage.

Vista Opportunities

Unit 6

Unit 6 is a 20 year-old plantation located at the junction of Forest Road 2500 and 2573. It is stocked primarily with Douglas-fir at 450 trees per acre. Located within LSR, the long-term desired future condition is late-successional and old-growth forest. The near term desired condition is continued individual tree growth and avoidance of stagnation. Species diversity can be improved by increasing the percentage stocking of minor species. These stands are generally too young to benefit from gaps or leave areas

Douglas-fir trees and western hemlock would be thinned to 15 foot spacing + 20% with varying density. All other minor species would be left. Slash within 100 feet of Forest Road 2500 would be pulled back into the unit.

Unit 2 and Forest Road 2500 Clearing Limits

Forest Road 2500 was constructed in the 1960s and reconstructed in the 1980s. Trees have become established in the area initially cleared for road construction (the clearing limit) adjoining the paved surface and maintained shoulder and ditches. These trees are very dense in places. They limit driver's sight distance at curves and intersections, limit views into the adjoining old-growth forest and vistas (Clearwater Viewpoint – Unit 2), and collect litter and obstruct its removal. Because of high density, trees of increasing height to diameter ratio often bend over into the roadway and need to be removed.

To address these problems, within 25 feet of the road, and up to a maximum of 50 feet from the road, trees would be thinned. Trees ($\leq$16 in dbh) at Clearwater Viewpoint (Wildcat Unit 2) would be selectively felled to re-open the viewpoint and maintain on-site scenic quality. In younger thickets along the road, trees would be thinned to variable 10-20 foot spacing. On slopes that fall steeply away from the road, felled trees may be left in place. Otherwise, felled trees would be chipped or pulled farther away from the road. Other than chippers and chain saws, this is a non-mechanized project. Approximately nine miles along a 17-mile stretch of Forest Road 2500 between Muddy River Viewpoint and Elk Pass would be treated.

Salvage

Unit 21

The western portion of Wildcat stand 21 has sustained significant windthrow effecting 70% of the trees. A salvage treatment is prescribed to remove downed and root-sprung trees. A portion of the down trees would be left to total 240 linear feet per acre, as well as 3 snags per acre. There would be no harvest from within the Riparian Reserves. Slash would be treated. Portions of the stand that are understocked would be planted with a mix of conifer species.

Forest Plan Amendment

Alternative B in this preliminary analysis proposes an amendment to the Gifford Pinchot National Forest Land and Resource Management Plan (Forest Plan). The proposed amendment is a minor change to one of the standards and guidelines in the Forest Plan. This site-specific amendment would be effective at the time of the decision and would apply only to the applicable units within the Wildcat Timber Sale if approved.

FP Standard/Guideline to be Amended:
Forestwide Standards/Guidelines, Water, Soil, and Air, Planning and Inventory, #6:
"Soil Management Guidelines, Gifford Pinchot National Forest" (Dec, 17, 1977), as amended, will apply unless on-the-ground assessment indicates a change in the guidelines is necessary (Plan, IV-60).

The Soil Management Guidelines (now called Soil Resource Inventory-SRI) detail soil interpretations to guide timber management. The SRI states that "*no tractor harvest equipment should be permitted on slopes over 30 percent. 'Loader loggers' are not included in this interpretation. This loader logger has demonstrated successful operation on more compactible soils and on slopes up to 35 percent*" (SRI, XII-2).

For the purposes of this project, the responsible official proposes to amend the Gifford Pinchot National Forest Land and Resource Management Plan (USDA 1990) to allow a feller-buncher (a type of harvester used in logging that cuts several trees before gathering them) to operate on slopes up to 45 percent, even on those units that are rated in the Soil Resource Inventory as not permitting tractor logging. The feller buncher can reduce the amount of time it takes to gather and load logs which can increase economic viability in timber sales while still maintaining the soil resource and operator safety on steep slopes. When the Soil Management Guidelines were developed, the feller-buncher had not yet been developed and was therefore not addressed directly in the guidelines.

Feller-buncher use is relatively new on this forest but has been used on other National Forests on gentle slopes up to 35 percent. Limited monitoring data exists for feller buncher use on steep slopes. It is anticipated that activity areas with feller buncher use is not likely to have a greater impact on soil quality relative to other parts of the proposed action with proper implementation of specific design criteria and mitigation measures. Its use would be limited within Wildcat ABC units; however this project gives the Forest an opportunity to evaluate the impacts and benefits associated with feller buncher use on steeper slopes. Results would be monitored and adjustments made as necessary for this sale and future sales.

The regulations for forest planning under the National Forest Management Act (36 CFR Part 219, as of July 1999) provide procedures for the Responsible Officials to amend a Forest Plan. The regulations state: "If the change resulting from the amendment is determined not to be significant for the purposes of the planning process, the Forest Supervisor may implement the amendment following appropriate public notification and satisfactory completion of NEPA procedures" (36 CFR 219.10(f)). The proposal to amend the Forest Plan was described in a scoping letter mailed to the public in December 2008. Analysis of these proposed changes is included in the soils section in Chapter 3.

Additional guidance on amending Forest Plans is provided in the Forest Service Manual 1900-Planning. Section 1922.51 describes non significant amendments as:

- Actions that do not significantly alter the multiple-use goals and objectives for long-term land and resource management;

- Adjustments of management area boundaries or management prescriptions resulting from further on-site analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long-term land and resource management;

- Minor changes in standards and guidelines; and/or

- Opportunities for additional management practices that would contribute to achievement of the management prescriptions.

The proposed amendment does not propose changes in management area boundaries or prescriptions, but does represent minor changes in standards and guidelines and provides for additional management practices that could contribute to achieving management prescriptions.

The proposed minor change to forestwide standard "Water, Soil, and Air/Planning and Inventory #6" would not alter any of the multiple use goals or objectives outlined in the Forest Plan and would not change the overall intent of the standard. The proposed change allows an exception for a particular, more modern piece of equipment. Therefore, there would be no change in the multiple use goal of protecting water, soil or air resources forestwide.

This amendment would provide an opportunity to use an additional management practice that would contribute to achievement of management prescriptions. The new use of this equipment would provide an additional option for timber management on steep slopes that improves logging efficiency and has economic benefits such as hand felling and log processing time and cost is reduced on skyline logging operations thereby increasing cost efficiency and a reduction in hand felling improves safety of logging personnel.

Project Design Features

Wildlife

All existing down logs that are remnants of the previous stands will be protected to the extent possible. If snags in adjacent late-successional and old-growth stands must be felled for safety reasons or to facilitate cable yarding, the resulting log will be left in place. Existing defective green trees, including those with broken tops due to snow damage and those with multiple boles and tops will be retained to provide for future snags. In Units 31, 32, 33, and 34, where there are numerous trees with multiple tops, it is not necessary to retain all of them but at least five per acre in these units will be retained.

Visual Emphasis

Units 1, 7, 12, 13, 16, 25, 27 and 34 abut Forest Roads 2500, 8300 and 8322 and have a retention visual quality objective. Design features would be applied to avoid or minimize the short-term visual effects of logging and apply to the area within 100 feet of Forest Roads 2500, 8300 and 8322:

- Leave tree paint designation would occur on the tree side facing away from the road.
- Cut tree stumps would be no higher than 4 inches, uphill side.
- Excess slash would be removed, either moved into unit or piled and burned.
- Landings would be minimized and placement reviewed by recreation staff.
- Rehabilitation of landings and temporary roads will not use root wads.

In addition, temporary roads entering Forest Roads 2500, 8300, or 8322 will avoid creating a long straight line-of-site from the system road and where feasible, should enter the system road at a right angle to minimize the time motorists can view the road corridor. Slash will be left in a condition of less than two feet above the ground, screened by shrubs, grasses, or other understory vegetation and sparsely distributed and behind large diameter, dead material as opposed to tangles of small limbs.

Invasive Species—Forest Plan Standards

1. To prevent the introduction of noxious weeds into the project area, all heavy equipment, or other off- road equipment used in the project is to be cleaned to remove soil, seeds, vegetative matter or other debris that could contain seeds. Cleaning should be done before entering National Forest Lands, and when equipment moves from or between project sites or areas known to be infested into other areas, infested or otherwise. Cleaning of the equipment may include pressure washing. An inspection will be required to ensure that equipment is clean before work can begin. (Equipment cleaning clause Wo-C6.35) (**Standard 2**).
2. Use weed-free straw and mulch for all projects, conducted or authorized by the Forest Service, on National Forest System Lands. If State certified straw and/or mulch is not available, individual Forests should require sources certified to be weed free using the North American Weed Fee Forage Program standards or a similar certification process (**Standard 3**). Mulch species shall preferably be from native seed sources or annual rye or cereal grain fields. Local contacts for weed free straw include: Ken Chase (broker contact) at 530-572-2759; Russ Martin at 541-426-3332 (acting Wallowa County Veg.

Manager who will be able to tell you if there is any straw available from that program), or Elwyn Crutcher at 360-939-2334 (he will deliver for a charge).

3. Inspect active gravel, fill, sand stockpiles, quarry sites, and borrow material for invasive plants before use and transport. Treat or require treatment of infested sources before any use of pit material. Use only gravel, fill, sand, and rock that is judged to be weed free by District or Forest weed specialists (**Standard 7**).
4. Native plant materials are the first choice in revegetation for restoration and rehabilitation where timely natural regeneration of the native plant community is not likely to occur. Non-native, non-invasive plant species may be used in any of the following situations: 1) when needed in emergency conditions to protect basic resource values (e.g., soil stability, water quality and to help revent the establishemtn of invasive species), 2) as an interim, non-persistent measure designed to aid in the re-establishment of native plants, 3) if native plant materials are not available, or 4) in permanently alterned plant communities. Under no circumstances will non-native invasive plant species be used for revegetation. (**Standard 13**). The South Zone botanist may be contacted for appropriate seeding and site preparation prescription. When seed is used it should be either certified noxious weed free or from Forest Service native seed supplies.

Invasive Species

1. During years of project implementation, conduct road brushing activities during spring-early summer, before seed heads mature, in order to prevent formation and release of viable seeds that could be dispersed along hauling corridors by vehicles, and/or when wind-borne seeds could disperse into newly harvested units.

2. Re-vegetate temporary roads, landings, and skid trails by applying native seed and mulch, in accordance with directions set out in the Gifford Pinchot National Forest native seeding prescription (Appendix C).

3. Clean machinery working within Units 1, 30 and 33 (where occurrences of *Canada thistle* have been reported) before moving to units not infested with Canada thistle.

Aquatics and Soils

The following project design features are considered Best Management Practices and have been tailored for site-specific conditions for the protection of water quality. Any proposals to change the aquatic and soils design features should involve consultation with an aquatics or soils resource specialist.

Ground-based machinery will not be operated where soil water content is high enough to cause detrimental puddling, defined as when the depth of ruts or imprints is six inches or more (Forest Service Manual, Chapter 2520, R-6 Supplement No. 2500.98-1). This design feature will limit the degree of detrimental soil rutting and puddling as well as reduce the potential for sediment delivery to streams.

Equipment traveling away from approved skid trails or temporary roads will operate on a slash mat of limbs and tops that is deposited directly in front of the machine wherever possible. The slash mat will be made as thick and continuous as practical for units approved for pre-bunching using ground based equipment, such as feller-bunchers, as a means to reduce soil disturbance. Activity would be planned to make as few trips as possible. The objective is to limit detrimental soil compaction, displacement, and disturbance to less than 20 percent of the unit area (GP Forest Plan, 1995) and to provide water infiltration and substrate for vegetative growth following logging and harvest activities.

One-end log suspension will be required for ground-based and cable yarding systems (except during winching or lateral yarding). No skidding is permitted across any streams. This will reduce the risk of soil compaction and displacement from dragging entire logs along the ground. The objective of this is to minimize erosion and potential sediment delivery to streams.

Streams within or adjacent to units will be protected to maintain or improve riparian reserve conditions in accordance with the Aquatic Conservation Strategy of the Northwest Forest Plan. Thinning is prescribed in the outer perimeter of the Riparian Reserves. A no-cut buffer immediately adjacent to streams within the riparian reserves prohibiting equipment operation, timber removal and temporary road construction or reconstruction is designated as 60 feet unless otherwise identified in unit specific project design features (Table 1). Exceptions include a greater no cut buffer width and/or pre-approved activities such as temporary road construction, reconstruction of old logging roads including intermittent stream crossings, system road improvements, and system road use for timber haul. Skyline yarding corridors are permitted through no cut buffers on Class IV streams only providing full suspension can be achieved within the entire no cut buffer width and less than 10% of the no cut buffer is affected by the corridor. One site potential tree height width no cut buffer is prescribed for all wetlands unless otherwise specified.

Harvested trees will be felled away from streams, springs or wetlands including the no cut buffers around these hydrologic features. Exceptions would be trees which are leaning towards these features, or when conditions would not allow safe felling. Any portion of a felled tree that lands in the no cut buffer will be left on the ground. The objective of this is to prevent damage to riparian vegetation and soils within Riparian Reserves.

Landings, temporary roads, skid trails and skyline corridors will be approved by the sale administrator prior to timber felling. The number of skyline corridors will be kept to a

minimum. Skid trails must be located outside of all no cut buffers. Skid trails will be spaced a minimum of 150 feet apart. Skid trails will be re-established at previous skid trail locations except where existing skid trails from prior entry are causing detrimental soil or hydrologic conditions that could be further avoided with alternative skid trail location. Skid trails will be subsoiled after use with a few exceptions as identified in Unit Specific Design Features. Subsoiling must be to a depth of 18 inches (minimum) and accomplished immediately following logging activities. Available logging slash will be placed across the subsoiled surface.

Temporary roads will be located where past logging roads were located, unless a new location would cause less resource effect. Rock will be applied only where needed to reduce erosion, puddling and compaction. Temporary road construction and reconstruction across intermittent streams are identified to occur in seven units as specified in unit specific project design features. Temporary road stream crossing structures will be designed to comply with standards and guidelines for permanent structures which accommodate high winter flows unless seasonal restrictions are in place. If a seasonal restriction is in place, temporary road stream crossing structures will be designed to accommodate a range of summer flows and removed prior to the fall wet season. The objective of this is to provide channel transport function and hydrologic connectivity, and to reduce the risk of sediment delivery to streams from culvert failures.

Landings will be located outside of all no-cut buffers. Landings will be limited to the area needed for safe and efficient yarding and loading operations and have proper drainage. Straw bale catchments or silt fences will be used to avoid sediment transport to road ditches or streams. Silt fences are most effective on flat ground. Sediment catchments such as hay bales can be secured in constructed ditches that drain landing sites on sloped ground. The catchments will be located to intercept runoff from the landing prior to reaching any road ditch or stream.

All locations allowed for pre-bunching shall be agreed upon prior to felling. Pre-bunching is the mechanical falling, limbing, bucking and bunching of trees to improve efficiency of helicopter and skyline yarding systems. The Rationale for the Wildcat Timber Sale Forest Plan Amendment for pre-bunching on steep slopes allows ground based equipment to travel on slopes greater than 30 percent and away from designated landings, temporary roads, or skid trails for the purpose of pre-bunching. The mechanical harvester will

a. Travel on planned trails and be limited to slopes less than 45 percent, including short, steep pitches.
b. Avoid traveling across the slope and turning on steep slopes.
c. Operate on a slash mat of limbs and tops that is deposited directly in front of the machine, as mentioned previously.
d. Not enter into riparian no cut buffers and unstable slopes.
e. Minimize excavation of road prism for access and restore these areas when pre-bunching activities are complete.

Corridor widths will be only as wide as necessary for the equipment to travel (less than 11 feet wide wherever possible). Equipment travel will be limited to one round trip. Processor will pull line or buck logs if needed to reach logs outside of cable road, and will not take equipment off the approved corridor.

Go-back trails used for equipment fueling and servicing will be approved by the Forest Service and be located where suitable grade and minimal impacts to soils and water

quality exist. The objective of this is to prevent surface soil erosion resulting from timber related ground disturbance and compliance with the Project-specific Forest Plan Amendment for Wildcat Timber Sale.

Activities conducted in stream courses will follow all the provisions specified in the Memorandum of Understanding with Washington State Department of Ecology including consideration of the recommended allowable work windows specified for certain activities.

All permanent culverts will be designed to accommodate 100-year flow events to be consistent with Gifford Pinchot Land Resource Management Plan Standards and Guidelines (USDA 1995). Road improvement will be designed to effectively allow water to be conveyed through the road prism without causing erosion or loss of slope stability. The objective of this design feature is to ensure channel transport function and hydrologic connectivity.

A spill plan will be developed and pre-approved prior to project implementation. The plan will include appropriate operational measures for handling hazardous materials. A Hazardous Material kit will be on site, and would contain materials to control/contain a spill of fuel, oils, and/or hydraulic fluid. Fueling equipment will be located outside of riparian reserves. All service work on heavy machinery and refueling will be done on an established system road at a site approved by the Forest Service. The objective of this design feature is to reduce the potential for damage to the stream and flood plain as a result of a hazardous material spill.

Hazard trees within a site potential tree height distance from a stream will be felled towards the stream and left on the ground. In the case that the felled tree would be at risk of interfering with surface flow into a culvert or culvert inlet area, they can be felled away from the stream.

Additional design features only apply to certain units (Table 1).

Table 1. Unit-Specific Design Features of the Wildcat Proposed Action.

Unit #	Project Design Feature
1	Protect the large patch of hardwood trees near the center of the unit by designating it as a "no cut" area. Preserve the dry meadow (and associated species), particularly northern portion, as much as possible, during construction of the adjacent planned landing.
3	100 ft. radius no cut buffer centered on occurrence of *Pseudocyphellaria rainierensis* (1 site) just outside unit Perennial Stream Site Potential Tree Height no cut buffers on Units' south and north edges (stream is outside boundary edge but no cut buffer extends into unit) Install two stream crossings on the temporary road during the dry season
4	Promote botanical species diversity within the stand by designating a "no cut" area around the patch of large trees located within the northern portion of the unit, since they are hosting a notably greater epiphyte diversity than the rest of the stand
5	75 ft. radius no cut buffer centered on occurrence of *Peltigera pacifica* (1 site)

	100 ft. radius no cut buffer centered on occurrence of *Tetraphis geniculata* (1 site) Locate new section of temp road to avoid intermittent stream crossing
7	75 ft. radius no cut buffer centered on occurrence of *Peltigera pacifica* (1 site)
8	Site Potential Tree Height no cut buffer on perennial stream
9	Site Potential Tree Height no cut buffers on eastern perennial stream Reconstruct failing culvert on FR2575 within unit to minimum standard Avoid disturbance to the ¼ acre rock outcrop located at the west edge of the unit by designating it as a "no cut" area.
11	Install stream crossing structure on temporary road during the dry season
12	Perennial Stream Site Potential Tree Height no cut buffer on southern unit boundary (shared with Unit 13). Thinning will result in a canopy cover of 50% or greater exclusive of heavy cut "gaps" and no cut areas.
13	100 ft. radius no cut buffer centered on occurrence of *Tetraphis geniculata* (1 site) Site Potential Tree Height no cut buffer on one wetland (approximately 50 X 25 ft) and perennial stream along northern unit boundary (shared with Unit 12) Install three stream crossings on the two temporary roads during the dry season
14	Site Potential Tree Height no cut buffer around headwater wetland in the draw on the south side of this unit, that is approximately 10 to 25 ft. wide and 200 ft. long. Thinning will result in a canopy cover of 50% or greater exclusive of heavy cut "gaps" and no cut areas to avoid increase risk of mass wasting.
15	Site Potential Tree Height no cut buffer around headwater wetland in the draw on the north side of this unit, that is approximately 10 to 25 ft. wide and 200 ft. long
16	Thinning will result in a canopy cover of 50% or greater exclusive of heavy cut "gaps" and no cut areas to avoid increase risk of mass wasting.
17	Thinning will result in a canopy cover of 50% or grater exclusive of heavy cut "gaps" and no cut areas to avoid increase risk of mass wasting.
18	Perennial Stream Site Potential Tree Height no cut buffer on southern corner (stream course is outside of unit, but outermost extent of no cut buffer is within)
19	Install stream crossing structure on the temporary road during the dry season No thinning will occur within the soil mapping unit with Very High Potential Risk of Mass Movement.
21	100 ft. radius no cut buffer centered on occurrence of *Tetraphis geniculata* (1 site)
22	No thinning will occur within the soil mapping unit with Very High Potential Risk of Mass Movement.
24	Site potential tree height no cut buffer around three most eastern perennial streams

	Avoid disturbance to one band of 50 ft. high cliffs by designating it as a "no cut" area.
25	75 ft. radius no cut buffer centered on occurrence of *Peltigera pacifica* (1 site) Site potential tree height width no cut buffer around five perennial streams Install three stream crossings on the temporary road during the dry season Avoid using existing skid trails within draws which are causing mass wasting
27	One Site potential tree height width no cut buffer on all six perennial streams Install stream crossing structure on the temporary road during the dry season
29	One site potential tree height width no cut buffer around boggy wetland area near FR 2588520 in the southeastern portion of the unit Construct cross drains or waterbars on FR2588520 (MP 0.2-0.3) to disrupt concentrated ditch flow around tributary that leaves the stand near the south corner which is contributing to increased peak flows from stream extension
30	Site potential tree no cut buffer on all eleven perennial streams which includes soil mapping unit 9–steep eroded canyon walls
31	100 ft. radius no cut buffer centered on occurrence of *Tetraphis geniculata* (1 site) Site potential tree height width no cut buffer around perennial streams which includes soil mapping unit 9–steep eroded canyon walls Place cross drains and water bars on temp roads and subsoil only where necessary to avoid any drainage problems Treat cutleaf blackberry occurrences prior to project implementation
32	100 ft. radius no cut buffer centered on occurrence of *Tetraphis geniculata* (1 site) Site potential tree height width no cut buffer around perennial streams which includes soil mapping unit 9–steep eroded canyon walls Place cross drains and water bars on temp roads and subsoil only where necessary to avoid any drainage problems
33	75 ft. radius no cut buffer centered on occurrence of *Peltigera pacifica* (1 site) One site potential tree height no cut buffer on West Pine Creek, perennial tributary and wetland
34	Install stream crossing structure on the temporary road during the dry season

Mitigation Measures

Mitigation measures are mandatory actions to mitigate for unavoidable project effects.

Wildlife

1. A limited operating period of March 1 to July 15 for Units 8 and 9 will be implemented to minimize disturbance near important raptor nesting habitat.

Aquatics and Soils

1. After activities are complete, temporary roads used in harvest activities will have all stream crossings structures removed, including any road fill and road surfacing (rock) from within bankfull width of the stream course. Temporary roads and landings will be subsoiled to a depth of 18 inches (minimum), create an uneven, rough surface without furrows and be accomplished immediately following logging activities. Available logging slash will be placed across the subsoiled surface. No ground-based equipment will be operated on subsoiled portions of roads and landings after subsoiling is completed to prevent re-compacting treated roadways and landings. Post harvest motorized access to temporary roads will be prevented by construction of an approved closure device (e.g., construction of a 4-foot high earth berm or other suitable material at the road entrance). Closure to vehicles is required to prevent subsoiled areas from being re-compacted, prevent erosion and sediment delivery, and to allow vegetation to develop. The objective of this measure is to rehabilitate areas compacted during management activities, accelerate recovery of compacted soils, and facilitate water infiltration and revegetation on those disturbed areas. These measures will also provide ground cover for exposed soils in order to reduce the potential for offsite erosion and maintain soil organic matter to prevent nutrient and carbon cycle deficits.

2. Areas of gouging or soil displacement resulting from suspended cable yarding systems and/or mobile yarding systems will be treated to prevent rill and gully erosion and potential sediment delivery to stream courses. Go-back trails used for equipment fueling and servicing will be rehabilitated post use. Steep slopes will not be subsoiled. Erosion control treatment may include, but is not limited to, repositioning displaced soil to re-contour disturbed sites, creating small ditches or diversions to redirect surface water movement, and scattering slash material to create flow disruption and surface soil stability. Erosion control measures will be designed in coordination with an aquatic resource specialist or soils scientist, prior to the close of the timber sale, and implemented by the purchaser by October 1st. The objective of this measure is to prevent surface soil erosion resulting from timber related ground disturbance.

3. Any sediment that is captured and deposited behind sediment catchments will be cleaned prior to the wet season and deposited out on the forest floor to ensure it does not have a direct flow path to a system road ditch or stream and will be captured by vegetation on the forest floor. These catchments will be removed following one wet season.

4. Forest Road 2588 MP 4-7 and associated spur roads use will be restricted to the dry season. The objective of this measure is to minimize sediment delivery from timber haul in Pine Creek, specifically the fish-bearing reaches of Pine Creek. This mitigation measure reduces sediment delivery from haul by 21% (sediment model estimate).

5. Remove existing culvert and fill of the unused section of temporary road on western perennial stream within Unit 8 to mitigate sediment delivery within the Clear Creek Subwatershed.

6. Decommission FR 2586170 (0.3 miles) when activities are complete to mitigate sediment delivery within the Muddy River Subwatershed.

7. Monitoring will be performed by the sale administrator in order to prevent/rectify resource damage that may occur as a result of ground disturbing activities. Resource damage includes: ponding, rutting, rilling, culvert blockages, stream channel instability, and the occurrence of scour or sediment transport and deposition downstream of cross drains. This resource damage may be encountered on adjacent system roads, temporary roads, skid trails, landings, stream crossings, riparian reserves or within harvest units where ground disturbance has occurred. Project activities will be curtailed, and corrective action taken, before work is allowed to resume, if resource damage is occurring. Implementation and effectiveness monitoring of BMPs will be documented by the sale administrator and made available to the line officer in order to determine when adjustments need to be made to prevent excessive resource damage.

Additional Protection Measures

Additional protection measures for Invasives near the thinned units of the proposed action exist.

1. Minimize road maintenance clearing zones to maintain shady conditions that help minimize invasive plant population expansion.

2. Control specified (see above) invasive plants at landings, culvert replacement sites, and along Timber Sale access roads for 1/2 mile preceding areas of ground disturbance (i.e. staging areas, and harvest units adjacent to roads), to 1/2 mile following area of ground disturbance, as specified below:
    a. During the season before the ground disturbing phase of project implementation begins, weeds shall be hand pulled, bagged and disposed of outside of Gifford Pinchot National Forest boundaries (unless Forest NEPA analysis allows for alternative treatment). Control efforts should occur before invasive species have set seed for the year (May or June in most units). The Gifford Pinchot National Forest (contact: South Zone Botanist) shall provide a list of weeds to be controlled previous to project implementation. The Sale Administrator shall inform the Gifford Pinchot South Zone botanist at least one month prior to when work is scheduled to commence, so that weed control activities may be appropriately scheduled by the South Zone Botanist.
    b. During seasons of project implementation weed re-occurrences along access roads

shall be controlled as specified above.

c. For two field seasons following project completion, weed re-occurrences at landings, and along access roads, shall be controlled as specified above. In addition, harvest units shall be surveyed for invasive plant establishment and/or encroachment. If new invasive plant populations are located within harvested units, population data shall be collected for entry into the Natural Resource Inventory System (NRIS) database, and invasive plants shall be controlled, as specified above.
d. After two years, the South Zone Botanist shall re-evaluate the weed control needs within the project area and determine whether further treatment is needed. It is likely that, at some sites, weed control beyond two years will be necessary.
e. All invasive plant control actions shall be recorded on a FACTS invasive plant treatment form (contact: South Zone Botanist).

Optional Restoration Opportunities Within Units

Additional optional restoration opportunities within thinned units of the proposed action exist (Table 2).

Table 2. Optional restoration within thinned units of the proposed action .

Unit #	Optional restoration within thinned units
5	Subsoil old logging road for 30 feet both sides of the intermittent stream with 5 foot high headcut
9	Decommission FR2575 from MP 1.5 to 1.67 (0.17 miles – removes failing culvert)
11	Subsoil old skid trails near the stream to remediate existing stream head cuts
13	Within site potential tree height buffer, cut and leave trees for headwall enhancement where mature conifers are tightly spaced unless within a site potential tree height width from the wetland. Also, create snags in areas adjacent to no cut buffers encompassing *Tetraphis geniculata* to help recruit future large wood for use by this species as well as other riparian species dependent upon large wood. These activities will be accomplished according to the silvicultural prescription and Riparian Reserves Standards and Guidelines for Timber, TM-1 (c), in order to acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (Headwater Enhancement of tributaries to Muddy River).
14	Cut and leave down wood where mature conifers are tightly spaced within the outer 120 feet of the site potential tree height width no cut buffer for the intermittent stream unless within a site potential tree height width of the wetland according to the silvicultural prescription and Riparian Reserves Standards and Guidelines for Timber, TM-1 (c), in order to acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (Headwater Enhancement of tributaries to Muddy River).
15	Within the 60 foot no-cut buffer, cut and leave trees for headwall enhancement where conifers are tightly spaced according to the silvicultural prescription and Riparian Reserves Standards and Guidelines for Timber, TM-1 (c), in order to acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (Headwater Enhancement of tributaries to Muddy River).
21	Cut and leave trees (20 trees/acre) between no cut buffers of intermittent streams originating as springs in southern section of unit. Also, create snags in areas adjacent to no cut buffers encompassing *Tetraphis geniculata* to help recruit future large wood for use by this species as well as other riparian species dependent upon large wood. These activities will be accomplished according to the silvicultural prescription and Riparian Reserves Standards and Guidelines for Timber, TM-1 (c), in order to acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (Spring Enhancement in Lewis River Tributary).
22	Construct access barriers after logging activities are completed on FR 2588380 which had limited use prior to project
23	Construct access barriers after logging activities are completed on FR 2588880 which was not being used due to brush prior to project

25	Stabilize the lower existing old logging road that will not be used for thinning of Unit 25, by removing three major stream crossings
27	Decommission FR 8322560 (0.7 miles) when activities are complete
29	Construct access barriers after logging activities are completed on FR 2588520 which had minimal use prior to project
30	Remove any culverts and associated fill on old logging roads that are not used for thinning
32	Remove blocked log culvert on west side of southern edge (10 feet of fill could deliver directly to West Pine Creek
33	Remove crossing at tributary to West Pine Creek and block access on FR 8300380 at MP 0.5
34	Construct access barriers after logging activities are completed on FR 8300540 which was not being used due to brush prior to project

Alternatives Considered but Eliminated from Detailed Study

Younger Stands

Twenty additional units (about 900 acres) in the Muddy River, Clearwater Creek and Clear Creek Subwatershed were considered for commercial thinning in an early alternative. Twelve of these units had small diameter trees where additional growth was recommended prior to commercial thinning. Seven of the units had marginally sized trees with challenging access factors, the combination of which resulted in recommending deferment of commercial thinning. One unit was developing late successional characteristics and not in need of commercial thinning. The Forest decided not to move forward with these units in the final proposal.

There were no other issues raised through scoping that were sufficiently significant to drive the development of another action alternative.

CHAPTER 3. ENVIRONMENTAL CONSEQUENCES

This chapter describes the current environment in the project area. It also displays potential effects (direct/indirect, beneficial/adverse, and cumulative) on resources that could occur if either of the two alternatives described in Chapter 2 were implemented. By comparing current conditions of each issue to future conditions as altered by management activities, the decision-maker and interested persons can assess the benefits of the alternatives, evaluate trade-offs posed by the environmental consequences, and determine if the relevant issues and concerns have been adequately addressed.

This evaluation is based on data gathered by members of the interdisciplinary team between 2008 and 2009, data from silvicultural examinations, information provided by resource specialists and the public.

The application of all design features from Chapter 2 as well as Forest Plan standards and guidelines, and Best Management Practices is integral to the assessment of impacts.

Table 3 lists activities that were included in the cumulative effects analysis for each resource.

Table 3. Projects Considered in the Cumulative Effects Analysis.

Action	Description	Date
	Past	
Timber harvest within the activity areas	Managed stands were clear-cut harvest followed by planting. Thinning and regeneration harvest of units adjacent to (not overlapping) some units of the proposed action.	Unknown
	Present and/or Ongoing	
National Forest System roads	Use of system roads on lands within the listed Sub-Basins.	Ongoing
Special forest products harvest	Commercial harvest and sale and free use of forest products.	Seasonal
Forest Trails	Management of forest trails including erosion work, route signing, and maintenance. Minimal extent and impact.	Ongoing
	Future	
Other Silvicultural Treatments	Subwatershed is dominated by "matrix" land allocations, are subject to timber harvest.	
Road Decommission	Decommissioning will likely continue where roads are harmful to natural resources. Clear Creek Roads Project Decision Notice was signed in August 2008 in which specific roads were specified to be decommissioned or closed.	Unknown
Global climate change effects	Human induced changes to atmospheric conditions, notably increased temperatures and heavy precipitation events.	Unknown

Soils

This section summarizes the effects on the soil resource of the proposed activities for the Wildcat Timber Sale. The extent of detrimental soil conditions within the activity areas (Wildcat units) of the action alternative was analyzed. Quantitative analysis and professional judgment were used to evaluate soil quality.

Existing Condition

Physiographic Setting

Landtype Association mapping (USDAFS GPNF 1999b, gplta) classifies the Wildcat Timber Sale project area into four basic landforms. Wildcat Timber Sale Units 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, and part of 12 are mapped as "Gently Sloping Upland Benches, Plateaus," with soils derived from "volcanic tephra." Wildcat Timber Sale Units 2, 13, 17 and parts of 1 and 12 are on "Steep, Moderately Dissected Mountain Slopes" with soils derived from "colluvium from … volcanic tephra." Wildcat Timber Sale Units 18, 19, 21, 22, 23, 24, 25, 26, 27, 29 and 30 are on "Steep, Slightly Dissected Mountain Slopes" with soils derived from "colluvium from marine volcanics and volcanic tephra." Wildcat Timber Sale Units 14, 15, 31, 32, 33, 34 and part of 30 are on "Lahar Terraces and Benches" with soils derived from "lahar deposits."

In general, Wildcat Timber Sale Units east of Muddy River and above 1,800 to 2,000 feet in elevation are in the cryic soil temperature regime, along with those west of Muddy River and above approximately 2,400 feet in elevation. Wildcat Timber Sale Units below these elevations are in the frigid soil temperature regime. Of the three temperature regimes on the forest, cryic is the coldest soil type; frigid soils being less cold.

Soils Mapping

Soils of the project area were mapped as part of the Soil Resource Inventory (Wade, et. al., 1992). This information is available at the Gifford Pinchot National Forest Headquarters. Soils in the activity areas are suitable for timber harvest in alignment with timberland suitability classification (FSM 2415.2) except in wetlands and wet meadows (Soil mapping unit 3) or in steep eroded canyon walls (Soil mapping unit 9), which border Wildcat units 30, 31, and 32.

Current soils information for sensitive soils in the project area was collected on a site-specific basis. Thirteen of the 32 units were field visited by a Forest Service Soil Scientists in 2007 and 2008. Soil mapping units (SMU) were modified for accuracy at the project scale, reflecting field observations and GIS analysis. A bias toward conservative soil interpretations were used for protection of soil resources and incorporation into project design features for units not visited.

Wildcat Timber Sale Units on lahar terraces, 31, 32, 33 and 34, have a slight potential for surface erosion. The remaining units have moderate or severe erosion potential, except for the steep slopes of Wildcat Timber Sale Unit 30, where the erosion potential is Very severe (Table 4). Soils in the area are generally low to moderate in fertility, however soil fertility does not seem to be a limiting factor in tree growth. The majority of topsoils in the activity areas are dominated by ash and pumice, including coarse sands, and fine sandy loams.

Table 4. Selected Soil Mapping Interpretations (Wade, et. al., 1992) in Wildcat Timber Sale units (activity areas)

								Slope Stability		
Soil Map Unit (SMU)	**Wildcat Unit**	**Acres in Activity Areas**	**Landform**	**Fertility**	**Surface Erosion**	**Displacement**	**Compaction**	**Natural Stability**	**Expect to increase landslides**	**Tractor Logging**
3	13	< 0.1	Wet Meadows (wetlands)	Moderate	Slight	Low	**High**	Very Stable	Unchanged	N/A[1]
9	30, 31, 32	2.5	Canyon Walls	Low	**Very Severe**	N/A	N/A	**Moderately Stable**	**Increased**	**Not** Permitted
11	30, 31, 32, 33, 34	993.1	Broad Outwash Plains	Low	Slight	Low to Moderate	Low to Moderate	Very Stable	Unchanged	Permitted
1231	1, 2, 32	23.8	Combination of Rock Outcrop-Talus-Dry Meadows and Smooth Sideslopes	Low to Moderate		**High**	Low to Moderate	Very Stable to **Moderately Stable**	Unchanged	**Not** Permitted
29	4, 5	28.3	Gentle, Smooth Ridgetops and Flats	Low to Moderate	Moderate	**High**	Moderate	Very Stable	Unchanged	Permitted
31	3, 6, 10, 12, 14, 15, 16, 22, 27, 29, 30	151.5	Smooth Sideslopes	Low	Moderate	N/A	N/A	Stable to Moderately Stable	Unchanged	**Not** Permitted

[1] The SRI give ratings of "N/A" to certain activities, presumably because they are unsuitable lands or the action would violate Forest Plan Standards and Guidelines.

Table 4. Selected Soil Mapping Interpretations (Wade, et. al., 1992) in Wildcat Timber Sale units (activity areas)

								Slope Stability		
Soil Map Unit (SMU)	**Wildcat Unit**	**Acres in Activity Areas**	**Landform**	**Fertility**	**Surface Erosion**	**Displacement**	**Compaction**	**Natural Stability**	**Expect to increase landslides**	**Tractor Logging**
34	5, 6, 7, 10, 11, 13, 14, 15, 16, 19, 22, 23, 24, 25, 26, 27, 29, 30	536.7	Gentle, Undulating Ridgetops and side slopes	Low	Moderate	**High**	Moderate	Stable	Unchanged	**Not** Permitted on slopes greater than 20 percent
35	12, 13, 18, 27, 30	215.4	Steep, Dissected Sideslopes	Low	**Very Severe**	N/A	N/A	**Moderately Stable**	**Increased**	**Not** Permitted
36	19, 21	129.2	Undulating	Low	Moderate	**High**	Moderate	Stable	Unchanged	Permitted
37	19, 21, 33	77.5	Steep, Uneven Sideslopes	Moderate	**Severe**	N/A	N/A	Stable	Unchanged	**Not** Permitted
54	30	38.9	Hummocky Landflow	Moderate	Moderate	**High**	Moderate	**Unstable to Very Unstable**	**Greatly Increased**	**Not** Permitted on slopes greater than 30 percent
57	1, 16, 17, 27	78.8	Uneven Toeslopes	Moderate	Moderate	**High**	Moderate	Moderately Stable to **Unstable**	**Increased**	**Not** Permitted on slopes greater than 30 percent

Table 4. Selected Soil Mapping Interpretations (Wade, et. al., 1992) in Wildcat Timber Sale units (activity areas)

								Slope Stability		
Soil Map Unit (SMU)	**Wildcat Unit**	**Acres in Activity Areas**	**Landform**	**Fertility**	**Surface Erosion**	**Displacement**	**Compaction**	**Natural Stability**	**Expect to increase landslides**	**Tractor Logging**
3157	4, 5, 8, 23, 24, 25, 26, 27	220.4			Moderate	N/A	N/A	Stable to **Unstable**	**Increased**	**Not** Permitted
5654	19, 22, 24	36.0		Moderate	Moderate	**High**	Moderate	**Unstable to Very Unstable**	**Greatly Increased**	**Not** Permitted
5754	4, 5, 8, 9, 12, 13, 14, 18	198.9		Moderate	Moderate	**High**	Moderate	**Moderately Stable to Very Unstable**	**Greatly Increased**	**Not** Permitted on slopes greater than 30 percent
Q	18	1.7	Quarry							

Soils in the project area are considered in a non-productive condition in the long term (greater than fifty years), where detrimental soil conditions exist. Evidence of ground based logging and other forest products harvest and recreational use exist within the Wildcat Timber Sale Unit boundaries. Non-system roads and landings that remain from past timber harvest and which have not been rehabilitated generally have low to moderate, or moderate to severe, soil compaction, depending on their age and characteristics of the soil.

Roads

National Forest system roads currently occupy between approximately 0 and 22.4 percent of the activity areas (Table 5). Non-system roads range from 0 to 3.4 percent of the activity areas. Wildcat Unit 2 ratio of road to acreage is very high due to the small size of the unit and its adjacency to Forest Service Road 25, (considered a part of the activity area as described in the management direction). System roads convert productive soils to an essentially non-productive condition in the long term (greater than fifty years). Most of the precipitation that falls on the compacted surfaces becomes surface runoff.

Table 5. Approximate extent of detrimental soil conditions[2]

Unit	Unit Acres	% non-system roads and landings	% System Roads	% Total
1	67.0	4.3%	4.7%	9.0%
2	0.7		22.4%	22.4%
3	46.0	2.4%	1.7%	4.2%
4	21.9	7.4%	3.3%	10.8%
5	44.0	2.4%	1.9%	4.4%
6	18.7	4.6%	9.7%	14.4%
7	65.0	2.0%	3.8%	5.8%
8	54.5	3.2%		3.2%
9	60.4	2.3%	2.9%	5.2%
10	63.1	5.4%	1.0%	6.4%
11	34.4	3.6%	1.8%	5.4%
12	13.7		2.2%	2.2%
13	66.4	2.8%	0.3%	3.1%
14	28.3	2.7%	1.9%	4.5%
15	55.6	1.6%	0.2%	1.7%
16	55.4	4.9%	3.2%	8.1%
17	7.0	12.0%		12.0%
18	37.2	1.7%	3.6%	5.3%
19	79.5	3.5%	1.6%	5.1%
21	118.2	4.9%	0.9%	5.9%
22	40.5	6.5%	3.6%	10.1%
23	62.5	5.3%	1.2%	6.5%

Table 5. Approximate extent of detrimental soil conditions[2]				
24	48.9	4.8%		4.8%
25	132.6	4.5%	1.0%	5.5%
26	18.1	8.2%	0.3%	8.5%
27	189.8	1.3%	2.4%	3.7%
29	40.6	2.5%	2.3%	4.7%
30	295.0	1.3%	1.0%	2.2%
31	366.6	2.0%	0.5%	2.6%
32	414.3	1.8%	0.0%	1.8%
33	165.8	1.4%	0.7%	2.0%
34	66.0	2.1%	0.6%	2.7%

Soil Organisms

Knowledge of specific fungal, bacterial, and arthropod populations is not available for analysis in this project. Biological soil crusts, commonly found in arid or semi-arid environments (USDA NRCS 1997) are not known to exist in the activity areas. Populations of soil organisms include mycorrhizal fungi, soil-dwelling arthropods, nematodes and bacteria. Loss of organisms in the short term likely occured through direct destruction from equipment operations on previously harvested units and from loss of habitat or substrate. It is expected that areas where losses occured have since re-populated and improved in proportion to recovery of soil physical properties and soil quality.

Slope Stability/ Potentially Unstable Soils

A Forest Service soil scientist specifically visited Wildcat Timber Sale units (4, 7, 8, 9, 23, 25 and 33) that contained soil mapping from the Soil Resource Inventory (SRI) of potentially unstable slopes and landslides (Table 4).

Gifford Pinchot National Forest *NEPA Assistance for the Soil Resource* (Wade, et. al. 1992b) classified SRI Natural Stability ratings as risk ratings below:

- Very High Risk – Generally, Class IV or V Natural Stability Rating. Sometimes designated as unsuited (for timber management) and removed from timber base via GP FSH 2409.13, Chapter 20 when the SMU is given a suffix "F", and thus is taken out of the timber base per the “Timber Land Classification.” This does not apply to any units of the Wildcat Timber Sale.

- High Risk – Generally, Class IV or V Natural Stability Rating. May or may not be unsuited - has most of the characteristics described in a.1. above; some timber harvest may occur by individual tree selection, small group selection, or very small CC; generally, no roads should be built in these areas - involve Geotech Group and Soil Scientist. These specialist may more accurately map the area and help develop the necessary documentation to move the area to the Very High Risk through the use of GP FSH 2409.13, Chapter 20.

- Moderate Risk – Generally, Class III or IV Natural Stability Rating. Some characteristics evident - careful road location and sale design will allow some timber harvest - involve Soil Scientist.

- Low Risk – Class I, II, and III Natural Stability Rating. Few if any characteristics present - planned timber harvest design to fit the ground situation can take place. Other interpretations need to be considered.

Four units (Units 19, 22, 24 and 30) had areas with soil types which were mapped in the SRI as Very High Potential Risk of Mass Movement. About half the Wildcat Units had areas with soil types which were mapped as moderate or high potential risk of mass movement (Table 6).

Table 6. Mass movement potential and risk ratings

Soil Map Unit (SMU)[3]	Wildcat Units involved	Acres in Activity Areas	Natural Stability	Potential Risk of Mass Movement
3	13	< 0.1	Very Stable	Low
9	30, 31, 32	2.5	Moderately Stable	Moderate
11	30, 31, 32, 33, 34	993.1	Very Stable	Low
1231	1, 2, 32	23.8	Very Stable to Moderately Stable	Low
29	4, 5	28.3	Very Stable	Low
31	3, 6, 10, 12, 14, 15, 16, 22, 27, 29, 30	151.5	Stable to Moderately [less] Stable	Low
34	5, 6, 7, 10, 11, 13, 14, 15, 16, 19, 22, 23, 24, 25, 26, 27, 29, 30	550.3	Stable	Low
35	12, 13, 18, 27, 30	244.3	Moderately Stable	Low to Moderate
36	19, 21	129.2	Stable	Low
37	19, 21, 33	77.5	Stable	Low
54	30	38.9	Unstable to Very Unstable	**Very High**
57	1, 16, 17, 27	74.1	Moderately Stable to Unstable	Moderate to **High**
3157	4, 5, 8, 23, 24, 25, 26, 27	227.2	Stable to Unstable	Moderate to **High**
5654	19, 22, 24	35.8	Unstable to Very Unstable	**Very High**
5754	4, 5, 8, 9, 12, 13, 14, 18	198.9	Moderately Stable to Very Unstable	Moderate to **High**

[3] Underlined SMU denotes the unstable soils set aside as riparian reserves.

Very High Risk Units

Wildcat Units 19 and 22 have a minimal amount of area with a soil mapping unit considered as Very High Potential Risk of mass movement. These areas within these units will not be thinned. Thinning in Wildcat Units 24 and 30 have been limited to exclude the soils with a "Very High" potential risk of mass movement and coincided with either the site potential tree height width no cut stream buffer or upland no cut buffer.

Moderate to High Risk Units

Wildcat Units 1, 4, 5, 8, 9, 12, 13, 14, 16, 17, 18, 23, 24, 25, 26, and 27 contain soils mapped as potentially unstable riparian reserves. No actively moving landslides in the activity areas were found in these units that were field verified (Units 1, 4, 5, 8, 9, 13, 18, 23, 24, 25, 26, and 27) by the soil scientist. Within the activity areas units, slopes appeared generally stable; not actively moving or likely to begin moving. Professional opinion of the Forest Service Soil Scientist is the that thinning will not cause mass movement in the activity areas.

For the units containing soils mapped as potentially unstable riparian reserves that were not field verified, Wildcat Units 12, 14, 16, and 17, a more conservative approach was assumed. These units project design features include precluding new temporary road construction and requiring thinning spacing that would result in retainment of 50% canopy cover..

Exceptions existed as discussed in the following section *Unstable Slopes*.

Soil mapping of SMU 35 occurs in Unit 18. The area designated as SMU 35 in Unit 18 is potentially unstable and would be excluded from any management activity by a "no-cut" buffer beginning at the slope break at around 45 percent (south of the road), going all the way to the stream to the south. No management activity is proposed on the steep slopes of the west side of the unit above the road. Wildcat Units 30, 31 and 32 are bordered by SMU 9, which is in the steep canyon walls of Pine Creek and another stream that cut into the Mount St. Helens lahar terrace. No management activity is proposed on SMU 9.

Unstable Slopes

The Gifford Pinchot National Forest geohaz GIS layer identifies active and past-active landslides within the Project Area in Units 13, 18, 27, 30, and the banks of the rivers between Units 30, 31 and 32. Field investigations found actively moving landslides in these units except in Unit 33. The action alternative (with incorporated design features) excludes all management on landslides delineated by the Forest "geohaz" layer (USDA 1999). These areas are designated as either "no cut" upland areas or one site potential tree height no cut buffers with two excpetions. Unit 33 does not have any signs of instability in or near the activity area and so is considered very low risk of landslides where thinning is recommended.

Another exception is the "headwall enhancement" treatment of Unit 13 as described in optional restoration activities. This treatment would cut and leave trees to attain larger trees in the stream adjacent riparian areas that have a high likelihood of delivering large wood to fish bearing streams at some point in the future.

Summary of Existing Condition
Past ground-based timber harvest have altered soil properties and potentially decreased soil productivity in the planning area. Damage to soil physical properties on skid trails and landings has recovered over time, but soil quality was reduced where ground-based skidding operations displaced organic surface layers or caused deep compaction. Detrimental conditions are limited to less than 20% (Forest Plan Standards and Guidelines for soils) in all of the activity areas except Wildcat Unit 2, which has 22.4 percent detrimental conditions.

Environmental Effects

The extent and distribution of detrimental soil impacts such as compaction, displacement, and severe burning, measured in percent of each activity area, are used to analyze the effects of management activities on long-term soil productivity.The risk of significant change in the rate, size, or number of mass wasting events on unstable and potentially unstable soils is used to analyze the effects of management activities on slope stability.

The degree or intensity of soil productivity losses is variable depending on the nature of the impacting mechanism. Losses to soil productivity associated with permanent features of the transportation system, including system roads, are essentially permanent.

Alternative A – No Action
Direct and Indirect Effects
Soil Productivity
There would be no losses in soil productivity expected in this alternative. Existing National Forest system roads and landings would not be restored and remain as an irretrievable commitment.

Timber Harvest
The No-Action Alternative would involve less ground disturbance than the Action Alternative. There would be no change in soil productivity due to logging related compaction, puddling, displacement. Detrimental conditions would remain as listed in Table 7. Existing logging roads and landings would not be used or restored, and would likely remain in a detrimental condition for the foreseeable future as an irretrievable commitment.

Slope Stability
There would be no significant change in the rate, size, or number of mass wasting events due to the no-action alternative.

Alternative A—No Action
Cumulative Effects
There would be no cumulative effects caused by the no action alternative. The cumulative effects of foreseeable management activities would in general be similar to the proposed action alternative, collectively improve soil productivity in the long term, mostly due to reductions in soil compaction by road decommissioning or similar restoration activities, but creating short-term losses in soil quality. Future timber sales would typically subsoil all temporary roads and landings following their use.

Alternative B – Proposed Action
Direct and Indirect Effects
Soil Productivity
Direct effects due to soil disturbing activity occurs on site and affects only the area where the action occurs. Potential effects of the proposed activities on soil productivity are due to compaction, puddling, displacement, erosion, severe burning and loss of soil organic matter. Irretrievable losses in soil productivity due to soil disturbing activities are limited to permanent features of the transportation system including National Forest system roads, non-system roads, landings and skid trails that are not subsoiled because they are not part of the proposed action. Locally concentrated losses in soil quality would occur in the short term due to additional compaction and displacement caused by the proposed activities. The extent of soil disturbance (temporary road construction and landings) to areas previously undisturbed is expected to be less than 0.5 percent of any activity area with the prescribed logging system design.

Fuels Treatment—Burn Piles
Slash in some of the units would be piled by hand and burned. Detrimental soil damage due to hand piles is not a serious concern because the extent of burning in the activity areas would be relatively small and spread out across units.

Severe burning is not analyzed as an effect on soils on landings because of the overriding impact of the landing construction and associated use, especially since the large burn piles would occur on landings. Very little nutrients would remain that would be affected by burning because they are not available to volatilize. Therefore consideration or calculations of soil disturbance due to burning do not include piling or burning slash on roads or landings.

Timber Harvest--Soil Compaction and Displacement
No losses in soil productivity due to ground-based equipment travel is expected in any of the Wildcat units. The additional area of soil disturbance (compaction or displacement by temporary roads and landings) resulted in all units having less than 20% soil disturbance with the exception of Unit 2. Unit 2 did not have any additional areas of soil disturbance. The range was estimated without consideration of any of the project design features or mitigation measures. Existing landings and non-system roads that are not used would not be restored, and would likely remain in a detrimental condition for the foreseeable future as an irretrievable commitment. Temporary road and landings involved in the sale activities would be restored according to Project Design Features listed in Chapter 2.

Generally, the duration and intensity of impact from skid roads is less than temporary roads and landings, but the extent is greater. However, in any cases, it is difficult to make a clear distinction between them. Up to approximately 12 percent of the Unit 17 would involve varied forms of ground disturbance of soils in Alternative B. Measures such as subsoiling, revegetation and fertilization are intended to restore productivity, further reducing the extent of impacts. Skid roads would not create detrimental soil conditions greater than 20 percent of the activity areas, and are not expected to result in losses in soil productivity.

Table 7. Prediction of remaining detrimental conditions of proposed road and landing construction		
	No Action, Alternative A (%)	Action Alternative B (%)
Estimated Activity Area disturbance without mitigation measures[4] (detrimental impact)	Same as existing condition	0.2 to 22.4%
Percent Increase in Activity Area disturbance	Same as existing condition	0 to 0.5%

In general, the intensity of short term losses in soil quality would be relatively low in skid roads to moderate in temporary roads and landings (Table 8). The losses in soil quality would lessen with time. This would translate to similar effects on soil productivity; however the mitigation measures in Chapter 2 would ameliorate the soil compaction and allow a relatively rapid recovery.

Table 8. Magnitude, Duration and Intensity of Losses to Soil Quality		
Duration	Intensity of Soil Productivity Loss	Magnitude (Extent)
Short term, *Alternative A, No Action*	None	None
Short term, *Alternative B, Proposed Action*	Low: skid roads (w/ mitigation measures) Moderate: temporary roads and landings	Small to Moderate
Long term, (more than 50 years), *Alternative A, No Action*	None	None
Long term, (more than 50 years), *Alternative B*	Low on temporary roads and landings with mitigation measures (subsoiling)	Small

Logging on Steep Slopes
Alternative B proposes ground based equipment travel on soils mapped by the SRI which do not permit tractor logging according to the Forest Plan (Wade, et. al., 1992). Thus a project-specific Forest Plan Amendment is necessary to carry out this portion of the proposed action. Soils that are potentially affected by this activity are located in over half the units of the proposed action (Units 1, 3, 8, 9, 12, 13, 14, 15, 17, 18, 19, 21, 22, 23, 24, 25, 26, 27, and 29).

Identified design features would limit ground-based equipment logging to slopes less than 45 percent on steep slopes. Professional judgment and peer opinion suggest that the design feature

would be sufficient to protect the soils resource, as discussed in Chapter 2, Rationale for Project-Specific Amendment to the Forest Plan. Therefore, ground-based equipment would not create detrimental soil conditions that are any more damaging than those on the rest of the proposed action.

Long Term Effects - more than 50 years
Ground-based equipment will work on previously disturbed roads and landings, and restore those areas where new temporary roads and landings are constructed (see mitigation measures in Chapter 2). Therefore long term detrimental soil conditions would not be created.

Soil Organisms

Background
Logging and site preparation can affect the numbers of species and abundance of soil organisms. Soil dwelling organisms are not specifically addressed by standards and guidelines at Forest or Regional levels, but the magnitude, duration and intensity of effects to soil dwelling organisms are likely to be similar to that of soil quality.

Direct effects from soil compaction, lack of vegetation, or lack of plant litter covering the soil surface tends to reduce the number of soil arthropods (Soil Quality Institute 2002). The proposed activities may change soil habitats and the food web, and alter soil quality, or the capacity of soil to perform its functions (Tugel, A.J., 2001, Chapter 2).

Some of these organisms, called mycorrhizae, have been shown to profoundly affect forest growth and productivity. Mycorrhizal fungi assist trees in absorbing water, nutrients and provide protection from pathogen attack. Soil compaction, loss of soil organic matter, and changes in vegetation can effect soil organisms and result in productivity loss.

Aquatic/Soils Project Design Criteria and Mitigation Measures which protect soil productivity would also protect or benefit soil organisms and their habitat. Magnitude, duration and intensity of effects to soil dwelling organisms are likely to be similar to that of soil quality effects.

Limiting the degree and extent of the effects listed above provides protection for the majority of the populations of soil organisms within the activity areas. These effects are assumed to be temporary and recover naturally, after restoration efforts like subsoiling and seeding/planting.

Long Term Effects- more than 50 years
Populations of soil dwelling organisms would have essentially recovered in the long term. Restoration by subsoiling, fertilization and revegetation, which was intended to accelerate recovery of soil productivity, would improve conditions in disturbed areas. The organisms then can re-colonize the disturbed areas when conditions become favorable.

Slope Stability
The action alternative (with incorporated design features) is designed to exclude management from actively moving landlisdes. Field visits to potentially unstable soils and active or past active landslides within Wildcat Units also determined where thinning activities are precluded. Precluding management from these areas minimized changing the rate, size, or number of mass

wasting events from the activities in the proposed action. The inherent risk ratings are listed in Table 5 and range from low to high in certain parts of the Wildcat Units.

Thinning is not expected to contribute to any new failures in the activity areas with documented field visits. A design feature of the proposed action is to avoid all unstable slopes by designating actively moving landslides as "no-cut" areas. Professional opinion of the Forest Service Soil Scientist is the risk is low where field verified, and that thinning will not cause mass movement in the activity areas as proposed.

The period of greatest susceptibility to debris slides is between 3 and 10 years after cutting trees. If global warming results in a significant increase in high precipitation events, then potential risk could increase the size, number, or frequency of landslides.

Alternative B—Proposed Action
Cumulative Effects

Cumulative effects on the soil resource include all past, present, and reasonably foreseeable actions that cause soil disturbance within the project area (Table). The proposed activities (with incorporated design features), in combination with past or reasonably foreseeable future actions on nearby federal land and adjacent private land, would not likely increase the amount of detrimental soil conditions in the long term. The contribution of soil disturbing impacts by the proposed action would not cumulatively degrade soil productivity or the soil resource with proper implementation of design features and mitigation measures. Because roads or other permanent features will not remain as part of this project, the amount of detrimental soil conditions would not increase across the watershed. Restoration by subsoiling, fertilization, and revegetation would initiate recovery of productivity, but is unlikely to return the soil to its original condition and productivity.

In the long term, the action alternative combined with all past, present, and reasonably foreseeable management activities would not cumulatively affect localized populations of soil dwelling organisms in the activity areas because populations of soil dwelling organisms would have recovered in the long term.

The proposed activities (with incorporated design features), in combination with past or reasonably foreseeable future actions on nearby federal land and adjacent private land, are not likely to increase the frequency or magnitude of mass wasting events. Project design features of the action alternatives avoided unstable slopes. Soils on slopes where tree root masses die and rot away, are expected to recover their strength within the decade (Wade, et. al. 1992b).

The combined effects of foreseeable management activities would collectively improve soil productivity in the long term, mostly due to reductions in soil compaction by road decommissioning or similar restoration activities. However, the total effect is not greater than the sum of the individual effects. Timber sales typically subsoil all temporary roads and landings following their use. These and other foreseeable activities would neither increase nor significantly decrease soil productivity or populations of soil dwelling organisms.

Carbon losses through disturbance of forest soils could result in more carbon dioxide entering the atmosphere (a positive feedback that increases climate change) (USEPA 2007). Disturbances that

can increase carbon losses include soil warming that volatilizes organic carbon and burning of soil organic matter.

It is currently not possible to discern significant climate change effects of the proposed action, given the lack of effects that can be meaningfully evaluated under current science, and modeling. Degraded soils could in theory absorb more carbon and store it as organic carbon, if they were managed correctly, and remove carbon dioxide from the atmosphere.

A potential result of climate change is an increase in extreme precipitation events. In the event of extreme precipitation event, an increase in soil moisture during these events, could increase the size, number, or frequency of landslides. A speculation of effects on soil productivity as a result of global warming due to increased heavy precipitation events could include an increase in soil erosion during periods when soils are exposed and an increase in soil mass wasting events. There may also be an increase in plant growth as soil temperatures are warmer for longer seasons, thus increasing biological and soil-forming activity at these high altitude sites.

Rationale for Project-Specific Amendment to the Forest Plan

Ground-based equipment is proposed for certain logging operations on steeper slopes that are rated in the Soil Resource Inventory as not permitting tractor logging. This document proposes to amend the Gifford Pinchot National Forest Land and Resource Management Plan (USDA 1990) to allow these operations on slopes up to 45 percent, as described in the Wildcat Timber Sale Aquatic and Soils Project Design Features and Mitigation Measures.

When the Soil Management Guidelines were developed, the feller-buncher did not exist. The guideline restricts the use of tractor equipment, but the effects of the tractor equipment at the time the guidelines were expected to have a greater impact on soil resources. There is a current need for increased economic viability in timber sales and one way to do that is reduce the amount of time it takes to gather and load logs. Many believe that a feller-buncher can create this efficiency while still maintaining the soil resource on steep slopes.

The use of a feller-buncher is still relatively new and monitoring data is limited and non-conclusive. However, it is expected that with specific design criteria and mitigation measures in place, the proposed action in these activity areas is not likely to have a greater impact on soil quality relative to other parts of the proposed action. This assumes that proper implementation of Project Design Criteria and Mitigation Measures. Results would be monitored and adjustments made as necessary.

Observations from a field visit to a helicopter logging unit done by pre-bunching with feller/buncher equipment indicated that it was hard to distinguish impacts (Figure 4, Figure 5) and detrimental soil conditions resulted from only a haulback road and ephemeral stream crossing (Hagerty 2008). Project Design Criteria for the Wildcat Units have designated go-back trails at approved locations and no equipment crossings of streams so these two illustrated circumstances would be avoided in the proposed action of Wildcat Timber Sale.

Figure 4. Soil effects from pre-bunching on 30-45 percent slopes with ground based equipment on Gifford Pinchot National Forest.

Figure 5. More soil effects from pre-bunching on 30-45 percent slopes on Gifford Pinchot National Forest

Effects to soils from ground-based winter logging on steep slopes were monitored on the Umatilla National Forest on January 9, 2009 (Busskohl 2009). Conditions in soils comparable to the Wildcat Timber Sale were described below.

> "…steep(er) ground with feller-buncher and cut-to-length (ctl) equipment. The feller-buncher actually was allowed into a couple units that were otherwise designated for harvester/forwarder (ctl) as it was too steep for that system to operate safely and w/o undue sidling. So ended up with some bunching and yarding with a skidder.
>
> "Conditions … were ideal for operations and they shut down at noon, which is a common thing in winter operations over here. Ground was frozen and/or had decent (18'+) snow, so good results on soils. It was apparent there was some conditions a few days earlier … too wet in places and got some rutting and side-hill displacement, though still very limited in extent.

Results were shown in Figures 6, Figure 7 and Figure 8, and described as

> "... acceptable/good results on steep ground with moderately deep ash over residual basalt soils, with mostly snow-covered and/or frozen conditions, but shallow frost in places and occasional break thru to unfrozen soil...."

Figure 6. Soil effects of winter logging, skidder trail looking downhill.

Figure 7. Soil effects of winter logging, appears to lack sufficient slash bedding; skidder trail looking uphill.

Figure 8. Soil effects of winter logging, skidder trail traffic across the slope.

Some conclusions and observations drawn from the effectiveness monitoring, and experience of the Umatilla Forest Soils Scientist, were

> "Key, as always it seems, is conditions and the operator. As it gets steeper, becomes more necessary for machinery to go straight up and down the hill to avoid side ops. and risk of rolling, and undue track/wheel sliding and displacement."
> "Amount of down wood and generated slash to work on and leave for erosion control are key factors."
> "[Soils that are] saturated, or real dry… tend to compound potential disturbance."

The 'down wood and slash' observation that the key is both condition and operator is demonstrated as shown in **Error! Reference source not found.**. The statement regarding operator proficiency, steepness, and 'up and down the hill' versus 'side ops' seems to be supported by **Error! Reference source not found.**.

Hydrology

Existing Condition

Current conditions in the Muddy River and Swift Reservoir watersheds reflect a history of natural and human induced disturbances, similar to other forested watersheds in the western Cascades. Historically, vegetative conditions across watersheds were at varied successional stages from disturbance processes such as wildfire, floods, drought, and insect or disease outbreaks. Wildfire was probably the most common and pervasive disturbance factor affecting forest conditions at the watershed scale. Stand replacement fires in this area occurred at scales of tens-to-thousands of acres, and at frequencies of tens-to-hundreds of years. Some areas of the watershed burned multiple times in the past century. Floods were probably the most frequent disturbance process in riparian areas in terms of inundating off-channel areas, redistributing sediments, recruiting large wood, and maintaining channel form.

Since the early and mid 1900s, timber harvest and associated activities became another dominant process affecting vegetative conditions and hydrologic function in watersheds. The practice of regeneration harvest by patch clearcutting created a mosaic of forest canopy openings and seral classes across the varied landscape. In general, gentler sloping portions of watersheds were more intensively logged than the steeper portions and areas of watersheds closer to population centers were logged earlier than more remote areas with challenging access. Stream channels were directly and indirectly disturbed by road construction associated with timber harvest along with demand for forest recreation experiences. In the late 1970's, channel cleanout became another significant activity affecting streams.

The1980 eruption of Mt. St. Helens changed the watersheds in this project area. Lahars (mudflows) moved down Smith Creek, Pine Creek and the Muddy River. The tephra deposits in these rivers filled canyons and were highly susceptible to surface erosion, shallow mantle failures and debris torrents in the steep channel sideslopes and drainages. Clear Creek was not directly and less significantly affected by the 1980 eruption.

Flow Regime

Changes to hydrologic maturity of stands and potential effects to peak flows
The potential for altering the timing and magnitude of peak flow is increased as an increasing proportion of the watershed is harvested and put into a young forest condition or open condition. Studies have shown that in forest openings, or areas that have had forest cover removed, snow accumulation is increased due to the loss of canopy interception. Furthermore, rates of snowmelt can be higher in openings, particularly during rain-on-snow conditions, because of the turbulent transfer of latent heat from warm, moist air masses to the snowpack. With higher levels of snow accumulation and increased rates of snowmelt, these openings generate more runoff during rain-on-snow events, which can contribute to increased peak stream flows.

Hydrologically mature forest is generally characterized as stands with an average diameter at breast height of 8 inches or greater and 70% or greater canopy closure. The proportion of acres

considered hydrologically mature were assessed to be causing less than 10% increase in water available runoff in drainages encompassing the project area (1-5, 18, and 32-34) of the Muddy River and Clear Creek Subwatersheds (Muddy River WA, 1997). Previously harvested stands within these drainages have further matured hydrologically since 1997. Current condition of the project area within the drainages of the Muddy River and Clear Creek Subwatersheds is considered to be *properly functioning* in terms of peak flows from changes to fully forested conditions.

The proportion of acres considered to be hydrologically mature were assessed to be causing greater than 10% increase in water available runoff in drainages encompassing the project area (6 and 7) of Pine Creek Subwatershed (Lower Lewis River WA, 1996). Previously harvested stands within these drainages have further matured hydrologically since 1996 and correspondingly, the increase in runoff has diminished on Forest lands.

Analysis of a different and more current vegetation data indicated two drainages (08D and 08E) encompassing the project area have 20 and 30 % of area with hydrologically immature stands as defined by conifer stands with mean diameter of 8" or less. This different data set was analyzed as it encompassed the entire Pine Creek Subwatershed where significant proportion of the area is privately owned and associated vegetation data was previously unavailable. The amount of hydrologically immature stands in these drainages is considered to be causing additional runoff, particularly in the lower privately owned areas. Current conditions of the drainages encompassing the project area in Pine Creek are considered to be *functioning at risk* in terms of peak flows from changes to fully forested conditions. Similarly, the drainage, downstream of the project area in Pine Creek, is mostly privately owned with stands of various ages but predominately young stands and presumed to be *functioning at risk* in terms of peak flows from changes to fully forested conditions. The entire Pine Creek subwatershed is considered at a moderate risk to increased peak flows.

Hydrologic maturity in thinned stands is considered affected when canopy closure decreased below 40%, a breakpoint at which stand conditions are considered more reflective of open conditions rather than mature forest conditions. This reference point was established from the collective professional judgment of hydrologists on the Gifford Pinchot National Forest for the purpose of evaluating proposed thinning projects in absence of research findings. Snow accumulations on the ground are expected to increase as a result of decreased interception in the forest canopy in stands thinned to less than 40% canopy closure. The processes causing this change is that snowmelt may be more rapid as snowpacks have greater exposure to wind and other elements that cause snowmelt, and the removal of some portion of the stand would tend to cause increased soil moisture levels as a result of lower evapotranspiration. These conditions would occur in a thinned stand until the canopy closure redeveloped. It is recognized that actual changes in snow accumulation and snowmelt do not occur at a point, but occur as a continuum of incremental changes in a number of process components.

Areas that are thinned to a canopy closure of less than 40 percent are considered hydrologically immature and therefore would contribute to increased runoff at the stand scale, and may contribute to increased peak flows at various drainage scales. The degree to which these stand scale changes are manifested as changes in stream flow at various drainage scales is dependent

upon a number of factors related to both the extent and intensity of changes to forested conditions, and characteristics of the drainage and subwatershed. Grant et al, 2008 found peak flow increases from changes to hydrologic maturity diminishes as drainage size increases, and detection of peak flow increases was limited to peak flows of moderate frequency and magnitude with a return period of six years or less.

Flow Regime

Changes to stream channel network from road ditches and effects to peak flow

Peak flows can also be increased by roads as roads can increase the total volume of water available for rapid transport to stream channels in two ways. Roads intercept precipitation, which results in overland flow over compacted surfaces – reducing infiltration rates. Secondly, shallow subsurface flow may be intercepted at road cut-banks and converted to rapid surface runoff. This process effectively increases drainage density in a watershed, which can result in increased peak flows (Wemple et al., 1996; WFPB 1997).

Stream channel network extension was estimated based on a modification of methods described by Wemple et al. (1996). Drainage density is widely accepted as an index of drainage efficiency, and is defined as the sum of stream length ($\mathbf{L}_S$) over the drainage area (A):

$$D_d = (\sum \mathbf{L}_S) \div A$$

Wemple et al. proposed that roads modify drainage density by extending the total length of effective surface flow, or stream channel network. This stream channel network extension can be estimated by adding the length of road segments discharging runoff directly to stream channels, and by adding the length of newly eroded gullies located on hillslopes where channels did not previously exist. Gully information was not available for this analysis, so a modified formula is used to represent the stream channel network extension in a drainage, where $\mathbf{L}_{RC}$ represents the length of road segments discharging runoff directly to stream channels:

$$D'_d = [\sum (\mathbf{L}_S + \mathbf{L}_{RC})] \div A$$

Road drainage ditches and road surfaces capture surface runoff and surface flows. The ditch flow allows water to reach streams faster thereby increasing peak flows. Additionally, ditch flows capture and transport fine grained sediments to streams. For this project area, channel network increase of 10-25% is considered moderate risk indicating a moderate likelihood that streamflow is increased as a result of existing roads, particularly during high flows.

Channel network increase in drainages encompassing the project area (1-5, 18 and 32-34) of the Muddy River, Clearwater Creek and Clear Creek Subwatersheds were assessed at less than 25% with the exception of 1, 2, 4 and 18 (Muddy River WA, 1997). The amount of road that contributes to the channel network was estimated as 500 feet both sides of a stream crossing, the length of road between the road-stream crossings and the next adjacent ditch relief culvert. The GIS information used to estimate stream crossings. Stream length extension has not been comprehensively field verified and distance between culverts likely varies across the project area so differences may exist between modeled results and conditions on the ground. The results provide an estimated range of road-related channel network increase and used the best available information. Road decommissions had occurred within drainages 2 and 4 on Forest Service lands since 1997 and the channel network density for these drainages were recalculated at 25% or less increase in channel network extension (Table 9).

Table 9. Estimated channel network increases within drainages of the Muddy River and Pine Creek.

Muddy River Watershed Analysis Drainages	Area (mi^2)	Channel network length, miles		Channel density, mi/mi^2		Percent increase
		Streams (L_S)	Road-related extension (L_{RC})	Streams (D_d)	Total (D'_d)	
1	4.3	12.4	16.6	2.9	3.8	34
2	4.4	31.6	39.8	7.1	8.9	25
4	3.0	18.9	22.9	6.4	7.6	20
18	4.4	21.2	26.7	4.8	6.1	26
Lower Lewis River Watershed Analysis Drainages						
5	9.1	47.1	53.4	5.2	5.9	13
6	9.4	52.7	71.1	5.6	7.6	35

Current conditions of the project area within all drainages in Muddy River Watershed are considered to be *functioning at risk* in terms of peak flows from increases to channel network with the exception of Drainage 1 which was reported as 34% increase in the extension of the stream channel network by roads and ditch lines in the Muddy River Watershed Analysis. Drainage 1 is considerd to be *functioning at unacceptable risk* in terms of stream drainage network extension. This drainage is located at the very base of the Muddy River Watershed and has 8% Non-Forest lands (234 acres) in which roads have recently been constructed.

The channel network density increase in drainages encompassing the project area (5 and 6) of Pine Creek Subwatershed were modelled as 13% and 35% increase in channel network density in the Lower Lewis River Watershed Analysis. The channel network increase from roads was not recalculated due to the lack of updated road data. Drainage 6 has significant areas of privately owned lands (62%). The increased channel network in Drainage 5 encompassing the project area of Pine Creek Subwatershed is considered *functioning at risk*. The increased channel network density in Drainage 6 encompassing the project area of Pine Creek Subwatershed is considered *functioning at unacceptable risk*. The existing road network alters the pathways and movement of water through these two drainages. The lowest drainage in Pine Creek Subwatershed is also heavily roaded and thus influences runoff and streamflow characteristics. Therefore, the entire Pine Creek Subwatershed is considered at moderate risk for increased peak flows from increases in stream channel network density.

The sensitivity of subwatershed changes in peak flow magnitude and timing is based on the hydrologic maturity of stands and increase stream channel network but also is a function of the unique characteristics of the drainage area being considered. Each drainage is unique in terms of

how it processes precipitation inputs and water runoff. Conditions inherent in the watershed such as geology, soils, and topography can strongly influence how incoming precipitation is processed before it leaves the watershed as streamflow or is returned to the atmosphere. The general shape of the watershed can influence the temporal sequencing of runoff responses occurring from different parts of a watershed. Soil depths, geology and slope can influence storage time and capacity and can affect the rates at which precipitation is routed through the stream network.

Individual tributaries and mainstems within a watershed respond differently to increased peak flows based on inherent conditions. Major tributaries in each of drainages 1, 2 and 4 in the Muddy River Subwatershed lacked evidence of increased peak flows such as excessive stream bank instability in high gradient reaches or incision in low gradient reaches suggesting the risk of increased peak flows from channel network increase was attenuated at the base of the drainage areas (Stream Survey Reports). The instream response to increased peak flows in Pine Creek is not discernable from the overwhelming and continuing affect of the mudflows that occurred within Pine Creek during the 1980 volcanic eruption.

Translation of these changes at the drainage scale to changes in peak flow at the subwatershed scale is further dependent on flow paths and water routing through the drainages which would tend to accentuate or attenuate differences in runoff found at the drainage scale. The subwatersheds encompassing this project have different capacities to route flow. The Muddy River and Clearwater Creek appear to have capacity for retention of water in surface and subsurface flows so actual changes to discharges from stream network extension are expected to be very small. Pine Creek appears to have large capacity for subsurface flow but has a relatively streamlined surface drainage structure. Clear Creek Subwatershed appears to have the least capacity to moderate peak flow within the subwatershed but rather flows rise and fall quickly in response to precipitation.

Sediment Regime

Erosion and sediment delivery from road related activities and use

The largest contributor of sediment to the aquatic system in the Muddy River and Pine Creek Subwatersheds is the tephra deposits from the 1980 eruption. These deposits are continually being eroded off the hillslopes and into stream channels which transport the material mostly during peak flow events. The Clearwater Creek Subwatershed was affected by the 1980 eruption by the hot gases which burned trees in large contiguous areas. These areas were harvested and replanted, and are currently in about 20-25 year old stand conditions. This subwatershed had numerous landslides on the steep valley slopes during the 1996 flood which deposited in the mainstem of Clearwater Creek. Roads within the landslide paths were either obliterated by the landslide during the event or subsequently decommissioned to remove the unuseable portions of roads that persisted on the landscape.

Road related sediment delivery to the mainstem Muddy River and Pine Creek occurs but is small in comparison to the sediment load being carried from the tephra deposit of the 1980 eruption and associated lahars (Figure 9). The response reaches of the Muddy River change dramatically following flood events. One response type reach widened 76% after the 1980 eruption (Muddy River WA). Response reaches along the eastern branch of Pine Creek below the project area are

actively changing as water flows through the highly erodible lahar deposits. Clear Creek Subwatershed was minimally affected by the 1980 eruption and so Clear Creek transports significantly less tephra material during peak flow events (Figure 10).

Roads can impede surface water infiltration, intercept subsurface flows, and provide a direct surface linkage for delivering water to stream channels. By changing hydrologic flow paths, roads can contribute to changes in the hydrologic performance and be significant sources of fine sediment in streams draining densely roaded areas.

Within the Pacific Northwest, road densities of 2.0 miles/square mile or higher is of concern due to the effects on threatened and endangered fish species. For subwatersheds with Bull Trout populations, a target of 1 mile/square mile is a goal for watershed restoration. Subwatersheds with road densities above these thresholds are typically targeted for restoration efforts to reduce road lengths and densities through road decommission projects. The Clear Creek Roads Environmental Analysis has planned to decommission 14.2 miles of system roads within the Muddy River (3.8 miles) and Clear Creek (10.4 miles) Subwatersheds.

The road density for the four subwatersheds were calculated for only the Forest Service managed lands and do not accurately portray the true road density Pine Creek or Muddy River subwatersheds due to the absence of accurate road data on private lands (Table 10). Pine Creek Subwatershed has significant acres of private lands while the Muddy River Subwatershed has small areas of private lands.

Table 10. Road Density of Subwatersheds in the Wildcat Thin Project Area.

Subwatershed	Subwatershed area (Square Miles)	Road Lengths (Miles)	Roads/Subwatershed (Miles/Square Miles)
Clear Creek	19.3	32.3	1.7
Muddy River	24.4	42.0	1.7
Pine Creek	23.7	50.0	2.1
Clearwater Creek	39.6	73.1	1.9

Road density and location were considered as *functioning at risk* for these four subwatersheds as they are potentially accessible to Bull Trout. Muddy River, Clearwater and Clear Creek subwatersheds are *properly functioning* in terms of road density for salmon and steelhead. Road density is a simple indice of the risk of changes to aquatic ecosystems. These changes are more accurately described by using other indices i.e. road related extension to stream networks and sediment delivery from various activities.

Figure 9. Muddy River about River Mile 10 cutting through tephra deposit (2005).

Figure 10. Clear Creek about River Mile 1.0 (2005).

In the absence of volcanic eruptions, road networks are the most important source of accelerated delivery of sediment to anadromous fish habitats in forested watersheds of the Pacific Northwest (Ice 1985; Swanson et al. 1987). Principal mechanisms for sediment delivery to streams from roads in the project are culvert failures, fillslope failures, surface erosion, road runoff carrying sediment laden water and direct erosion of cut and fill slopes. Unlike the composition of landslide sediments, course angular rock (2-6") and finer materials including sand and silts are believed to dominate the largest fraction of sediments delivered via roads to stream channels. Most fines are transported from roads to streams during storms that mobilize fine sediments from the road surface. Road drainage is typically delivered to streams through roadside ditches and culvert outlets. Not all sediment production from roadways reaches the aquatic system because surface runoff from road surfaces and ditches is often directed to unchanneled slopes below the road where runoff has the potential to infiltrate the ground surface or to be filtered by forest vegetation before entering streams.

Two factors affecting rates of sediment production from surface erosion on roads are road traffic levels and precipitation. Studies done on the Olympic Peninsula and in southwest Washington found that sediment production was increased by two orders of magnitude when comparing lightly trafficked and heavily trafficked forest roads during periods of runoff (Reid and Dunne 1984, Sullivan et al 1989). These studies also found that when traffic levels remained heavy during a runoff event, sediment concentrations in road drainage waters remained at a relatively high level throughout the storm.

In general, roads lacking surface rock, those with steep grades and steep sideslopes, and those that cross streams or are in proximity to streams are the greatest contributors of sediment from surface erosion. Many of the roads surface material in the Wildcat Thin Project Area have had minimal maintenance due to lack of access need for timber haul. Consequently, surface materials are broken down and thinner than originally constructed. Most roads are directly linked to the channel network because of the naturally high stream density (function of high annual precipitation) and the connection through roadside ditch drainage.

Disturbance from road surface blading, ditch cleaning, maintenance, reconstruction and timber hauling will produce sediment available for delivery to streams. Road work will be conducted during the dry months and some sediment introduction is expected during the summer months from the dust created by these activities and by subsequent vehicle traffic on the newly treated roads. Most of the sediment delivery from these actions would occur later in the fall when precipitation and runoff levels increase and transport the disturbed sediment. Substantial flushing of sediments from road surfaces and roadside ditches into tributaries and surface channels that are connected to the stream would occur during the first significant runoff event of the fall. Based on research conducted elsewhere in the state of Washington, turbidity and suspended sediment levels would climb rapidly as ditchflow carrying sediment laden water begins to occur during the first fall freshet, but would then rapidly decline as roads and ditches are essentially cleaned by the precipitation and runoff (Reid 1981, Reid and Dunne 1984, Bilby 1985). Subsequent periods of traffic on the roads would cause turbidity levels to climb again, or to be sustained at higher levels.

Simple sediment production models estimate the rates of surface erosion from road use of system and temporary roads in the Wildcat Thin Project Area (Standard Methodology for Conducting WA, 1995). More accurate estimates of sediment production and delivery would require extensive information on road surfacing, drainage frequency and distance between road drains and streams. Assumptions used in the Surface Erosion from Roads Model are 1) roads have basaltic parent material, 2) existing cut and fillslopes are over 80% vegetated, 3) annual precipitation was 47 inches or more, and 4) no seasonal restrictions to log haul with the exception of FR2588 and associated local roads. Traffic levels varied as described in the model and considering extent of use from No Traffic, Light Traffic to Moderate Traffic. Mitigations of sediment delivery such as project design criteria and road decommissions are also modeled to estimate the reduction of sediment production from these activities.

Suspended sediment concentrations in ditchflow have been measured at 500 to 7,000 mg/l and as high as 20,000 mg/l during active hauling in a study completed in the western Cascades of Washington State (Bilby 1985). Once ditchflow begins to occur, suspended sediment concentrations in receiving streams can increase by over an order of magnitude as a result of the introduction of turbid ditch flow to the stream. The finer grained material can be held in suspension within the stream and transported relatively long distances in the steep channels within the analysis area and into fish bearing reaches of the main streams. As this material travels downstream, the concentrations are likely to decline at some unknown rate due to significant dilution from other contributing streams that are not impacted by the road runoff.

Turbidity and suspended sediment levels are likely to be lower due to the greater opportunity for significant dilution in the valley bottom streams of Clear Creek where the majority of fish habitat exists in Clear Creek Subwatershed. The road related sediment contribution to Pine Creek, Clearwater Creek and Muddy River would not be discernible within the much larger sediment load being worked through these systems from results of the 1980 volcanic eruption and associated effects.

Erosion and sediment delivery from harvest activities

Within the project area, past harvest practices within stream adjacent areas have resulted in a few places where persistent erosion continues although revegetation has rehabilitated most of the past disturbance areas. Thinning activities within riparian reserves of the proposed units could potentially deliver sediment to streams from felling and yarding. Implementation of recommended project design features will minimize surface disruption and prevent most of the disturbed areas within the unit from excessive erosion and sediment delivery to streams.

Water Quality and Water Temperature

Changes to water quality from harvest activities

Water quality other than temperature is generally good in all three subwatersheds encompassing the project area due to the lack of contaminant sources and the lack of anthropogenic disruption to processes that would affect water quality parameters other than temperature.

Water temperatures during summer months represent the critical water quality parameter. Pine Creek maximum summer temperatures decreased slightly between 2003 and 2006 as measured at one location at the base of the subwatershed although remaining above the 2006 Washington

State Department of Ecology temperature standard (7-Day Max average of 13 degrees Celsius) for Bull Trout habitat (Figure 4). The Muddy River, Clearwater Creek and Clear Creek water temperatures are warmer than the Washington State Department of Ecology temperature standard (7-Day Max average 16 degrees Celsius) for anadromous fish habitat. The Regional Ecosystems Assessment Process Report estimated that historic maximum stream temperatures for the entire Lewis River watershed ranged between 14 and 19 degrees Celsius (USDA, 1993).

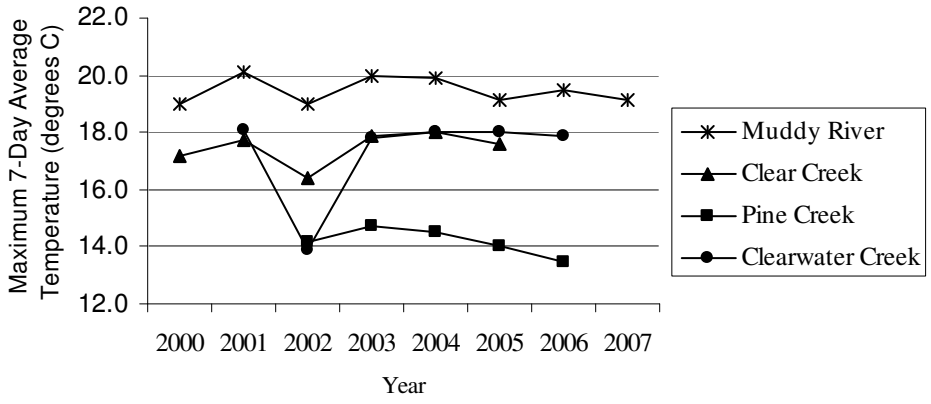


Figure 11. Water temperature (7 DAD Max) on the mainstems of the four subwatersheds within the Project Area.

The warmer waters in the Muddy River and Clearwater Creek are attributed to the watershed wide recovery from the 1980 volcanic eruption (Muddy River WA). The source of heat to Clear Creek has been under investigation in the last few years. Stream temperatures remain below the standards in the two main branches forming Clear Creek in the upper subwatershed (above the project area). Clear Creek then flows through a canyon in a roadless area with contiguous mature forest and emerges from the canyon with warmed waters. Stream temperature data from 1997 indicated that the creek warmed above the standard midway through a roadless canyon reach in July. An analysis of effective shade did not show any extensive reaches where stream warming occurs that were not attributed to its north-south orientation allowing solar heating. The streams flow in contact with bedrock which absorbs heat during the day and transfers it back into the water during the night may be another source of heat to the mainstem Clear Creek but the relative contribution of that warming is not considered a major source. Effective shade to tributaries were predominately modeled as greater than 65%, a level at which no affect to stream temperatures occur.

One tributary to the Muddy River was monitored during 2005 and had a seven day maximum average (7 DAD Max) of 16.8^{o}C. The source of the heating in this tributary primarily occurs in the lowest reach where the tributary flows through the Muddy River floodplain prior to joining the Muddy River. This floodplain area lacks mature conifers that would provide shade to the tributary and the Muddy River.

Environmental Effects

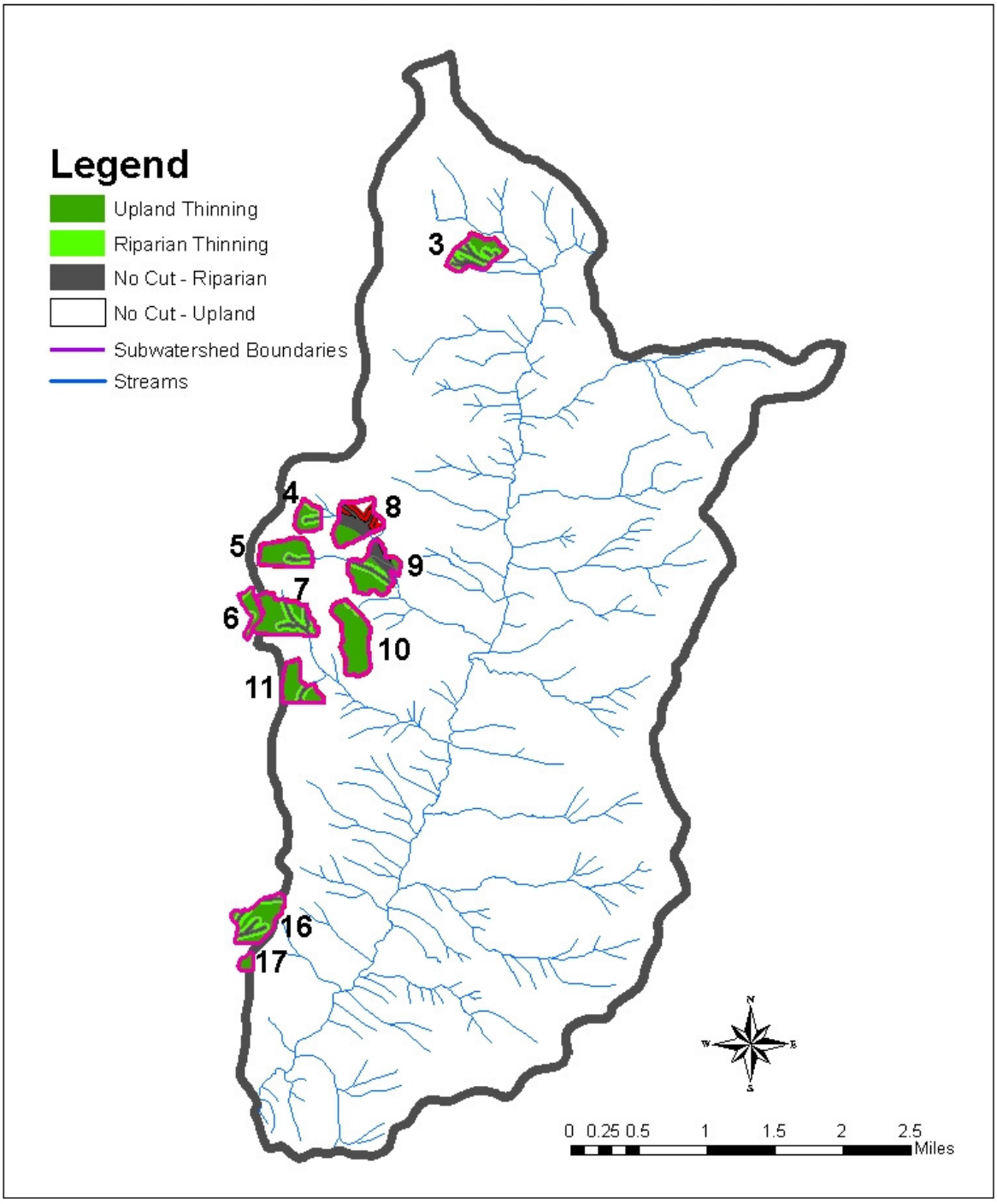
Flows Regime
Alternative A—No Action
Direct, Indirect and Cumulative Effects
Peak flows from changes to hydrologic maturity of stands
In the No Action Alternative, conditions of hydrologic maturity in stands on Forest lands would improve from tree growth at the same continuing rate. The hydrologic maturity of forested stands on lands managed by the Gifford Pinchot NF will continue to improve.

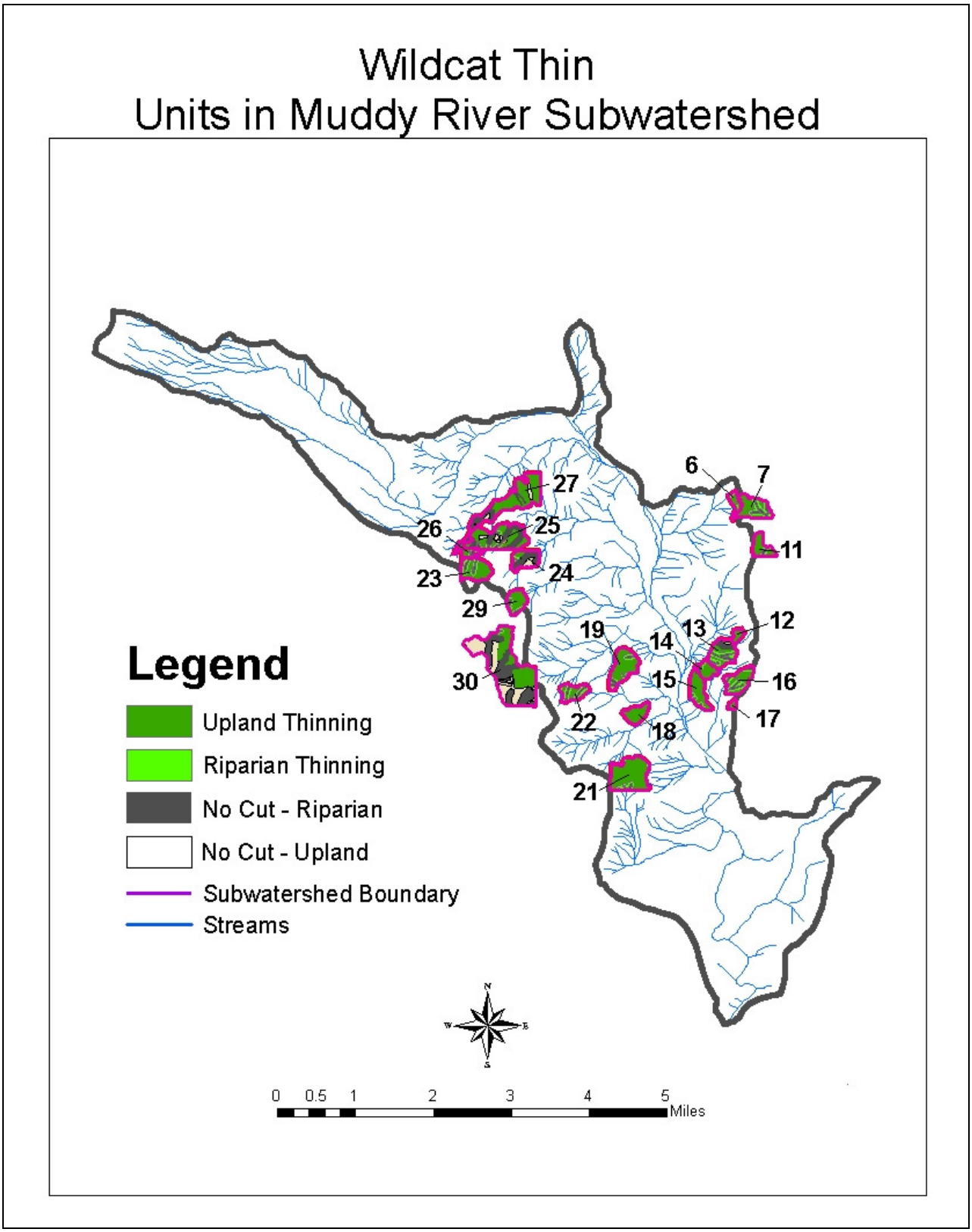
Flows Regime
Alternative B—Proposed Action
Direct and Indirect Effects
Peak flows from changes to hydrologic maturity of stands
Under the proposed action alternative, 31 stands would be modified by the thinning. Twenty nine of these thin units are within the Clear Creek, Muddy River and Pine Creeks Subwatersheds and comprise about 3-7 percent of the subwatershed areas (Figure 12). Two stands within the Clearwater Creek Subwatershed include less than 1 % of the subwatershed area. Most of the stands currently have a mean diameter of greater than 8" and canopy closure greater than 60% and are considered hydrologically mature. Thinning prescriptions for most of the units would result in forests with canopy closures of 40% or greater. Therefore, the hydrologic maturity of stands and runoff will not be affected from thinning most of the stands.

Three types of exceptions to this exist in the action alternative. One small unit (7 acres), Unit 17, has a mean diameter of trees at 8" and is currently considered hydrologically immature. The thinning will result in 50% canopy cover and will accelerate growth, so the stand will reach hydrologic recovery sooner than with the No action alternative. The second exception is the western edge of Unit 21 (11 acres) where windthrow occurred. This unit edge is considered hydrologically immature with only 35% crown closure and will be salvaged and restocked so that a healthy forested stand can develop.

The last exception is for Units 24-26 where thinning to a wider spacing is prescribed with resulting canopy closure of 30%. This treatment would convert hydrologically mature stands to hydrologically immature condition until the canopy closes in again. The effect of changes in vegetative conditions at the stand scale may increase the runoff at the stand scale, but due to the very small proportion of the subwatersheds to be converted to hydrologically immature conditions, peak flows are not expected to increase at the drainage or subwatershed scale (Table 11).

Wildcat Thin
Units in Clear Creek Subwatershed




Wildcat Thin
Units in Muddy River Subwatershed
Legend
Upland Thinning
Riparian Thinning
No Cut - Riparian
No Cut - Upland
Subwatershed Boundary
Streams
6
7
27
26
25
11
24
23
29
12
19
13
14
30
15
16
22
18
17
21
0 0.5 1 2 3 4 5
Miles

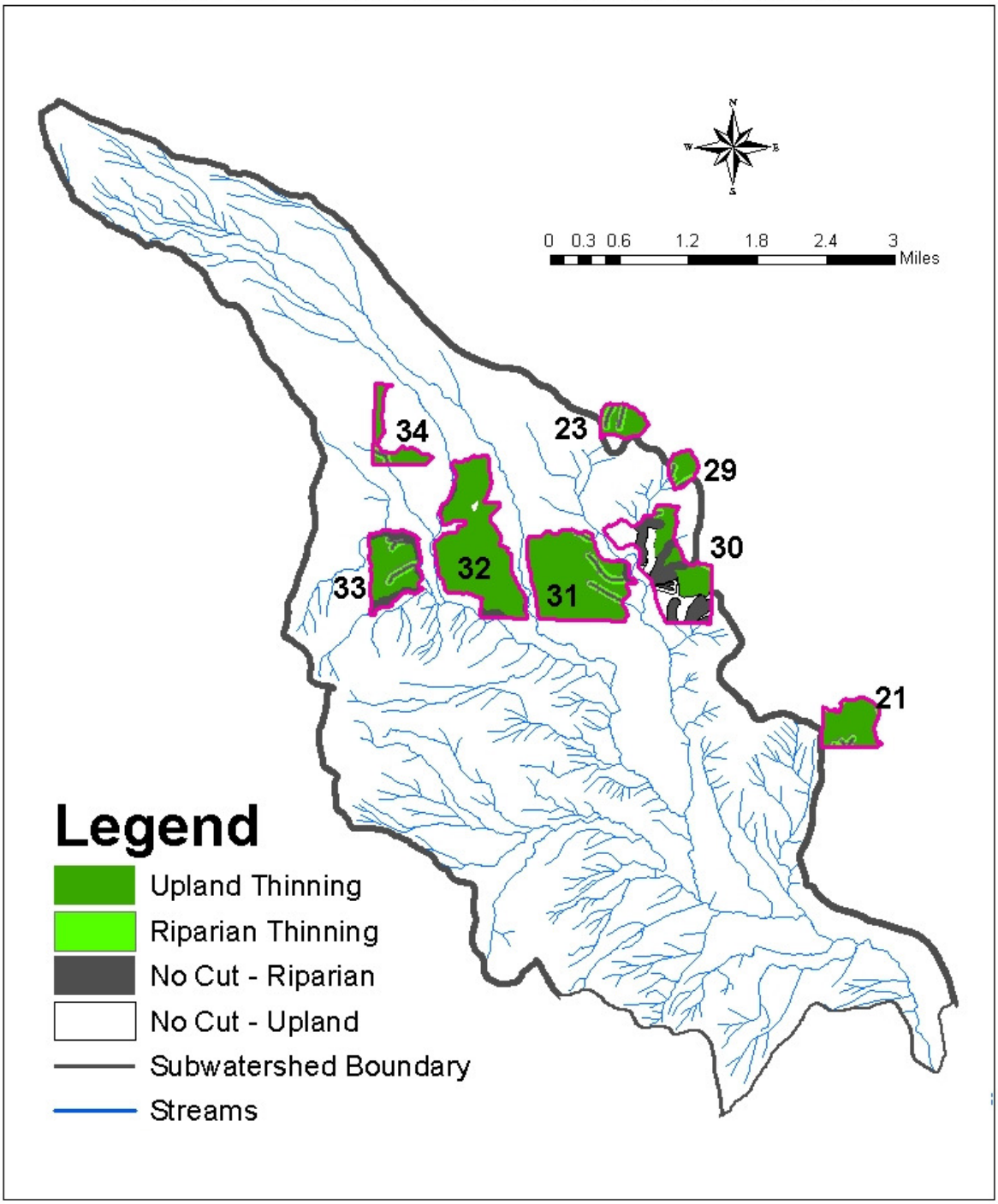


Figure 12. Alternative B – Units in Clear Creek, Muddy River and Pine Creek Subwatersheds.

Table 11. Areas thinned that will create hydrologically immature conditions.			
Unit Numbers	**Area thinned to greater than 50% canopy closure (acres)**	**Area of Drainage (acres)**	**% of Drainage area changed**
Unit 17 – Drainage 3	7	2826/3036	Less than 1
Unit 21 – Drainage 1	11	2835	Less than 1
Units 23, 24 and 25 – Drainage 4	123.3	1903	6.5

Direct and Indirect Effects

Peak flows from changes to stream channel network increases

Stream channel network extensions ranging between 10-26% in some drainages are considered to be functioning at risk in terms of resulting increases to peak flows. This risk level indicates a moderate likelihood that streamflow, particularly high flows, are increased as a result of existing roads. Road decommissioning activities are the primary actions expected to effect channel network extension by removing road-stream crossings. Neither the no action nor the action alternative will change the modeled results for channel network extension as the road decommissions proposed in the action alternative do not have a significant number of stream crossings.

The action alternative includes installation of ditch relief culverts prior to timber harvest activities and would decrease the channel network in the drainages of the Pine Creek Subwatershed although the magnitude of change is minor. Actual changes to discharge are expected to be very small and below measurable levels.

The action alternative includes the construction of temporary roads and reconstruction of past logging roads to access landings and thinning units, including thirteen temporary stream crossings. Temporary roads constructed for logging would have stream crossings removed and drainage established through construction of waterbars, cross drains and grade breaks if not completely decommissioned prior to the wet season. These project design features will ensure that surface waters do not concentrate on the road surface, are disconnected from the permanent road system, and thus not contribute to stream channel network extension. Consequently, neither the action nor no action alternative will change the drainage network extension which in its current condition poses a moderate risk to increased peak flows within the Clear Creek, Clearwater Creek, Muddy River and Pine Creek Subwatersheds.

Cumulative Effects

Peak flows from changes to hydrologic maturity of stands and increased stream channel network

This project was assessed in combination with currently ongoing and proposed future projects to assess the cumulative effects on peak flows. Currently, the Clear Creek Roads Project Environmental Assessment proposes to decommission 14.2 miles of system roads within the Muddy River and Clear Creek Subwatersheds. The decommissioning of these roads will reduce the road density from 1.7 miles per square mile to 1.1 mile per square mile in the Clear Creek

Subwatershed and from 1.7 miles per square mile to 1.62 miles per square mile in Muddy River Subwatershed. Other restoration in the Action Alternative include decommissioning FR2586170 and 8322560 for a total of 1.2 mile. If implemented, the road density would further decrease to 1.58 miles per square mile in the Muddy River Subwatershed.

These road decommissions eliminate stream crossings which would lessen the moderate risk to increased peak flows from stream drainage network increases, although the modeled increased peak flows would remain above 10% and considered a moderate risk.

The private lands within Pine Creek Subwatersheds and a few areas in the lowest area of the Muddy River Subwatershed continue to be converted from fully forest conditions to hydrologically immature conditions. Future management plans on the private lands is not known. The instream affects of these increased peak flows are not possible to discern within Pine Creek and the Muddy River as the lahars that were deposited from the 1980 eruption of Mt. St. Helens continue to be transported and temporarily stabilized.

Sediment Regime

Alternative A—No Action

Direct, Indirect and Cumulative Effects

Stream sediment delivery from use and activities associated with roads

In the no action alternative, roads will continue to produce sediment based on normal use levels which was estimated as 120.9 tons/year for Pine Creek Subwatershed, 95.1 tons/year in the Muddy River Subwatershed, 64.5 tons per year in the Clear Creek Subwatershed and 4.5 tons per year in the Clearwater Subwatershed (Table 12).

Alternative B—Proposed Action

Direct, Indirect and Cumulative Effects

Stream sediment delivery from use and activities associated with roads

In the action alternative, portions of the haul route will be treated to repair and improve drainage structures, improve the road surface, and clear vegetation along roadsides and in ditches prior to haul. Following haul, portions of the haul route will again be treated to repair damage done during logging and to ensure proper drainage and stability of the roads. Road reconstruction includes application of surface rock in necessary areas (spot rocking), replacing damaged or poorly functioning culverts, adding ditch relief culverts where necessary, and replacing or stabilizing fill and subgrade materials.

Approximately 13 culverts will be replaced as part of the reconstruction of system roads for this project. The streams would be dry at the time of the work and the sediment disturbed during reconstruction would not be mobilized until the first rain of the wet season. Replacement of stream culverts will require excavation of fill material over and around the existing pipe, removal of the pipe, and replacement with a new pipe and fill material. Some direct excavation within the channel would need to occur to provide an adequate size and condition of the culvert bed prior to laying new pipe. Sediment introduction and disturbance of the stream channel with this activity is unavoidable although project design features will be used to minimize the actual sediment introduced to streams.

Table 12. Sediment production from roads used in the Wildcat Project Area.				
Subwatershed	**Activity**	**No Action (Tons/Yr)**	**Action (Tons/Yr)**	**Project Design Features**
Pine	Log Haul	110.5	272.0	Haul on FR2588 and associated spur roads restricted to dry season.
	Temp Roads	10.4	97.1	Use in one season, re-establish drainage and erosion control
Pine Total		120.9	369.1	
Muddy	Log Haul	87.9	295.4	Haul on FR2588 and spur roads restricted to dry season. Decommission 2586170 (0.5 mi.) Decommission 8322560 (0.7 mi.)
	Temp Roads	7.2	92.4	Use in one season, re-establish drainage and erosion control
Muddy Total		95.1	387.8	
Clear	Log Haul	61.3	194.4	
	Temp Roads	3.2	24.8	Use in one season, re-establish drainage and erosion control
Clear Total		64.5	219.2	
Clearwater	Log Haul	4.5	15.4	
	Temp Roads	0	3.6	Use in one season, re-establish drainage and erosion control
Clearwater Total		4.5	19.0	

Sediment production from timber haul and use of the system and temporary roads was estimated as 369.1 tons/year for the Pine Creek Subwatershed, 387.8 tons/year in the Muddy River Subwatershed, 219.2 tons/year in the Clear Creek Subwatershed, and 19.0 tons/year in the Clearwater Creek Subwatershed. The estimations assume that all haul and road use occur in a single year. The Wildcat Thin Project area will be divided into multiple sales and the likelihood of all the units actively harvested in any one year is remote. A more likely scenario would be that unit activity would occur throughout a three year period or longer and therefore the sediment production could be one third of the approximated values. It is not possible to know the exact year of unit activities. Although these figures are considered reasonable in that they fit into the range of sediment production values found in the literature, they are considered extremely rough estimates due to the limited data on specific conditions of the various roads and the simplicity of the model parameters. The results are primarily provided to allow comparisons of relative sediment production rates between alternatives with consideration of project design features.

The amount of material actually transported to streams is expected to be relatively low during the period of maintenance and reconstruction. Disturbance of the road surface both by reconstruction activities and by hauling will generate sediment and dust some of which will be transported to the aquatic system during the time of disturbance.
Most of the sediment produced from the activities would be mobilized in subsequent runoff periods, and would be relatively short term pulses of high turbidity and sediment movement in

the streams closely connected to the haul routes and temporary roads. Past experience with culvert removals on road decommissions has shown that turbidity levels increase rapidly as culverts are removed and material from around the culverts is eroded. As transportable material is removed from the site, the turbidity levels decrease rapidly to near pre-project levels. As this material travels downstream, the concentrations are likely to decline at some unknown rate due to significant dilution from other contributing streams that are not affected by the project.

In the fish bearing streams, the increased turbidity and suspended sediment levels are likely to be lower due to the greater opportunity for significant dilution in those streams. The road related sediment contribution to Pine Creek, Muddy River, and Clearwater Creek would not be discernible within the much larger sediment load being worked through these systems from either the mudflow deposits or blast deposits from the 1980 eruption. The road related sediment contribution from the project to Clear Creek would not be discernable from the natural sediment load moving during runoff events.

Alternative A—No Action
Direct, Indirect and Cumulative Effects
Stream sediment delivery from thinning stands
The no action alternative will not have any sediment delivery to streams from thinning.

Alternative B—Proposed Action
Direct and Indirect Effects
Stream sediment delivery from thinning stands
In the action alternative, thinning in Riparian Reserves occurs in all units of the project. Minimum 60 foot no cut buffers on all non fish bearing streams and 220 foot no cut buffers on all fish bearing streams will provide sediment filtering through fully vegetated areas prior to any surface flow reaching a stream course. Project design criteria have specific no cut buffers for all steams in all units. The probability of sediment reaching a stream is a function of the amount of disturbed soil made available for delivery to the stream from felling and yarding of trees, and the presence of a pathway and mechanism for moving that material to a stream. Surface soil disturbance from thinning inside Riparian Reserves would occur primarily as a result of yarding activities when the trees are dragged along the ground surface to landings because the felling of trees is not expected to cause appreciable ground disturbance. The probability of sediment from thinning and yarding activities entering the stream is low considering all the project design criteria minimizing disturbance and sediment delivery and leaving intervening fully vegetated areas that provide filtering of any sediment laden surface discharges in the no cut stream adjacent buffers. The magnitude of sediment reaching a stream from thinning and yarding activities is considered immeasurable.

Cumulative Effects
Stream Sediment Delivery (from roads and thinning)
The direct and indirect effects of stream sediment delivery from use and activities associated with roads and from thinning stands of the action alternative would be cumulative. In the short term, road decommissions would also contribute sediment delivery to streams primarily from culvert removal areas during the first wet season after the decommissioning activities are complete. The Clear Creek Roads Project recommended road decommissions in Muddy River

Subwatershed (3.8 miles) and in Clear Creek Subwatershed (10.4 miles). The criteria that were used to select roads for decommissioning in the Clear Creek Roads Project EA included number of road crossings, length of road intersecting unstable lands and/or intersecting riparian reserves along with a low maintenance level which would indicate little or no current maintenance (culvert cleanings). The amount of sediment delivered to streams from decommissioning roads is expected to be significantly less than would occur if roads were left under the current maintenance schedule. These roads were all considered a high risk to aquatics and the risk of culvert failures were high due to the lack of maintenance.

In the long term, the decommissioned roads will decrease sediment production. The quantity of the decreased production could be modeled in several different ways. One way to estimate the decreased production of sediment would be to quantify the amount of road fill taken out of the stream course in the decommissioning as this is the amount of sediment that would be delivered if a culvert failed. Cook and Dresser found that stream crossings that were restored through decommissioning delivered 3-5% of the amount of fill material than was originally located at that crossing (2004). This method of estimating sediment delivery was not used due to the lack of site specific information.

Decreased production from the absence of use of the road is another method. This second method was chosen so that the sediment production rates could be comparable to the sediment production from other project related activities. This method underestimates the full sediment delivery reduction benefit from road decommissions as it is only estimating the reduction from eliminating use, and does not estimate the reduction from the elimination of culvert failure risks. Sediment production decreases from the road decommissions were estimated as 9.7 tons/year in the Muddy River Subwatershed and 62.4 tons/year in the Clear Creek Subwatershed. These roads are expected to be decommissioned over several years rather than one year so the reduction in sediment delivery approximates the long term and cumulative reduction. Some of these roads are needed for use in the Wildat Thin Project and so the decommissioning may occur in a similar dry season as the thin activities. This simple analysis indicates the road decommissions reduces the sediment delivery to streams in Clear Creek Subwatershed and, to a lesser extent, Muddy River subwatershed during a similar period in which the Wildcat Thin Action Alternative would be occurring if selected (Table 13).

Table 13. Cumulative Sediment Production from Road Decommissions and Wildcat Thin Action Alternative.

Subwatershed	Current use on future road decommissions (Tons/Yr)	Sediment production post road decommissions (Tons/Yr)	Decrease in sediment production from road decommissions (Tons/yr)	Total sediment production in Wildcat Thin Action Alternative (Tons/yr)	Cumulative Sediment Production in Wildcat Thin Action Alternative and Post road decommissions (Tons/Yr)
Muddy River	11.4	1.7	9.7	387.8	378.1
Clear Creek	80.9	18.5	62.4	219.2	156.8

Water Temperature

Alternative A—No Action
Direct, Indirect and Cumulative Effects
Stream temperatures from changes to stream shade within stands
The no action alternative will have no effect to water temperatures. Recent continuous temperature data is only available for the mainstems of these subwatersheds, Pine Creek, Clear Creek, Clearwater Creek and the Muddy River and at one tributary to the Muddy River.

The no action alternative would not enhance riparian conditions to improve connectivity or accelerate growth in riparian reserves that are currently highly fragmented from past harvest.

Alternative B—Proposed Action
Direct and Indirect Effects
Stream temperatures from changes to stream shade within stands
The Action Alternative will not thin areas providing shade to any perennial streams. Most of the perennial streams have 220 foot no cut buffers to protect shade. Units 23 and 26 have small perennial streams (summer wetted width less than 3 feet) with 60 foot no cut buffers to protect stream shade. This stream was monitored in 2005 and had a seven day average maximum was 16.8^{o}C at the confluence with the Muddy River. This tributary has multiple tributary headwaters in Unit 23 and 26, and flows through Unit 25 and Unit 27 over five miles prior to reaching the Muddy River floodplain. This stream is cool until it flows onto the Muddy River floodplain at which time it warms while paralleling the Muddy River for half mile before flowing into the Muddy River. The source of warming is the lack of mature conifers providing stream shade on the Muddy River floodplain which is a result of the mudflow that occurred during the eruption.

In the Clear Creek Subwatershed, Units 3, 8 and 9 have one or more perennial streams adjacent to or within the unit boundary where a full site potential tree height no thin buffer will maintain existing shade and microclimate. Unit 7 has the upper extent of perennial flow in one tributary within its boundary. This creek ranges from 2-4 feet wide as it flows through the unit. A 60 foot wide buffer where no thinning would occur is proposed so that the outer riparian vegetation could be improved while maintaining adequate shade adjacent to the small stream.

Unit 30 and 33 include perennial streams where a site potential tree height no thin buffer will maintain existing shade and microclimate. These perennial streams flow directly into the main fish bearing streams within the Pine Creek Subwatershed. All the fish bearing streams of Pine Creek Subwatershed have a site potential tree height no thin buffer to maintain existing shade and microclimate. The remaining riparian reserves are proposed for thinning to enhance growth similar to the treatment proposed for the adjoining portion of that stand which was previously managed as one congruent stand.

Harvest activities within the units do not affect shade of any streams flowing during the warm summer months. The 220 foot untreated buffers along most perennial and all fish bearing streams and the 60 foot no cut buffers along the narrower perennial streams will retain existing shade in the areas providing shade to perennial streams. The 220 foot untreated buffer around wetlands will maintain the associated water table and vegetated shade around the wetlands.

The Action Alternative will thin 3% or less of the stream riparian reserves of the Clear Creek, Clearwater Creek, Muddy River and Pine Creek Subwatersheds. Treated stream riparian reserves between 180 and 440 feet from fishbearing streams and between 60 and 220 feet from all other streams would be thinned to a 40% canopy cover to maximize the increased growth benefits of thinning. Thinning would open treated portions of the Riparian Reserves to increased sunlight and increased variability in air temperature, relative humidity and winds. This would result in slightly drier conditions during summer months, and greater fluctuations in air temperature and humidity within treated portions of the Reserves. This effect would slowly decrease as individual tree canopies respond to the thinning and grow into the space created in the thinned forest canopy.

As the forest canopy in Riparian Reserves begins to close in following thinning treatments, the microclimate within the Reserves would begin to recover to pre-treatment levels. This recovery is estimated to occur over a period of 5 to 10 years. The thinning conducted in Riparian Reserves should produce larger trees sooner than they may otherwise have developed. Over the course of 50 years, thinned stands would be expected to have grown an additional 6 to 7 inches in diameter as compared to trees in untreated stands (pers comm. Bruce Holmson). The increased diameter growth will provide larger trees for future wood recruitment to the riparian floor and potentially streams (Table 14).

Table 14. Riparian Thin areas in the Wildcat Thin Project Area.

Subwatersheds	Riparian Thin (acres)	Stream Riparian (acres)	Percentage Riparian reserves harvested (%)
Clear Creek	98.2	4266.7	2
Muddy River	218.9	7378.9	2
Pine Creek	99.1	7026.8	1
Clearwater Creek	23.5	8880.1	Less than 1

Alternative B—Proposed Action
Cumulative Effects
Stream temperature from changes to stream shade
No known future activities will effect stream temperatures from changes to stream shade on forest lands within the Clear Creek, Clearwater Creek, Muddy River and Pine Creek Subwatersheds. Several restoration projects are proposed to promote tree growth and channel stability within the Muddy River (8 miles) and Clear Creek (lowest mile) floodplains. These projects will promote tree growth, increase number of conifers growing directly adjacent to the mainstems, and enhance channel stability by adding large wood. In the long term, there projects are expected to contribute to shading of Clear Creek and the Muddy River and reduce the solar radiation reaching these streams.

Pine Creek and to a lesser extent Muddy River Subwatershed include private lands which have been recently harvested or cleared for residential housing. The extent to which this affects stream temperatures is unknown. The lahars that were deposited from the 1980 eruption is the dominant disturbance mechanism in the Muddy River and Pine Creek and the associated young vegetation along the channels remains the primary source of heating in these mainstems.

Aquatic Conservation Strategy Objectives

The Aquatic Conservation Strategy (ACS) is an integral part of the 1994 Northwest Forest Plan. The ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems within public lands. The ACS includes four components (Key Watersheds, Watershed Analysis, Watershed Restoration and Riparian Reserves) and has nine objectives toward meeting the goal of healthy ecosystems and watersheds. ACS Objectives are applied over time at project, watershed, and broader scales. The Wildcat Timber Sale Environmental Analysis' (EA) Proposed Action is to thin timber stands and includes road-related activities, such as log haul, temporary road construction, and road decommissioning. Some of these activities occur within the Riparian Reserves land allocation established by the Northwest Forest Plan.

Key Watersheds

The entire Wildcat Timber Sale Project Area is designated as a Key Watershed and is located on the Mt. Saint Helens National Volcanic Monument. Key Watersheds are intended to serve as refugia for at risk stocks of native and anadromous fish. Activities to protect and restore aquatic habitat in Key Watersheds are higher priority than similar activities in other watersheds. In the Proposed Action, thinning activities occur in 2% or less of the stream Riparian Reserve. Although the magnitude of thinning activities in relation to the entire Key Watershed is small, they are considered a benefit to the riparian areas where they will be implemented.

Watershed Analyses

Watershed Analyses for the Wildcat Timber Sale Project Area were conducted by the Gifford Pinchot National Forest in 1996 and 1997. The Lower Lewis River Watershed Analysis and the Muddy River Watershed Analysis were reviewed by Forest Service Resource Specialists and the recommendations found in these analyses were integrated in the design of the proposed timber sale project. Specifically, it was identified that previous timber harvest activity in the project's analysis area has resulted in densely stocked areas within Riparian Reserves. As recommended in the Watershed Analyses, road decommissioning, including the removal of old logging roads, was considered an important restoration priority within the project's analysis area.

Watershed Restoration

Watershed restoration is an integral part of the Aquatic Conservation Strategy because of its role in the recovery of fish habitat, riparian habitat, and water quality. The Lower Lewis River and Muddy River Watershed Analyses rated road decommissioning as a high priority and silvicultural treatment of riparian and upland stands as a moderate priority.

Riparian Reserves

In the watershed analyses conducted for this area, the Resource Specialists found that previous timber harvest activity in the project's analysis area has resulted in densely stocked areas within Riparian Reserves. The development of late seral characteristics within the designated Riparian Reserves found in the Wildcat Timber Sale Project Area would improve critical habitat for riparian and aquatic-dependent fish and wildlife species.

Consistency with ACS Objectives
Alternative A – No Action
For Alternative A - No Action, all objectives of the ACS (listed below) would be maintained at current levels. This is because no timber sale-related activities would be taking place under the No Action Alternative. The sediment regime would not be enhanced under the No Action Alternative, however, because Forest Road 8322-560 or Forest Road 2586-170 would not be decommissioned, and the restoration of old logging roads within the units would not be implemented.

Consistency with ACS Objectives
Alternative B—Proposed Action

Objective 1: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.

The proposed action is expected to maintain the distribution, diversity, and complexity of watershed scale features. The proposed action improves the proportion of forest in late seral stage by enhancing growth of tree diameters and live crowns in previously harvested and stocked stands. This activity will enhance tree growth and stand diversity in 2740 acres. Although the Proposed Action has restorative benefits, the amount of acreage within each subwatershed is limited, ranging from less than one percent in Clearwater Creek to 7% in Pine Creek.

The proposed action does not involve any new permanent roads. Temporary roads will be restored when activities are completed and, therefore, will not persist as a road feature. Road rehabilitation activities include Forest Service Best Management Practices, including: (1) requiring activities to be completed prior to the wet season, (2) removal of culverts and culvert fill material, and (3) stable configuration of stream banks at culvert crossings.

Objective 2: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

In the proposed action, spatial connectivity is enhanced by thinning activities that lead to the restoration of late seral components, such as large trees, diverse understory and overstory species and sizes, and future coarse wood. Spatial connectivity occurs by: 1) enhancing tree growth in dense stands with stagnated growth rates and diminished crowns, 2) inter-planting with shade-tolerant species, and 3) creating or maintaining downed logs and snags. This proposed restoration is particularly prominent in the Riparian Reserve buffers of the small tributaries and headwater areas. The extent and range of riparian thinning is small. Approximately 361 riparian acres would be treated in four Subwatersheds. This represents 2% or less of the stream Riparian Reserves in any one of the four subwatersheds.

The restoration within one site potential tree height width of headwater streams within Units 13 and 21 will specifically enhance down wood in riparian reserves by thinning trees to enhance growth of standing trees, leaving cut trees to provide down wood and creating snags to provide future down wood. This will benefit species such as amphibians which depend upon large down wood and *Tetraphis geniculata* (moss) which depend upon down decaying large wood.

Spatial and temporal connectivity within and between watersheds will be maintained because no new permanent roads are proposed for the Wildcat Timber Sale. Temporary roads would be designed with drainage features in order to minimize disturbance to surface flow. These drainage features will include adequately sized culverts which will be removed following use. Activities proposed for the Wildcat Timber Sale will not create physical barriers or otherwise degrade migration and access for aquatic organisms.

A high level of connectivity along stream courses is maintained because of the adequately-sized no cut riparian buffers protects the existing ecosystem which contains a high level of vegetative species diversity, varied structural component (deciduous, conifer and shrub species) and a continuously vegetated forest floor incorporating sediments and nutrients. Decommissioning Forest Road 8322-560 or Forest Road 2586-170 would restore stream connectivity by removing culvert obstructions and allowing the unimpeded movement of water, wood, sediment, invertebrates, and vertebrate species.

Objective 3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

Thinning within the Riparian Reserves will increase the growth of standing live trees and will increase the quality of future large wood recruitment by optimizing the size and quantity of large wood within the riparian stand portions. Specific recommendations for cut-and-leave trees (leaving trees on the ground after selectively cutting them) in Units 14, 15, and 21 will ensure that large trees develop in areas where there is a high likelihood that large wood will be delivered to streams. Future large wood recruitment to streams will contribute to sustaining the physical complexity and stability of the stream, including the retention and accumulation of smaller sediments, such as spawning gravels.

New temporary road design for the Wildcat Timber Sale includes some intermittent creek crossings. Design criteria of the project are described in Chapter 2 and ensure that the physical integrity of the stream banks and bottom configurations at the crossings are maintained.

Objective 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

The non-treated buffer widths would protect trees that produce the shade and maintain the instream temperatures of the creeks within and adjacent to the timber units. The untreated buffer widths are equal to one site potential tree height on all fish-bearing streams and most perennial

streams, and they are equal to 60 feet on the small, narrow (1-4 feet wide), non fish-bearing, perennial streams, Therefore, the water quality will remain within the range that maintains the biological, physical, and chemical integrity of the system, which will benefit the survival, growth, reproduction, and migration of individuals composing the aquatic and riparian communities.

Objective 5: Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

Riparian thinning under the proposed action has a low probability of introducing sediment to the streams. This is because the thinning activities are designed so that no ground disturbance will take place within the untreated riparian buffers immediately adjacent to the streams. Activities outside of these untreated buffers, such as tree harvest using mechanical equipment, are unlikely to contribute sediment to the streams because the buffers would capture the disturbed soil being transported in overland flows before it reaches the stream. Design Criteria and Best Management Practices that minimize erosion and sediment movement throughout the units are listed in Chapter 2.

Best Management Practices that minimize sediment delivery to streams include: (1) limiting timber haul to the dry months for the roads that are closely linked to the fish-bearing reaches of Pine Creek, (2) maintaining and improving road drainage features prior to hauling activities, and (3) placing sediment barriers in ditchlines and other areas linked to stream systems where ground disturbance due to road reconstruction occurs. Even with the Best Management Practices, some sediment will be mobilized from haul route reconstruction and use. However, not all of this sediment would reach a stream because there are many relief culverts that can intercept ditch flow and drain the sediment-laden water onto the forest floor and away from the streams.

The character of the sediment delivered to the streams would be fine grained. This means the sediment would be suspended within the water column and would experience dilution from the other tributary streams that are not impacted by road runoff. Increases in turbidity and suspended sediment levels in the streams that are caused by haul route usage are likely to be low due to the degree of dilution that is expected. This is especially true for the lower stream reaches and the larger streams where the majority of the fish in these stream systems are found. This dilution would also minimize the chance that the sediment will accumulate in any one reach downstream from the sediment input area.

The ground disturbance that is expected to occur from this timber sale would be localized and the ground would re-vegetate within one growing season. The increases in instream sediment from timber haul and culvert work are expected to be short-term in duration, significantly diluted, and infrequent in timing as they move downstream in random pulses. These short-term effects will not be discernible against the range of variation of natural sediment processes at the watershed scale.

The proposed action would decrease the chronic erosion sources associated with Forest Road 8322-560 and Forest Road 2586-170 if these roads are decommissioned. The old logging roads

that are also current, chronic erosion sources would have their stream crossings removed, subsoiled and rehabilitated if implemented.

Objective 6: Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

The magnitude of change in peak flows resulting from the proposed thinning activities in the Wildcat Timber Sale is expected to be undetectable above background levels. This is due to only a few timber units having their vegetation structure changed to the degree that would affect the hydrologic maturity of that stand and, consequently, increase runoff rates during peak flows. The runoff from these stands would be small and not measurable at the stand, drainage, or subwatershed scales. One unit, Unit 17, will attain a hydrologically mature condition quicker after thinning occurs because the level of thinning it receives will accelerate tree growth.

Objective 7: Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

In timber units 13, 14, and 33, the untreated riparian buffer width around the wetlands will be one site potential tree height. This will maintain the water table elevation and vegetation that are currently providing its unique riparian characteristics. Floodplain inundation will be maintained because the Proposed Action does not include ground disturbance in the floodplain or high water areas of these sites.

Objective 8: Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Riparian thinning would promote the development of late seral characteristics within the timber stands. These late seral characteristics would provide thermal regulation. The untreated buffers on aquatic features provide an adequate area for sediment transport interception, diverse riparian plant community protection, and increased tree growth. The increased tree growth will provide future course wood for the riparian forest floor and stream. The Wildcat Timber Sale requires untreated buffers along all riparian stream corridors and wetlands. These buffers encompass diverse plant communities, protect current shading levels for thermal regulation, protect stream banks from operational disturbances, and ensure that soil disturbance does not get routed to streams or wetlands.

Objective 9: Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

Establishing an untreated riparian buffer zone will protect areas adjacent to streams from disturbance and will maintain populations of native plants, invertebrates, and riparian-dependent

vertebrate species. The untreated riparian buffers maintain the microclimate, an important habitat parameter for species that are sensitive to temperature and humidity changes. These species include amphibians and certain types of vegetation, as well as many avian and mammal species that use the riparian areas adjacent to streams as travel corridors.

The Proposed Action provides for the development of habitat conditions within the riparian areas and across the landscape to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species at the project and watershed scales.

Summary

In the long term, the Wildcat Timber Sale would contribute to the restoration of the riparian vegetation and aquatic conditions within the Clear Creek, Clearwater Creek, Muddy River and Pine Creek 6th field watersheds by promoting the development of late-successional forest characteristics within the Riparian Reserves and the upland stands. This would be accomplished through various timber sale-related activities, such as (1) reconstructing undersized crossings, (2) improving road drainage, and (3) decommissioning existing roads and/or old logging roads. The thinning treatments are designed to help meet the Desired Future Condition for Late-Successional Reserves and Adaptive Management Areas, as described in the Gifford Pinchot National Forest Land and Resource Management Plan. Because terrestrial vegetation and aquatic components, and their processes, are so interwoven and interdependent, meeting the Desired Future Condition for these land allocations will also contribute to abundant, well-dispersed, high-quality habitat for riparian-dependent species.

Designated no-cut buffers along all stream courses, avoiding any perennial stream crossings when constructing temporary roads, and implementing Best Management Practices, management requirements, and required mitigation measures will protect riparian areas and maintain the existing vegetation, connectivity, water flow, water quality, and habitat within these subwatersheds.

The proposed Wildcat Thin Timber Sale includes some activities that are expected to result in short-term increases in sediment introduction to streams at some individual sites. For example, culvert installations, culvert replacements, and road decommissioning work all have the potential to create short-term sediment movement some of which may end up in streams. However, the increased sediment from the project activities is expected to be localized and short-term. Disturbances to the stream channels and adverse water quality impacts, with the exception of increased turbidity, are not anticipated. Sediment inputs to streams from culvert work are likely to create turbidity pulses that last for only a few hours, at most, and produce sediment plumes that are 0.5 miles or less, before water clarity returns to background levels. Construction sites may continue to produce small amounts of sediment throughout the first winter until the sites are fully revegetated and stable. Any short-term increases in sediment production or turbidity are expected to be well within the range of what would typically occur during high winter flows or as a result of natural streambank erosion and sediment movement processes. At the subwatershed and watershed scale, changes in turbidity or sediment movement will not be detectable.

Fisheries

A complete Fisheries Biological Assessment (BA) and Biological Evaluation (BE was completed for the Wildcat Timber Sale and can be found in the project file. The results of the BA and BE are summarized here. Fish species analyzed in the BA were taken from the Pacific Northwest Region, USDA Forest Service Threatened, Endangered, and Species Proposed for Listing document, updated February 2008, as well as the Pacific Northwest Region, Regional Forester's Sensitive Species List, updated January 2008.

Existing Condition

The Gifford Pinchot National Forest (GPNF) has a total of eight fish species that are federally-listed as endangered, threatened, or sensitive. No fish species or critical habitat on GPNF is currently *proposed* for federal listing. Of the eight Federally-listed and Forest Service sensitive fish species found on GPNF, only Columbia River (CR) bull trout (all life stages) and an experimental population of Lower Columbia River (LCR) coho are found within the project planning area.

LCR steelhead, LCR chinook, and LCR coho, are not currently able to access the Muddy River and Swift Reservoir-Lewis River 5th-field watersheds because upstream fish passage is blocked by dams at Merwin Lake, Yale Lake, and Swift Reservoir. However, 2000 coho have been trucked above these barriers and released within the Swift Reservoir-Lewis River and Muddy River 5th field watersheds every summer for the five years as part of experimental studies (Haspiel 2008). Efforts to reintroduce LCR steelhead, LCR chinook, and LCR coho upstream of these dams are currently being planned under the Lewis River Settlement Agreement (see the cumulative effects section for further details). However, until these three fish species are officially introduced into the Swift Reservoir-Lewis River and Muddy River 5th field watersheds in 2011, the coho that are currently found there have 10J Experimental Status under ESA and the USFS is not required to consult with NOAA for them.

Based on a pre-field review, Columbia River (CR) bull trout occur within the project's action area in the Pine Creek HUC-6 watershed and, based on anecdotal evidence, in the Clear Creek, Clearwater Creek, and Muddy River HUC-6 watersheds. There is anecdotal evidence that CR bull trout have been found up to river mile (RM) 10 of the Muddy River mainstem, up to RM 9 in the Clear Creek mainstem, and up to RM 9 (approximately) in the Clearwater Creek mainstem. There are no CR bull trout within the immediate action area or thinning units themselves. At the closest points, CR bull trout (all life stages) may be present approximately 0.2 RM downstream from Unit 31 in the unnamed eastern tributary to Pine Creek. All other units have approximately 0.25 RM, or more, distance between the intermittent and/or perennial streams within the units and the mainstem streams outside their unit boundaries where there are CR bull trout present.

Coastal Puget Sound bull trout, Pygmy Whitefish, and Interior Redband Trout are not present in any of the watersheds in the Mt. Saint Helens National Volcanic Monument. Thus, there are no effects anticipated for any other proposed, endangered, threatened, or sensitive (PETS) fish species from the Wildcat Timber Sale (see Table 1) and these species will not be discussed further.

Environmental Effects

Summary of Findings

It is our determination is that the proposed action of the Wildcat Timber Sale ***may affect, not likely to adversely affect*** CR bull trout. The proposed action of the Wildcat Timber Sale ***may adversely affect*** Essential Fish Habitat for chinook and coho. We determine that the Proposed Action of the Wildcat Timber Sale will have ***no effect*** on LCR steelhead, LCR chinook, LCR coho, Coastal Puget Sound bull trout, Critical Habitat for LCR chinook, or Critical Habitat for LCR coho. In addition, we determine that the implementation of the Wildcat Timber Sale will have ***no impact*** on Puget Sound coastal cutthroat trout, interior redband trout, or pygmy whitefish as these species do not occur in the area affected by this project and cumulative or downstream impacts are considered to be minimal to non-existent.

Table 15 summarizes the effects from the proposed action on (PETS) fish species. When No Effect or No Impact is determined, those species will not be further described or discussed in this Biological Assessment.

Table 15. Summary of effects determinations for threatened, endangered, proposed, & sensitive fish species from the Proposed Action/Action Alternative of the Wildcat Timber Sale.

SPECIES NAME	SPECIES STATUS	FIELD REVIEW		EFFECTS
		Habitat Present in Pine Creek, Clear Creek, Clearwater Creek, or Muddy River HUC-6	Species present in Pine Creek, Clear Creek, Clearwater Creek, or Muddy River HUC-6	Proposed Action
Columbia River Bull Trout *Salvelinus confluentus*	Threatened	**Yes**	**Yes – all life stages in Pine Creek & adult stages in Clear Creek, Clearwater Creek, and Muddy River**	**LAA***
Critical Habitat for Columbia River Bull Trout	Designated	No (not designated on NF lands)	N/A	No Effect
Coastal Puget Sound Bull Trout *Salvelinus confluentus*	Threatened	No	No	No Effect
Critical Habitat for Coastal Puget Sound Bull Trout	Designated	No (not designated on NF lands)	N/A	No Effect
Lower Columbia River	Threatened	No	No	No Effect

Table 15. Summary of effects determinations for threatened, endangered, proposed, & sensitive fish species from the Proposed Action/Action Alternative of the Wildcat Timber Sale.				
SPECIES NAME	**SPECIES STATUS**	**FIELD REVIEW**		**EFFECTS**
		Habitat Present in Pine Creek, Clear Creek, Clearwater Creek, or Muddy River HUC-6	**Species present in Pine Creek, Clear Creek, Clearwater Creek, or Muddy River HUC-6**	**Proposed Action**
Steelhead Trout *Oncorhynchus mykiss*				
Critical Habitat for Lower Columbia River Steelhead Trout	Designated	No	No	No Effect
Lower Columbia River Chinook Salmon *Oncorhynchus tshawytscha*	Threatened	No	No	No Effect
Critical Habitat for Lower Columbia River Chinook Salmon	Designated	No	No	No Effect
Lower Columbia River Coho Salmon *Oncorhynchus kisutch*	Threatened	No	No	No Effect
EFH for Coho and Chinook Salmon	N/A	**Yes**	No	**May Adversely Affect***
Interior Redband Trout *Oncorhynchus mykiss*	USFS Sensitive	No	No	No Impact
Pygmy Whitefish *Prosopium coulteri*	USFS Sensitive	No	No	No Impact
Puget Sound Coastal Cutthroat Trout *Oncorhynchus clarki clarki*	USFS Sensitive	No	No	No Impact

***LAA = May Affect, Likely to Adversely Affect**

Alternative A—No Action

Direct, Indirect and Cumulative Effects

The potential for the implementation of the No Action Alternative to negatively impact instream sediment/turbidity, substrate embeddedness, temperature, drainage network, road density/location, peak/base flows, riparian reserves, or migration barriers in streams within the analysis area is *neutral* in the short-term. Alternative A is the No Action alternative; therefore, it does not prescribe any riparian thinning, temporary road construction, reconstruction, or decommissioning, landing building/usage in the Riparian Reserve, or haul route usage. Thus, there is *no effect* to the CR bull trout population within the Wildcat Timber Sale analysis area from the implementation of the No Action Alternative.

There are 13 stream crossings that have blocked, undersized, and/or damaged culverts associated with this sale that would not be replaced under the No Action Alternative, leading to further disruptions to the sediment regime within these sub-watersheds. There are several roads in the Pine Creek sub-watershed that would not have ditch relief culverts installed, in addition to other road maintenance activities, and this would mean that the channel network here would not be slightly decreased, as they would have with the implementation of the Action Alternative. There are also two road decommissioning activities associated with this sale that would not be implemented under the No Action Alternative. While these two road decommissions are not expected to affect channel network extension because they do not contain a significant number of stream crossings, the sediment levels currently produced by these road segments would continue unabated. In the No Action Alternative, roads will continue to produce sediment. Based on normal use levels, this was estimated at 120.9 tons/year for the Pine Creek sub-watershed, 95.1 tons/year in the Muddy River sub-watershed, 64.5 tons per year in the Clear Creek sub-watershed, and 4.5 tons per year in the Clearwater Creek sub-watershed.

Additionally, fish and other riparian-dependent populations may not experience the significant long-term benefits derived from riparian thinning practices, which include a higher rate and volume of large woody material recruitment and greater pool frequency and quality. Also, late-successional riparian conditions, along with their associated beneficial riparian and instream effects, would not be attained as quickly due to the lack of a riparian thinning prescription. The thinning conducted in Riparian Reserves should produce larger trees sooner than they may otherwise have developed. Over the course of 50 years, thinned stands would be expected to have grown an additional 6 to 7 inches in diameter as compared to trees in untreated stands (Holmson, personal communication 2007). The increased diameter growth would provide larger trees for future wood recruitment to the riparian floor and potentially streams. These thinning benefits are especially important because the proposed timber units are mostly composed of dense, second-growth, managed stands. These riparian and instream benefits, such as improved pool habitat and frequency, would be expected to improve habitat and population levels of the CR bull trout present in the Clear Creek, Muddy River, Pine Creek, and Clearwater Creek 6th field watersheds.

Sediment/Turbidity

Turbidity is used as an indicator of fine sediment suspended in the water, and substrate embeddedness is an indicator of fine sediment that settles onto the streambed. Fine sediments, even at relatively low levels, deposited on spawning areas during critical life cycle stages can decrease survival of eggs and emerging fry by decreasing inter-gravel dissolved oxygen content and suffocation. Suspended sediments increase the physiological stress of juveniles and adults by causing gill abrasion, leading to a higher incidence of disease and infection. Significant increases in fine sediment levels reduce interstitial spaces between substrate particles, leads to shifts in invertebrate community structure, fills pools, and can entomb redds. In such cases, eggs are smothered, prey available for rearing juveniles is reduced, and habitat features are lost. Pool siltation reduces the available refugia for juvenile and adult fish. Fine sediments can also cause higher stream temperatures due to reduced water reflectivity and a reduction in the stream's width-to-depth ratio (shallow water heats faster than deep water).

Sediment delivery of a large enough magnitude relative to stream size may change the instream substrate character and embeddedness. There are various surface erosion processes at work within a watershed and management actions, such as road building and timber harvest, that do not have adequate mitigation measures and Project Design Criteria, have the ability to accelerate the surface erosion process within a watershed. Sediment delivery to streams during and after harvest activities can be via roads, yarding activities, riparian function impairment, and landslides. When siltation occurs, spawning substrate becomes supply limited, and this can reduce the future bull trout population numbers.

Alternative B—Proposed Action
Direct and Indirect Effects
There would be negative short-term and site-specific effects to sediment/turbidity and substrate embeddedness indicators which in turn may have small, short-term effects to CR bull trout. This is due to the likelihood of varying amounts of fine sediment entering Pine Creek, the unnamed western tributary to Pine Creek, the unnamed eastern tributary to Pine Creek, Muddy River, Clearwater Creek, and Clear Creek during road work, landing, and haul activities, especially in the Riparian Reserves.

Thinning in Riparian Reserves occurs in all units of this project. Minimum 60 foot no cut buffers on all non fish bearing streams and 220 foot no cut buffers on all fish-bearing streams would provide sediment filtering through fully-vegetated areas prior to any surface flow reaching a stream course. There would be a minimum no-cut buffer of 220 feet on almost all perennial and/or fish-bearing streams. Additionally, thinning in Riparian Reserves with high channel stability will occur at least 60 feet away from non fish-bearing and/or intermittent streams.

The road reconstruction would occur to some extent within Riparian Reserves, which would entail 13 intermittent stream crossings. These stream crossings would not occur where there are CR bull trout present. The closest of these proposed intermittent stream crossings (within 1 RM) to CR bull trout, occurs in units 30 and 31. The intermittent stream crossing in unit 30 is approximately 0.35 RM upstream from CR bull trout in the unnamed eastern tributary to Pine Creek, and the two intermittent stream crossings in unit 31 are approximately 0.25 RM upstream from CR bull trout in this same creek.

The proposed road decommissioning would, in the long-term, lessen the amount of sediment entering the Muddy River stream system from degrading roads.

Negative effects to aquatic habitat from sediment inputs from log haul would likely occur. However, adverse impacts would be limited due to mitigation measures to control erosion and sediment delivery to stream channels. Some adverse impacts to CR bull trout may occur from log haul during the Wildcat Timber Sale due to the proximity of these fish to some of the poorly-surfaced haul routes.

Approximately 16 landings are located within the Riparian Reserves and also within 0.75 miles upstream of CR bull trout. Some of these are existing landings that require no heavy reconstruction, but reconstruction landings will require greater levels of ground-disturbance. Because there will be approximately 2.0 acres of ground-disturbance from landing construction

and usage within close proximity to CR bull trout, it is likely that CR bull trout will be adversely affected to some degree. The magnitude of any sediment reaching streams with CR bull trout due to temporary landing use and construction within the Riparian Reserve would not be detectable above background levels because of the high levels of naturally-occurring turbidity/sediment in Pine Creek and Muddy River.

There is a high probability that CR bull trout will be adversely affected by the sediment/turbidity and substrate embeddedness caused by the road-related work associated with the Wildcat Timber Sale. These are adverse, fairly localized, infrequent, short-term effects to CR bull trout, but they will be lessened because: (1) the culvert installations/removals are on intermittent streams, (2) the streams will be dry or have very low flow at the time of implementation, (3) temporary roads will be used for one season or, if decommissioning is not possible before the winter, they will have drainage features removed, (4) proper drainage will be reestablished, (5) erosion control features will be implemented, (5) CR bull trout are found in the mainstems, not in the intermittent tributaries, no closer than 0.25 miles away, (6) road decommissioning will improve stream conditions for CR bull trout in the long-term, and (7) all FS Best Management Practices will be undertaken as part of the culvert replacements, road decommissioning, and other road-related work.

Actual adverse impacts to the aquatic system from increased sediment delivery or turbidity would be relatively small, localized, intermittent, and temporary. Effects to CR bull trout would not be detectable beyond background levels at the watershed scale. These negative effects would disappear in the long-term.

Essential Fish Habitat

Alternative A—No Action

Direct, Indirect and Cumulative Effects

There would be no effect to EFH under the no action alternative, as none of the habitat elements would be altered.

Alternative B—Proposed Action

Direct and Indirect Effects

There are some short-term, negative turbidity/sediment and substrate embeddedness effects expected from the Wildcat Timber Sale to EFH for coho and chinook due to the *proximity* between some of the timber sale actions and the EFH designations. Road reconstruction, road decommissioning, landing construction within the Riparian Reserve, and timber hauling would deliver some fine sediment to streams within the proposed project area. Any sedimentation effects would be short-term, infrequent, and localized.

For the timber thinning component of this project, there are adequate no-cut riparian buffers on all waterbodies within and adjacent to the timber units so that it is unlikely that any measurable sediment input to the waterbodies will occur from this action.

Log hauling on unpaved forest roads would increase the delivery of sediment, and turbidity and substrate embeddedness, to stream channels. However, impacts would be reduced by the standard BMPs that would be implemented to control erosion and sediment delivery to stream

channels, as well as mitigation measures that would significantly reduce the overall amount of sediment reaching the streams. Some sedimentation effects are expected in the unnamed eastern tributary to Pine Creek because of log haul on FR 2588 (0.25 RM distance to EFH) and in Pine Creek due to log haul on FR 8320 (0.15 RM distance to EFH), and (3) in Muddy River due to log haul on FR 2586 (0.15 RM distance to EFH).

For the landing construction component of the Wildcat Timber Sale, there are approximately 16 landings that are expected to elevate turbidity/sediment and substrate embeddedness in stream reaches that may contain CR bull trout. Approximately 16 landings will be located within the Riparian Reserves, usually at intermittent stream headwaters, and will also be within 0.75 RM of a stream containing CR bull trout. The closest of these landings to a stream with CR bull trout is within unit 15 and is approximately 0.25 RM from the Muddy River. The other 15 landings are between 0.5 and 0.75 RM away from Clear Creek, Muddy River, and the unnamed eastern tributary to Pine Creek. Building and using these landings will result in approximately 2 acres of ground disturbance within the Riparian Reserves.

The following road-related activities that are expected to measurably elevate instream sediment levels in the Muddy River and the unnamed eastern tributary to Pine Creek, which are designated EFH for chinook and coho, are:

(1) 6 culvert replacements, failed fill repair, re-establishment of the drainage ditch lines, and 3 miles of aggregate surfacing on FR 2588 (0.5 RM from EFH in the unnamed eastern tributary to Pine Creek),
(2) culvert unplugging and maintenance, rebuilding drainage ditches, drainage ditch maintenance, and spot rocking on FR 8320 (0.5 RM from EFH in Pine Creek),
(3) temporary road reconstruction, including three intermittent stream crossings, in unit 31, approximately 0.1 RM, 0.15 RM, and 0.25 RM to EFH in Pine Creek,
(4) road decommissioning 0.7 miles of FR 8322-560, near unit 27, containing two intermittent stream crossings located approximately 0.75 RM and 1.0 RM from the Muddy River.

For these reasons, the designated EFH for coho and chinook is expected to be adversely affected by the Proposed Action of the Wildcat Timber Sale and, therefore, the determination is **may adversely affect**.

Cumulative Effects to Fish and Fish Habitat

Alternative A, the No Action alternative, would not contribute to any cumulative effects resulting from other actions/projects occurring in the Pine Creek, Muddy River, Clearwater Creek, and Clear Creek 6th field watersheds. The effects described above for Alternatives B and C would be cumulative with other actions in the Lewis River-Swift Reservoir and Muddy River 5th field watersheds that have occurred, are occurring, or would occur in the foreseeable future forms that would contribute to increases in sediment, turbidity, substrate embeddedness, temperature, drainage network, road network, peak/base flows, migration barriers, and negative impacts to Riparian Reserves. Some of these contributing actions/projects are:

1. General forest road use and maintenance that contributes to the sediment, turbidity, and substrate embeddedness of the streams;
2. Permanent road use and temporary road construction, use, and decommissioning that are part of other projects that contribute to stream sediment, turbidity, substrate embeddedness, drainage network, road density and location, including the Clear Creek Roads Project and the Wildcat Timber Sale DEF;
3. Additional road stabilization, road closures, and culvert replacements that may be undertaken in the future by the Forest Service, such as the stream crossing improvements that may be proposed in the Clear Creek Roads Project and the Wildcat Timber Sale DEF, that may affect stream sediment, turbidity, substrate embeddedness, road density and placement, peak/base flows, drainage network, and migration barriers;
4. Riparian thinning, temporary road construction, and road decommissions associated with timber harvest projects, such as the Wildcat Timber Sale DEF and other future timber sales that may affect levels of instream sediment, turbidity, substrate embeddedness, temperature, drainage network, peak/base flows, and the Riparian Reserves.
5. Riparian thinning, riparian planting, removal of riparian invasive plants, instream large wood placement, streambank and gravel bar large wood placement, and spawning gravel augmentation associated with proposed instream and riparian restoration projects, such as on the Muddy River, Clear Creek, and Pine Creek. These projects may affect stream sediment, turbidity, substrate embeddedness, temperature, pool frequency and quality, and Riparian Reserves.
6. Timber harvest and permanent and temporary road construction associated with timber harvest on private lands that may affect instream sediment, substrate embeddedness, turbidity, temperature, drainage network, road density and placement, peak/base flows, streambank condition, width/depth ratio, floodplain connectivity, refugia, large woody material, pool frequency and quality, migration barriers, and Riparian Reserves.
7. Timber harvest, permanent road building, and permanent infrastructure building (residential housing development) on private lands, particularly in the Pine Creek and Muddy River 6th field watersheds, that may affect chemical contaminants-nutrients, instream sediment, substrate embeddedness, turbidity, temperature, drainage network, road density and placement, peak/base flows, streambank condition, width/depth ratio, floodplain connectivity, refugia, large woody material, pool frequency and quality, migration barriers, and Riparian Reserves.

The potential to experience cumulative effects, particularly sedimentation-related effects, to perennial fish-bearing streams is high in the Pine Creek sub-watershed and low in the other three sub-watersheds with the implementation of Alternative B, the Action Alternative, and neutral with Alternative A, the No Action Alternative. The potential for cumulative sedimentation or turbidity effects is low from the combined actions of Wildcat Timber Sale and the projects/actions listed above due to: (1) the projects/actions occurring across several 5th and 6th field watersheds and being implemented across several years and (2) the road improvements/decommissions and similar mitigation measures and BMPs being implemented at many of the projects. Road improvements that incorporate road closure or decommissioning may result in short-term increases of sediment. Fish and their habitat, particularly in the Pine Creek sub-watershed, would potentially be impacted in the short-term because of the amount of sediment generated through the first winter flush. However, it is reasonable to assume that it

would be difficult to discern the amount from natural variability in watersheds and above the sediment naturally-produced from the lahar. Long-term benefits would be derived from road decommissioning or road improvements because of standards that provide for full fish passage or adequately sized culverts and natural processes within ephemeral-intermittent drainages would not be compromised.

Any sediment delivered to the streams in the Wildcat Timber Sale analysis area from the aforementioned projects is presumed to move through in medium to high (Pine Creek) and small (Muddy River, Clear Creek, Clearwater Creek) pulses through time and be in quantities that are too small to be discernible from background levels. Even in Pine Creek, the quantities, timing, and transport rate are considered to be similar to the sediment regime under which the aquatic ecosystems in the analysis area evolved, particularly because of the large sediment loads experienced due to the 1980 volcanic eruption.

Silviculture

Existing Condition

Plant Associations

The planning area lies within the Southern Washington Cascades Province of the Pacific Northwest (Franklin & Dyrness 1973). The vegetation is temperate coniferous rainforest. The stands proposed for treatment are within the Western Hemlock Zone (Topic et al 1986).

Present vegetation within units is described by plant associations (Table 16). Most western hemlock plant associations are represented except for extreme dry and extreme wet. All of these plant associations indicate productive forests that are suitable for sustained timber management. The sites are in the upper echelon of forest productivity for the Gifford Pinchot National Forest.

Table 16. Wildcat Plant Associations

Plant Association	Site Characteristic	Timber Productivity	Project Units
Western hemlock / swordfern (CHF125)	Moist and warm, lower slope positions	High	3,10,25,
Western hemlock / vanilla-leaf (CHF221)	Mesic and warm	High	7,11,22,
Western hemlock / dwarf Oregon grape (CHS125)	Mesic and cool	Moderate-High	1,8
Western hemlock / dwarf Oregon grape / swordfern (CHS126)	Mesic, warm sites	High	9,16,23,26,
Western hemlock / dwarf Oregon grape / salal (CHS127)	Mesic, upper slope positions	Moderate-High	12,13,14,15,19,30
Western hemlock / Alaska huckleberry/ salal (CHS614)	Mesic, cool sites	Moderate	17,31,
Western hemlock / Alaska huckleberry / dogwood bunchberry (CHS615)	Mesic, cool sites	Moderate-High	5,23,24,27,29,32,33,34
Western hemlock / dogwood / vanilla-leaf (CHS224)	Dry, warm sites	High	4

Stand History, Structure, and Composition

All Wildcat stands being proposed for treatment originated following clearcut harvests that occurred between 1960 and 1980. These traditional clearcuts removed all of the commercial-sized trees. Cutting extended to the channels of both intermittent and perennial streams. The resulting slash was typically broadcast burned and the area was hand planted to Douglas-fir at densities of 450 to 600 seedlings per acre. Exceptions to this occured within Unit 33 where the unit appears to have been machine piled, burned, and left for natural regeneration, as were small portions of Unit 31, 32, and 34. Most stands received a pre-commercial thinning near age 20 to reduce Douglas-fir density to near 350 trees per acre with the exception of Units 12, 14 and 33.

Today, Wildcat stands are between 30 and 50 years of age. The most prevalent tree species in nearly all stands is Douglas-fir (*Pseudotsuga menziesii*) comprising 80% of the trees per acre and 85% of the basal area. In Units 33 and 34, westestern hemlock (*Tsuga heterophylla*), and Pacific silver fir (*Abies amabilis*) predominate. Other tree species present include western red cedar (*Thuja plicata*), western white pine (*Pinus monticola*), noble fir (*Abies procera*), red alder (Alnus rubra), black cottonwood (*Populus trichocarpa*), and Pacific yew (*Taxus brevifolia*). These other trees seeded or sprouted naturally following clearcutting, though some were advanced regeneration (survivors from the clearcutting and burning).

Largely due to planting, these stands are rather uniform in tree size and spacing. Most of these stands' basal area is in trees 7-17 inches dbh, with quadratic means averaging 12 inches. Trees in the co-dominant crown class are 70-90 feet tall. These stands are best described as having a single canopy story and in the stem exclusion phase of development (Oliver and Larson 1990).

Tree density is high in all units with 150-300 trees per acre. Wildcat stands have an average relative densities (Curtis 1982) of 64, and some exceed 80 (adequately stocked stands are near 40). This density has yet to greatly affect the growth rates of the largest trees, but stands as a whole are showing stagnant or declining diameter growth. Tree mortality due to the effects of suppression was not widely apparent. Some stands had stem collapse and broken tops due to snow, a reflection of poor height to diameter ratios. Mortality from armillaria root rot (*armillaria mellea*) often a result of suppression and poor vigor, was seen in Unit 31.

Disturbance agents have not had a big influence on stand structure in these stands. Windthrow has been significant in the western 11 acres of Unit 21, but it is of little significance elsewhere. Laminated root rot (*phellinus wierii*) is endemic throughout the area and causing some small pockets of Douglas-fir mortality. Some western white pine that was planted in response to the laminated root rot is present and has white pine blister rust (*Cronartium ribicola*). Black bears have girdled trees in nearly all units, especially enjoying western white pine where they can find it. As trees get larger, bear impacts should decline. Hemlock dwarf mistletoe (*aceathobium tsugensis*) affects many of the native western hemlock.

Given these stands' management history, there are very few (< 1 per acre) remnant downed logs, and virtually no remnant snags. New recruitment of snags and downed logs is low (<2 per acres), and are of small diameter.

Environmental Effects

Development of Late-Successional and Old-Growth Attributes in Mid Seral Forests in the Lewis LSR

Alternative A – No Action

Direct and Indirect Effects

Commercial timber harvest within an LSR is permitted when it promotes the development of late-successional and old-growth attributes. To demonstrate the different outcomes between no action and thinning, Wildcat stand growth was simulated using the Forest Vegetation Simulator Growth and Yield Model (Suppose Version 2.02, Western Cascades Variant).

Wildcat Units 1 and 8 were simulated. These two stands represent the extremes of tree density that currently exist in the LSR plantations that are being considered for thinning. Unit 1 has a Curtis relative density of 93 which is extremely dense. Unit 9 has a Curtis relative density of 41 with is in the realm of fully stocked. Both stands are near 40 years old.

Under no action, stands would be left to develop without any direct human manipulation, except for the suppression of wildfires. There is little natural disturbance from insects or disease in these stands and none was modeled. No indirect impacts from global warming or other atmospheric change were modeled.

The simulation used stand exam information for Units 1 and 8 that was measured in 2008. The following figures show the distribution of trees by their diameters for year 2010 and year 2050 when the stands would be 80 years old if no action takes place.

Both Unit 1 and 8 are characterized by a single canopy story comprised of Douglas-fir and lesser amounts of western hemlock or Pacific silver fir. Over the next 40 years the overstory will likely remain intact and differentiate little. The more diverse seedling/sapling layer will remain stunted by the lack of light (80-95% canopy cover) and growing space both above and below ground.

The attainment of late-successional and old-growth attributes is of particular interest. This assessment uses Research Note PNW-447 (USDA-FS 1986) to define these attributes (Table 17).

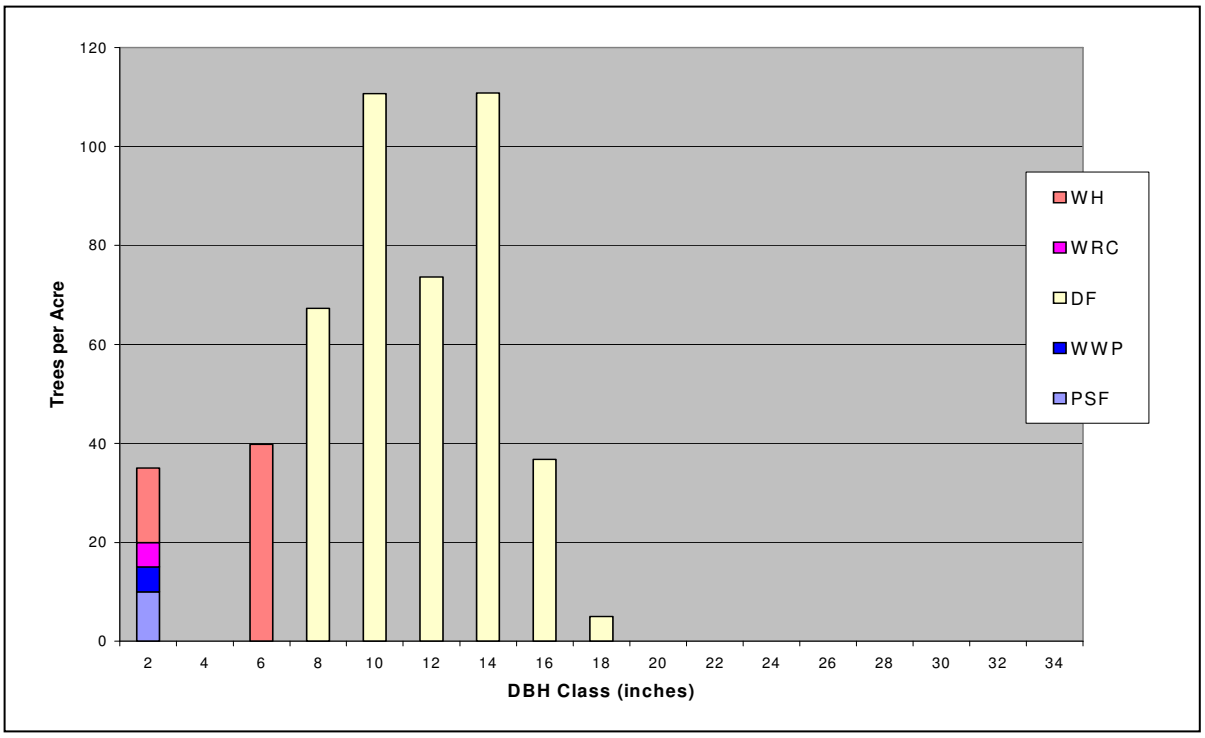


Figure 13. Wildcat Unit 1 Year 2010 Tree Distribution by Diameter Class. (Species abbreviations: DF – Douglas-fir, PSF – Pacific silver fir, WH – western hemlock, WRC – western red cedar, WWP – western white pine, RA – red alder)

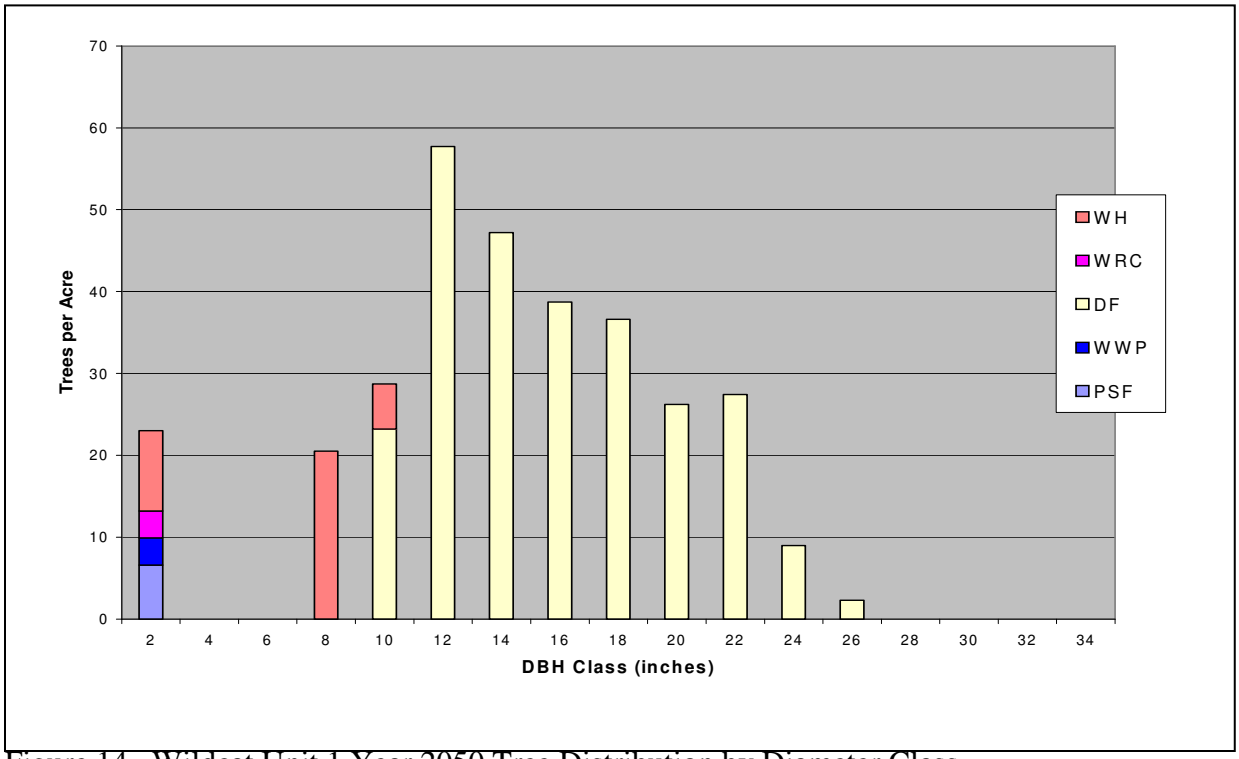


Figure 14. Wildcat Unit 1 Year 2050 Tree Distribution by Diameter Class.

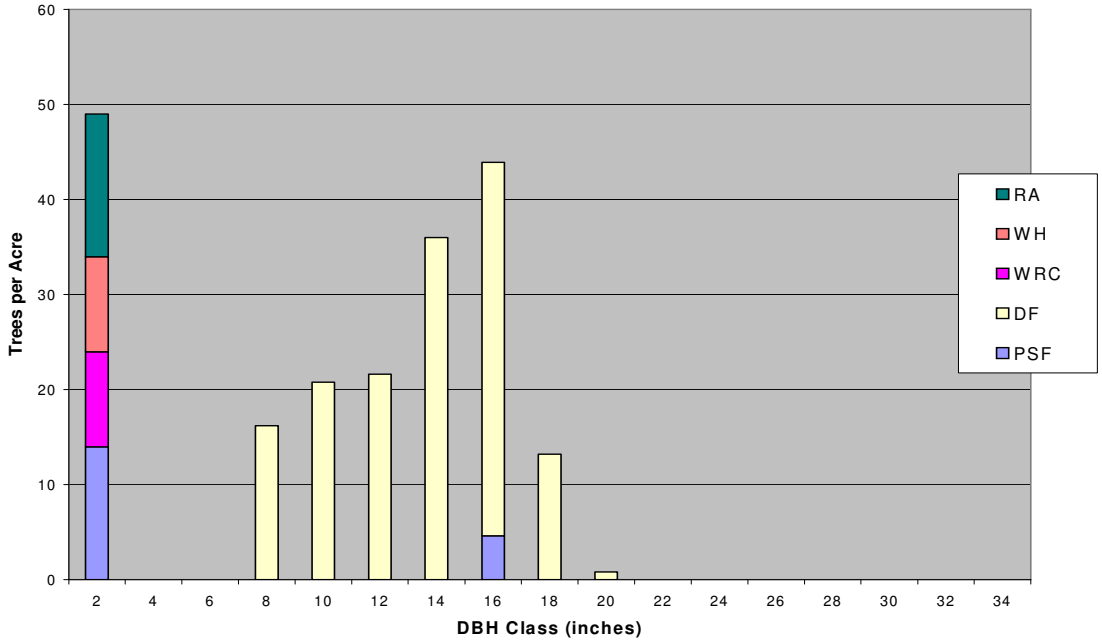


Figure 15. Wildcat Unit 8 Year 2010 Tree Distribution by Diameter Class.

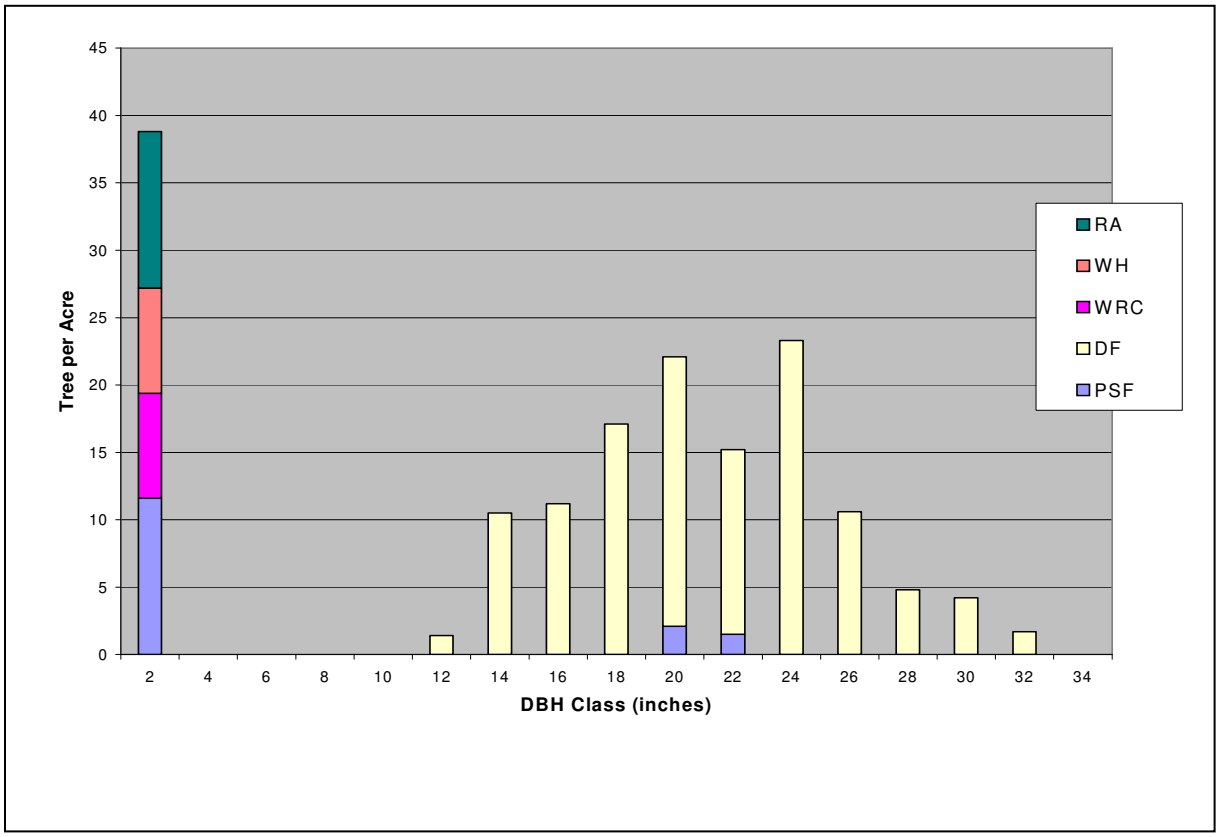


Figure 16. Wildcat Unit 8 Year 2050 Tree Distribution by Diameter

Table 17. Interim minimum standards for old-growth Douglas-fir and mixed conifer forests in western Washington and Oregon, and in California	
Stand Characteristic	**Douglas-fir on western hemlock sites (western hemlock, Pacific silver fir)**
Live Trees	2 of more species with wide range of ages and tree sizes Douglas-fir >8 per acre of trees >32-in diameter or >200 years old. Intolerant (INT) associates (western hemlock, western red cedar, Pacific silver fir, grand fir, or bigleaf maple) ≥12 per acre of trees >16-in diameter
Canopy	Deep, multilayered canopy
Snags	Conifer snags ≥4 per acre which are >20-in diameter and >15 ft tall
Logs	Logs ≥15 tons per acres including 4 pieces per acre ≥24-in diameter and >50 ft long

Wildcat Units 1 and 8 were simulated out to year 2170 when they will be 200 years old and old growth attributes characterized by decade (Table 18).

Table 18. Attainment of Old-Growth Attributes with No Action

		Wildcat Unit 1 No Action				Wildcat Unit 8 No Action			
Year	Age	Doug Fir/Ac >32 in	Int./Ac >16 in	Snags/Ac >20 in	Logs Tons/Ac >12 in	Doug Fir/Ac >32 in	INT/Ac >16 in	Snags/Ac >20 in	Logs Tons/Ac >12 in
2010	40	0	0	0	5	0	0	0	5
2020	50	0	0	0	4	0	4	0	4
2030	60	0	0	0	4	0	4	1	4
2040	70	0	0	1	5	0	4	3	5
2050	80	0	0	4	7	0	4	6	7
2060	90	0	0	7	12	3	3	9	9
2070	100	0	0	11	16	6	3	12	13
2080	110	0	0	14	22	10	3	15	17
2090	120	0	0	17	26	14	3	17	22
2100	130	1	0	20	31	18	3	18	27
2110	140	5	0	22	36	25	2	20	32
2120	150	7	0	24	42	28	2	21	37
2130	160	9	0	25	48	30	2	21	42
2140	170	14	0	26	53	32	2	21	49
2150	180	17	0	26	59	32	2	22	55
2160	190	19	0	27	65	31	2	65	65
2170	200	22	1	26	72	34	2	72	71

If Unit 1 is left as is, it will take until year 2130 when the stand is 160 years old for there to be more than eight Douglas-fir trees per acre that are ≥32 inches DBH. Unit 8 with a lower tree density develops 10 old-growth sized trees per acre by year 2080.

Neither stand develops much of a mid story of light intolerant trees with diameters of 16 inches. Unit 1 currently has four Pacific silver fir per acre that are already 16 inches in DBH, but with no additional trees growing up from sapling layer, this mid story component declines over time.

Density in both stands drives mortality to create old-growth like snag and down log loads between the years 2050 and 2080.

Cumulative Effects

No other planned silvicultural activities within these stands or adjacent to them are planned. Several stands abut open roads that are annually maintained and used. These activities may have incidental impacts to trees abutting the roads, but no cumulative effect on overall stand development.

Alternative B – Proposed Action

Direct and Indirect Effects

Under Alternative B, commercial thinning on 960 acres of plantations within the Lewis LSR would occur. The thinning treatment seeks to reduce tree density by removing the smaller, predominant tree species (just Douglas-fir in most units) and leaving the larger trees and shade intolerant species. Small gaps, ¼ to ½ acre, would also be created and planted with shade intolerant conifers if necessary, to provide immediate spatial variation and future vertical differentiation.

Thinning treatments for Units 1 and 8 were simulated to occur in year 2010. Treatments would leave 185 trees per acre and 85 trees per acre, respectively. Post thin, Curtis relative density would be 45 and 25, respectively. Based on the trees per acre left, these treatments would be characterized as light and moderate thins. Gaps were incorporated into the thinning simulation; the no treatment areas (e.g. skips, inner Riparian Reserves) within the stands were not (see the no action simulations for changes in the no treatment areas).

The following figures show the distribution of trees by their diameters for year 2010 (post thin) and year 2050 when the stands would be 80 years old. A primary effect of thinning is an increase in growing space that allows the largest trees in the stand to continue their rapid juvenile growth in diameter, height and crown. This allows both Units 1 and 8 to attain 10 Douglas-fir >32 inches DBH by years 2120 and 2070, respectively (Table 19). This is ten years earlier that would occur under no action.

Figure 17. Wildcat Unit 1 Year 2010 Post Thin Tree Distribution by Diameter Class.

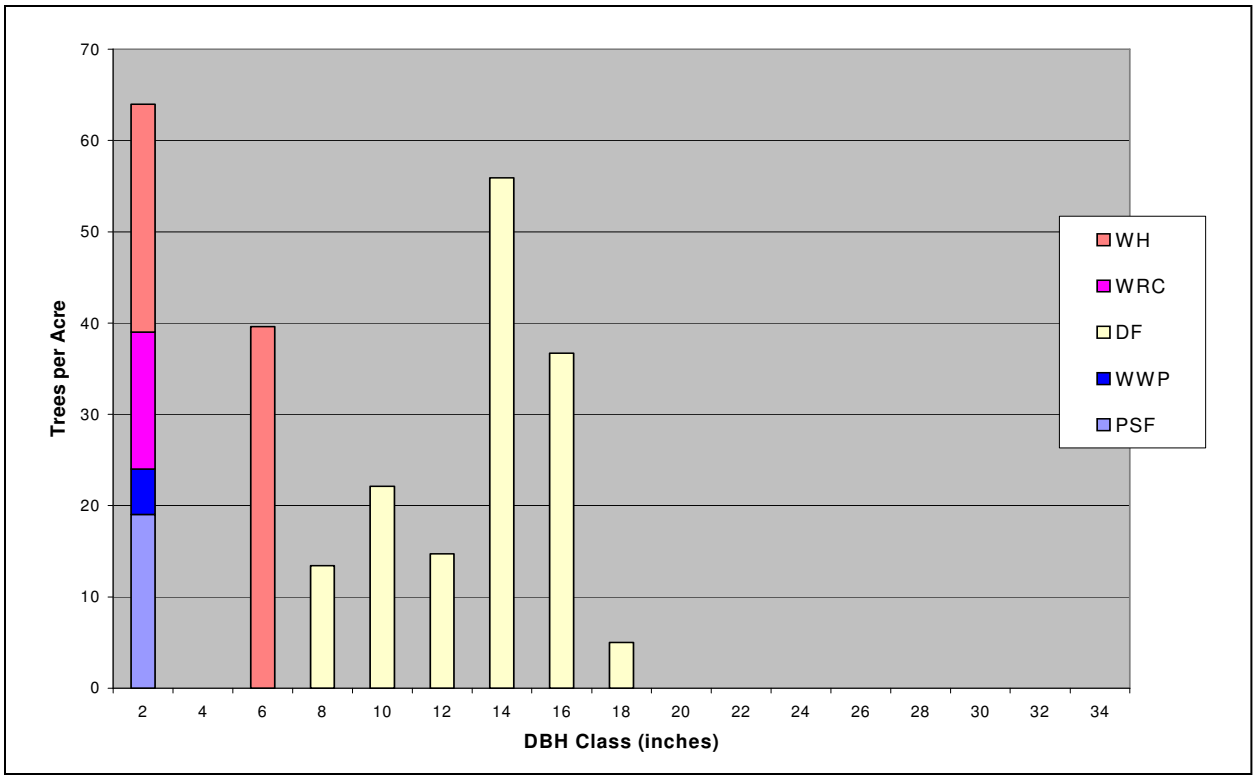
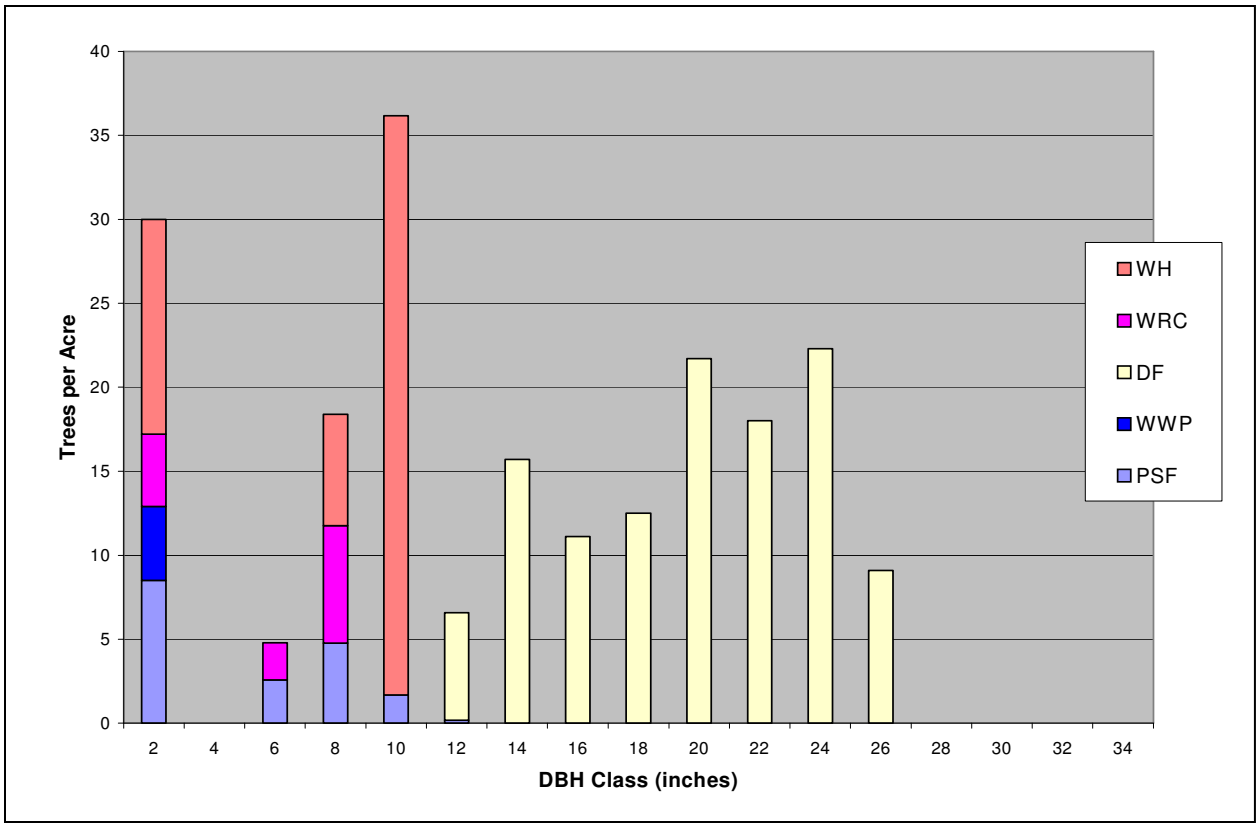


Figure 18. Wildcat Unit 1 Year 2050 Thinned Tree Distribution by Diameter Class.



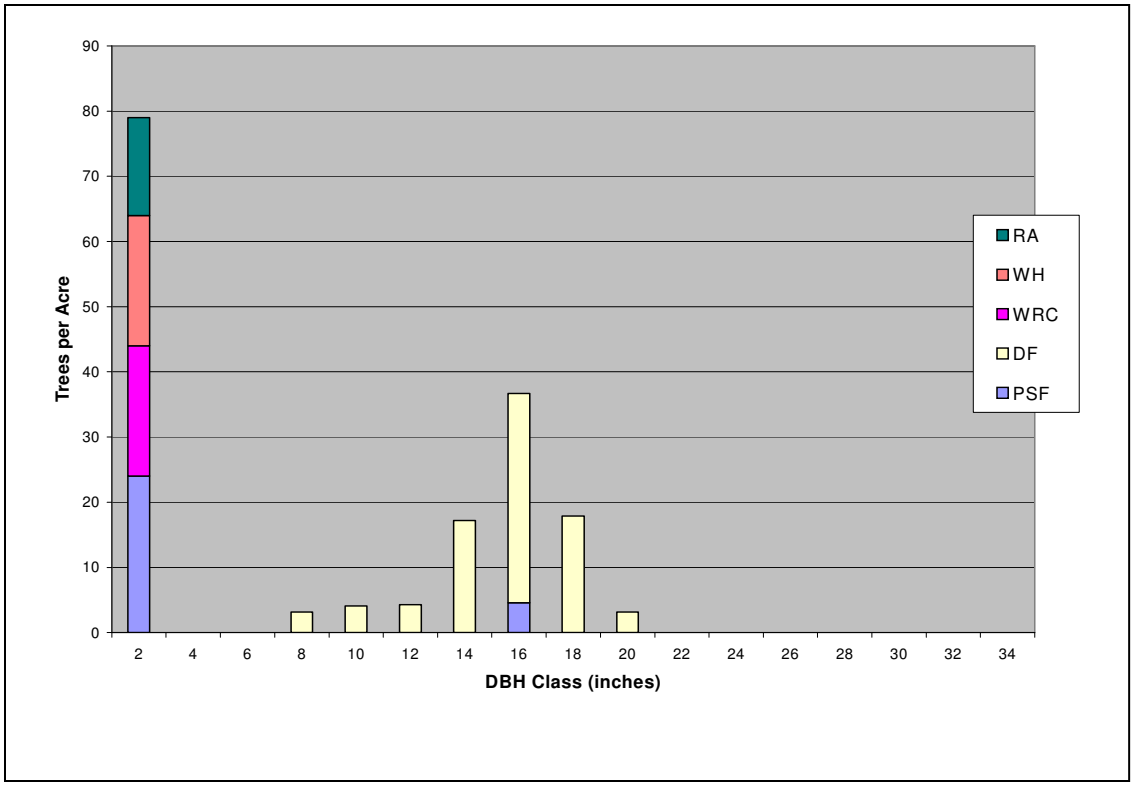


Figure 19. wildcat Unit 8 Year 2010 Post Thin Tree distribution by Diameter Class.

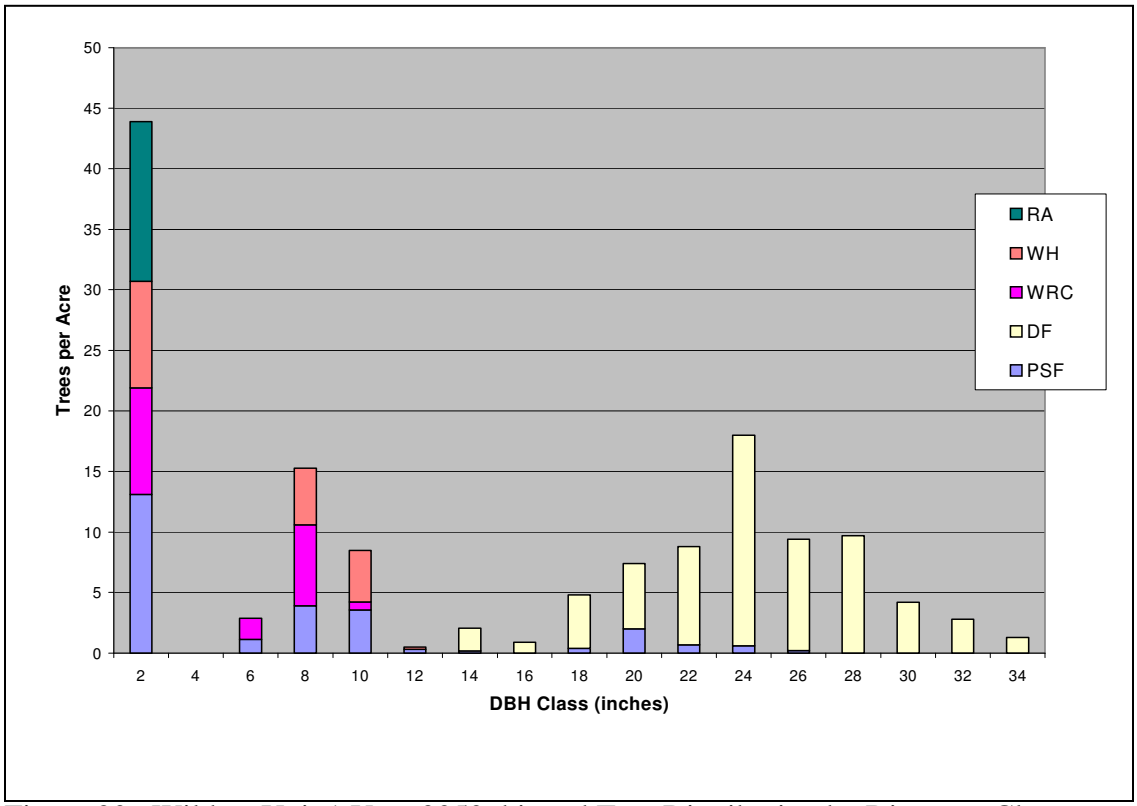


Figure 20. Wildcat Unit 1 Year 2050 thinned Tree Distribution by Diamater Class.

Table 19. Attainment of Old-Growth Attributes with Commercial Thinning

		Wildcat Unit 1 Thinning				Wildcat Unit 8 Thinning			
Year	Age	DF/Ac >32 in	Int./Ac >16 in	Snags/Ac >20 in	Logs Tons/Ac >12 in	DF/Ac >32 in	Int/Ac >16 in	Snags/Ac >20 in	Logs Tons/Ac >12 in
2010	40	0	0	0	5	0	0	0	7
2020	50	0	0	0	5	0	4	0	6
2030	60	0	0	0	6	0	4	0	5
2040	70	0	0	0	6	1	4	2	5
2050	80	0	0	0	5	2	4	3	5
2060	90	0	0	1	5	7	4	5	7
2070	100	0	0	3	5	13	4	6	8
2080	110	0	0	5	6	16	5	7	9
2090	120	0	0	8	9	20	7	9	12
2100	130	0	0	10	12	25	9	10	14
2110	140	2	2	12	14	30	11	10	17
2120	150	11	4	13	17	33	12	11	21
2130	160	16	5	15	21	35	13	11	25
2140	170	21	7	15	25	35	14	12	31
2150	180	24	11	16	29	35	14	12	37
2160	190	25	13	17	35	34	13	12	40
2170	200	28	17	17	40	35	13	12	44

Another primary effect is the development of mid canopy of large shade intolerant trees. The availability of growing space, both in the thinned areas and gaps, allows shade intolerant seedlings and saplings to develop into larger trees. By year 2120, Unit 8 has enough large, shade intolerant trees to meet old-growth requirements. The resulting varied and multi-layered canopy is important for several late-successional and old-growth dependent species. Under no action, there was virtually no mid canopy development from shade tolerant species.

Thinning delays the development of snags and downed logs due to a decrease in inter-tree competition and mortality. This delay is as much as 30 years when compared to no action. Consequently, the untreated areas (e.g. skips, inner riparian reserves) of Unit 1 and 8 become important in providing large snags and downed logs earlier in time. The mitigation measure to maintain 10 downed trees per acre provides a stop gap for this attribute, until natural down wood is generated.

Research on thinning in similar forests in the western Cascades of Oregon and Washington affirm the near term results of these simulations (Andrews et al 2005, Beggs 2004, Berryman et al 2005, Chan et al 2004, and Harrington et al 2005). Thinning maintains the rapid growth rates of the larger trees, particularly those near created gaps, landings, and temporary road. Variable density techniques promote both spatial and vertical heterogeneity.

Cumulative Effects

Similar to no action, there are no other planned silvicultural activities within these stands or adjacent to them, that would have a cumulative effect to stand development.

While not planned at this time, opportunities remainfor future silvicultural treatments that would help these stands attain late-successional and old-growth attributes. Both Units 1 and 8 could benefit from the artificial creation of snags and downed logs near year 2050 and stand age 80. Due to thinning, there will be an adequate base of large (>24 inches DBH) trees at that time from which snags and downed logs could be created. There will be 16 and 36 large trees per acre in Units 1 and 8, respectively.

Unit 1 would retain a high relative density and trees per acre and could benefit from an additional commercial thin near year 2050 and stand age 80. The need for additional treatments to attain old-growth attributes where light thinning was previously employed has been recognized in both the Bureau of Land Management Density Management Study (Cissel et al 2006) and the Olympic Habitat Development Study (Harrington et al 2004). A future thinning would be instrumental in maintaining growing space for large trees and shade intolerant mid story trees. It would be helpful for establishing an additional age class of trees. It would also provide the economic means for artificially creating large snags and downed logs. Other Wildcat LSR units that would retain a high relative density include Units 7, 10, 11, 13, and 27.

Sensitive Botanical Species

A complete Botanical Resource Report, which incorporates a biological evaluation is located in the project file. It was written, in part, following the guidance provided in FSM 2672.4 which establishes the objectives, standards, and process for conducting biological evaluations. It also follows the guidance, in part, provided in a letter to Forest Supervisors, dated August 17, 1995 (file code 2670/1950) that outlines a process for streamlining biological evaluations and conclusions for determining effects to listed, proposed and sensitive species. It includes analysis for Threatened, Endangered, Proposed and Sensitive (TEPS) plant species. A summary of the findings included in the report and biological evaluation is included below.

Existing Condition

The forests in the planning area are located within the western hemlock vegetation zone (Franklin & Dyrness 1973). The dominant overstory cohort of trees within units included *Pseudotsuga menziesii* (Douglas-fir), and *Tsuga heterophylla* (western hemlock), with some *Thuja plicata* (western redcedar), *Abies amabilis* (Pacific silver fir), *Taxus brevifolia* (Pacific yew), *Populus trichocarpa* (black cottonwood), and *Pinus monticola* (western white pine). *Alnus rubra* (red alder) is often found in the riparian zones. Some units contain springs and wetlands, a few units contain remnant older trees, and many units contain large rotting logs.

Unit 1: The overstory of this stand is dominated by young Douglas-fir (~ 40 yrs old,, 10-20 inches in diameter), with some western hemlock on moist aspects, and the understory is made up of sparsh salal and *Berberis nervosa* (Oregon grape), as well as some *Vaccinium alaskanse* (Alaska huckleberry). The stand aspect is predominantly westerly, with some south and north

aspects, and the topography ranges from flat to quite steep in riparian zones. There is a large hardwood stand and meadow in the flat area in the east part of the unit, with cottonwood, willow, oceanspray, redtop, yarrow, western fescue and yellow rattle (*Rhinanthus*). Unusual plants found within the meadow include a small population of *Botrychium multifidum* in the north part of the meadow (near tansy ragwort (*Senecio jacobaea*)), and a patch of *Buxbaumia aphylla*, on the northwest edge of the meadow, where it borders forest, north of road 2560.

Unit 2: The overstory of this stand is dominated by Pacific silver fir, western redcedar, and red alder. The stand has a primarily western aspect, and a fairly steep slope.

Unit 3: The overstory of this stand is dominated by Douglas-fir (~ 40 yrs old), with younger trees present in scattered canopy openings, with sparse western hemlock on the lower slope. The understory is dominated by Oregon grape, salal, and Alaska huckleberry, with some *Polystichum munitum* (swordfern) and *Pteridium aquilinum* (bracken fern). Within this unit, the central draw contained a small stream, which was sometimes braided through patches of red alder. The riparian zone contained old growth remnant trees, and many large downed logs.

Units 4 and 5: The topography of these units is undulating, with slopes flat to moderate; the aspect is predominantly east-facing. The overstory of these units is dominated by even-aged Douglas-fir (average dbh of ~ 8-10 inches), with partial to closed canopy, with scattered Pacific silver fir (uplands) and red alder (riparian). The understory is dominated by young western hemlock, vine maple, Alaska huckleberry, and Oregon grape. Dominant herbs include *Tiarella trifoliata* (foamflower), *Achlys triphylla* (vanilla leaf), *Cornus canadensis* (bunchberry), *Trientalis latifolia* (starflower), and swordfern. There are scattered stumps within the stand, but few sizeable downed logs; the best downed woody debris is within riparian zones. Within the unit's northern area, there are some larger (mature) trees and canopy gaps that host greater non-vascular epiphyte diversity.

Unit 7: This unit is dominated by a dense, even-aged Douglas-fir overstory (~10-18 inch dbh), with an understory of Alaska huckleberry, vine maple, and Oregon grape dominant in the understory, and a sparse herb layer. Some red alder is found within riparian zones, and a few black cottonwood Exist. Down woody debris is patchy. Stand aspect is primarily south and southeasterly.

Unit 8: The overstory of this stand is single layer, and includes Douglas-fir, Pacific silver fir, western hemlock, and some western redcedar. The understory is dominated by Alaska huckleberry, salal, *Rubus lasiococcus* (dwarf bramble), and Oregon grape, with scattered bunchberry, *Osmorhiza chilensis* (sweet cicely), and swordfern. The stand is moderately sloped, with primarily south and east aspects. A fair number of large logs exist in a late state of decay.

Unit 9: This is a mid slope stand with an east to southeast aspect, with a dense, even-aged canopy dominated by Dougas-fir that are ~ 10-18 inches in diameter. Alaska huckleberry dominates the shrub layer, and herbs are sparse. Red alder is found within riparian zones. Large woody debris is patchily distributed. There is a ¼ acre rock outcrop located at the west edge of the unit. Note that approximately 14 acres of stand tag 100745 was added to unit 9 after the end of botanical field season. For more information, refer to section IV. Analysis Methodology.

Unit 10: This unit is a mostly closed canopy stand dominated by Douglas-fir, with some western hemlock, and few western redcedar. Dominant understory shrubs included *Vaccinium ovalifolium* (oval-leaf huckleberry), Alaska huckleberry, *Vaccinium parvifolium* (red huckleberry) and *Holodiscus discolor* (oceanspray). The herb layer was comprised primarily of swordfern, with some *Hieracium albiflorum* (white hawkweed), *Linnaea borealis* (twinflower), and *Pyrola picta* (variegated wintergreen). The unit is primarily east facing with moderate slopes. There is some large woody debris patchily distributed within the unit.

Unit 11: This unit is dominated by Douglas-fir, western hemlock and Pacific silver fir. Understory shrubs include vine maple, red huckleberry, *Vaccinium membranaceum* (black huckleberry), oval-leaf huckleberry, oeanspray and *Rosa gymnocarpa* (dwarf rose), with *Ribes lacustre* (prickly currant) growing in moist areas. Understory herbs include twinflower, vanilla leaf, *Vancouveria hexandra* (inside out flower), *Chimaphila umbellata* (wintergreen) and bunchberry. There are a number of scattered large downed logs present with the unit, but most are in an advanced state of decay.

Unit 12: This moderately steep west/south-west facing unit is dominated by very dense young Douglas-fir with trees generally less than 7 inches in diameter. The shrub layer is sparse, and comprised of Oregon grape and salal. Few herbs, including vanilla leaf and swordfern exist. Large stumps are common, while large downed logs are occasional, and distributed throughout the unit.

Unit 13: This unit is steep, with a westerly aspect. The forest canopy is dominated by moderately to very dense Douglas-fir , with scattered western hemlock and occasional western red cedar. The unit has a sparse understory, with young western hemlock, and a shrub layer with vine maple, Oregon grape and salal. The herb layer is sparse throughout most of the unit, with vanilla leaf and swordfern. There is a wetland along a stream in the southernmost draw (approximately 50 X 25 ft.) with *Athyrium filix-femina* (lady fern), *Lysichiton americanus* (skunk cabbage), *Oxalis oregana* (wood sorrel), and *Veronica americana* (American speedwell). Large stumps and logs are common throughout much of the unit, especially in the draws. There is a landslide area located just north of the main stream within the steep, deeply cut draw.

Unit 14: This stand is located on a moderately steep slope with a northwesterly aspect. The upper portion of the unit contains the top of a flat to gently sloping knoll. The overstory is comprised of very dense even aged Douglas-fir, with a sparse second canopy of western hemlock. The understory shrub and herb layer is patchy and sparse, with vine maple, Oregon grape, red huckleberry, vanilla leaf and swordfern. Large stumps are frequent within the stand, but large woody debris is sparse. There is a headwater wetland in the draw on the south side of this unit, that is approximately 10 to 25 ft. wide and 200 ft. long; it has a red alder canopy with lady fern, *Circaea alpina* (enchanter's nightshade), wood sorrel, skunk cabbage and a rich carpet of bryophytes. The upper portion has a mucky sustrate, while in the lower portion the water is seeping over and through a rocky substrate.

Units 6 and 15: These units were added to the Wildcat project during 2008, after the end of botanical field season. Habitat information is limited; surveys for these added units or parts of units will be performed during field season 2009 before any on-the-ground activities occur.

Unit 16: This unit has moderately steep slopes and a generally western aspect. The overstory is dominated by dense to patchy Douglas-fir. The understory is sparse, with western hemlock and a sparse-patchy shrub layer, including vine maple, red huckleberry, Oregon grape, and salal. The herb layer is sparse, and includes *Anemone deltoidea* (Columbian windflower), sweet cicely, twinflower, *Adenocaulon bicolor* (pathfinder), *Viola sempervirens* (evergreen violet), and sword fern. Remnant logs, stumps and root wads are scattered throughout the stand. Riparian corridors host red alder and scattered black cottonwood, with lady fern, *Claytonia sibirica* (Siberian miner's lettuce) enchanter's nightshade, *Viola glabella* (stream violet), and skunk cabbage.

Unit 17: This unit is moderately sloped with a western aspect. The unit consists of a dense, single canopy Douglas-fir stand with few western red cedar. In the understory, shrubs include red huckleberry, Oregon grape and salal. The sparse herb layer includes twinflower and bracken fern.

Unit 18: This unit is located on moderate to steep lopes with a generally southeasterly aspect. The overstory is a moderately dense to dense canopy dominated by Douglas-fir, with scattered western hemlock and occasional western redcedar. There is a sparse young canopy cohort of western hemlock, and a sparse to patchy shrub layer dominated by vine maple, Oregon grape and salal. The herb layer is sparse with pathfinder and vanilla leaf dominant. There were few scattered large logs within the unit.

Unit 19: Note that stand tag 100569 was added to the analysis area, and to Unit 19, after the close of botanical field season, and has not been surveyed (see Section IV. Analysis Methodology). As a result, the unit description provided here reflects conditions within stand tag 100421 only. This unit is on a moderately steep to undulating slope, with north to east aspects. The overstory is moderately dense, and dominated by Douglas-fir, with scattered western hemlock and western redcedar; a second understory cohort is of sparse western hemlock saplings. The shrub layer is moderately dense, with vine maple, Oregon grape, salal and red huckleberry. The herb layer is sparse with swordfern, bracken fern and vanilla leaf. The south side of the western edge of the unit extends into old growth to the west (this reflects a mapping error; this old-growth portion will not be included within the harvest area (personal communication, Jon Nakae, 2009)). This area contains an open overstory of Douglas-fir, western hemlock, and western redcedar with many broken tops.

Unit 21: In this unit, the overstory is dominated by dense Douglas-fir, western hemlock, and western redcedar, with some Pacific yew, with few natural canopy gaps. Riparian zones host red alder. The shrub layer is dominated by vine maple, with some red huckleberry and Oregon grape. Little large woody debris exists and much of it was less than 3 ft in diameter.

Unit 22: This unit is gently sloped, with a generally northern aspect. The overstory is moderately dense and dominated by Douglas-fir, with scattered western hemlock, Pacific silver fir, and western redcedar; a sparse second canopy layer is of western hemlock saplings. The shrub layer is moderately dense, with vine maple, Oregon grape, red huckleberry and Alaska huckleberry (which was dense in patches). The herb layer is sparse with sword fern, bracken fern and vanilla leaf dominant. Riparian red alder was very sparse, as was large woody debris.

Unit 23: The topography of this unit was various, with a small summit in the southeast portion, and generally northerly and westerly aspects. The overstory is dominated by Douglas-fir, with some western hemlock. The shrub layer is dense in places, with oval-leaf huckleberry, vine maple and Oregon grape.

Unit 24: Within this unit, the overstory is dominated by Douglas-fir, western hemlock and western redcedar, with occasional Pacific yew. The shrub layer is dominated by vine maple, Alaska huckleberry, and Oregon grape. Red alder was found within riparian areas. There is one band of cliffs that passes through the unit, and is approximately 50 ft. high. This cliff band creates waterfalls on both branches of the small creek that passes over them. There is a conspicuous lack of large woody debris within the unit.

Unit 25: This unit is moderately steep, with a northwest to northeast aspect, and is deeply dissected with several draws containing small streams. The overstory is dense, and dominated by Douglas-fir, with scattered western hemlock and occasional western redcedar. The dense shrub layer is dominated by vine maple, Oregon grape, oval-leaf huckleberry, and salal. The herb layer is sparse, with vanilla leaf, twinflower and swordfern. Riparian zones within this unit are characterized by dense vegetation (consisting of red alder, vine maple and *Rubus spectabilis* (salmonberry)).

Unit 27: Note that a portion of stand tag 100158 was added to the analysis area, and to Unit 27, after the close of botanical field season, and has not been surveyed (see Section IV. Analysis Methodology). As a result, the unit description provided here reflects conditions within stand tag 100087 only. This unit is moderate to steeply sloped with a north to northwesterly aspect. The dense overstory is dominated by Douglas-fir, with scattered western hemlock and occasional western redcedar. A second canopy layer is sparse with small western hemlock. The shrub layer is moderately sparse to dense, with vine maple, Oregon grape, and salal. The herb layer is generally sparse with pathfinder and starflower. Riparian zones hosted red alder. There were large down logs scattered throughout the unit.

Unit 29: This unit is gently sloped with all aspects represented due to a small flat peak in the center of the unit. The overstory is co-dominant Douglas-fir, western hemlock and Pacific silver fir. The shrub layer is moderate to dense in some areas and consists largely of vine maple. The herb diversity is very low. Few canopy gaps within the stand exist. Few large diameter down logs were present in the stand. A boggy wetland area exists near the road in the southeastern portion of the unit hosting a riparian community.

Unit 30: Part of this unit is extremely steeply sloped, with a southwest facing aspect. Within the unit, there are bands of sandstone cliffs. This unit is deeply dissected with several east to west running draws with sharp ridges between. The draws generally contain active creeks that are often eroded down to bedrock, and generating a series of waterslides and waterfalls passing through the cliff bands. A 100+ ft. waterfall exists in the northern edge of the unit where multiple streams come together to form the primary north to south flowing stream. Erosion and unstable, downward migrating soils are common in this survey area. West of the stream, the landscape is more flat, with moderate hills and an undulating topography. The forest overstory consists of a moderately dense canopy of Douglas-fir, with scattered western hemlock and

occasional western redcedar, in draws and riparian areas. A dense shrub layer is dominated by vine maple, Oregon grape, red huckleberry and salal. A sparse herb layer includes vanilla leaf, bunchberry, twinflower, bracken fern and swordfern. Occasional *Abies grandis* (grand fir) and Pacific yew exist in the upper elevations of the unit. Abundant down woody debris exists within the unit, particularly in riparian zones. Many large stumps occur in the western portion of unit.

Unit 31: This unit is flat to moderately sloped, with areas of planar to convex upland slopes, and shallow, dry draws, with a southeast facing aspect. The overstory is dominated by even-aged closed canopy Douglas-fir, with a second canopy of sparse pole-sized western hemlock and occasional Pacific silver fir. Hardwoods are scarce, except along old logging roads, where red alder is common. Shrubs include Oregon grape, Alaska huckleberry, and black huckleberry. There are occasional areas, mostly in clearings in the SW of stand tag 100094, that are dominated by dense *Vaccinium*. Common herbs include foamflower, vanilla leaf, inside-out flower, and scattered ferns, including swordfern, *Blechnum spicant* (deerfern), and ladyfern. Though there are scattered stumps, there are few sizeable logs or other large down woody debris.

Unit 32: The topography of this unit is mild, with flat to gentle slopes, and a generally southern aspect. This stand comprises a mostly closed canopy Douglas-fir dominated forest with some western hemlock and Pacific silver fir, with few Pacific yew, western white pine and black cottonwood. The shrub layer is moderately dense to dense, and is dominated by oval-leaf huckleberry, Alaska huckleberry, red huckleberry, and *Holodiscus discolor* (oceanspray). Few canopy gaps exist. The herb layer is sparse, with sword fern, bracken fern, *Fragaria vesca* (wild strawberry), and white flowered hawkweed. There is some coarse woody debris in late stage of decay present in the stand, but it is sporadic. There are some lupine filled grassy openings within stand tag 100092, and some small pockets of blowdown. In un-vegetated "tephra pits" within stand tag 100092, elk wallows are evident with heavy browsing on nearby shrubs.

Unit 33: This unit is gently sloped, with undulating topography, and a generally easterly aspect. The forest is patchy and sometimes dense, and comprised of a mixture of western hemlock, Pacific silver fir and Douglas-fir, with a sparse second canopy of western hemlock and Pacific silver fir. Black cottonwood is scattered on the slopes and adjacent to old roads, which are numerous throughout the unit. The shrub layer is often dense with vine maple and Alaska huckleberry, especially in canopy openings and to the south side of the unit. The herb layer is sparse with vanilla leaf, swordern, and *Lycopodium clavatum*. The upper portion of the tributary to Pine Creek meanders through a network of creek-side wetlands. This area contains a network of *Salix sitchensis* (sitka willow), and an herb layer including sedges, rushes, and a diversity of moisture loving herbs. There are also a number of seeps and springs in the northeastern part of the unit that begin within the unit and break out into channels in places and then flow subsurface for a while, only to break out again, as they approach the tributary stream. There are a number of grassy openings within this stand, that seem to be 'created' meadows, probably not recovered from previous timber harvest. Red alder is present only in a couple of patches. Many elk tracks were observed near the creek.

Unit 34: This unit is mildly sloped with a south to southeasterly aspect. The overstory is dominated by Douglas-fir, with Pacific silver fir and western hemlock. Occasional late seral

western hemlock are present, especially in the north-pointing "finger" of this unit. In these areas, huckleberry shrubs are dense. Herb cover is sparse. Large woody debris is uncommon.

Methodology

The Regional Forester currently lists 81 threatened, endangered, proposed and sensitive (TEPS) botanical species documented or suspected to occur on the Gifford Pinchot National Forest. This list was updated in January 2008 and includes 49 vascular plants, 16 lichens, 4 bryophytes and 12 fungi. Pre-field review documentation, including a list of all TEPS and other rare and uncommon botanical species documented or suspected to occur on the Gifford Pinchot National Forest is summarized in the botanical resource report, located in the Wildcat project file.

Units 6, 15, and portions of 9 (~ 14 acres), 19 (all of stand tag 100569), and 27 (5 acres), were added to the project analysis area during late summer 2008, after the end of the botanical field season. As a result, no surveys were completed in these units, and survey data was therefore unavailable for consideration in project planning, or impact analyses. To address these omissions, the following assumptions have been made:

1. Surveys for these added units or parts of units will be performed during field season 2009.
2. If occurrences of any TEPS, or other rare and uncommon botanical species are located within these units, these locations will be addressed in the same manner as recognized occurrences: i.e., occurrences will be protected through project design features such as buffers, and/or habitat preservation/creation, as documented within design features section.
3. If occurrences of special habitats (such as meadows, old growth legacy features, rocky outcrops, etc.) are identified within these units, they will be addressed in the same manner as recognized occurrences: i.e., mitigations designed to prevent or ameliorate impacts to these habitats/features will be recommended to the line officer, as documented in the mitigation measures section.

Field Surveys:

Botanical surveys were conducted in Wildcat Thin Timber Sale during summer of 2008. Surveys were conducted for sensitive botanical species, based on the Regional Forester's January 2008 list (USDA Forest Service 2008). Surveys for other rare and uncommon species were also conducted (a complete list of the rare and uncommon species can be found in the project file).

Survey-impractical species that are sensitive, rare, or uncommon depend on components of pre-project clearances other than surveys, including known site searches and habitat evaluations, to provide the information needed to analyze potential risks to the species resulting from project activities. This analysis is then used to prescribe project design features and/or mitigations to address these risks. Of the survey-impractical species not specifically targeted during surveys, the Wildcat project area may provide habitat for 11 fungi and one lichen species. These species are discussed in the Botanical Resource Report and summarized below within the Environmental Effects section.

Environmental Effects

Occurrences for three sensitive species were found within the Wildcat project area, including *Tetraphis geniculata*, *Peltigera pacifica*, and *Pseudocyphellaria rainierensis*. Special habitats, including wetlands, rocky outcrops, meadows, and hardwood gaps were located in some of units.

Threatened, Endangered & Proposed Plant Species

Alternatives A and B
Direct, Indirect and Cumulative Effects

At this time there are no federally listed (proposed, endangered, threatened - TEP) plant species known to occur on the Forest, however one federally threatened species (*Howellia aquatilis*) is suspected. *Howellia aquatilis* has an extremely narrow habitat tolerance, generally confined to wetlands with seasonal drawdown. Wetlands to be impacted by this project were surveyed and no TEP species were located. Thus, project alternatives will have **no effect** on federally listed botanical species.

Sensitive Species

Surveys performed within and immediately surrounding the project area located three sensitive species: *Peltigera pacifica, Pseudocyphellaria rainierensis,* and *Tetraphis geniculata*. A determination of impact for each species is documented below, and summarized in Table 3. Many resources were referenced in developing the rationale for effects determinations and recommended mitigations, including (but not limited to): Arora (1986), Castellano et al. 2003, Chen et al. 1990, Harpel and Helliwell 2005, Hitchcock et al. 1969, Lawton 1971, Lesher et al. 2000, Survey and Manage Management Recommendations for lichens and bryophytes, McCune and Geiser 1997, Pojar and MacKinnon 1994.

Tetraphis geniculata

Tetraphis geniculata is a bryophyte (moss) that grows on rotten stumps and logs, in shady, humid forests at low to middle elevations. The species ranges from northern California to Alaska. According to a 2005 ISMS query UPDATE, 103 sites for this species have been located in Washington and Oregon, 60 from the Gifford Pinchot National Forest. In addition, 34 new sites for this species were located during surveys of the Tee Timber Sale during 2005, 8 new sites were located during surveys of the Canyon Thin Timber Sale during 2006, and 17 new sites were located during surveys of the WinThin Timber Sale during 2007 (total now known from the Gifford Pinchot National Forest = 119 sites). Superficially, it appears that the Gifford Pinchot may provide some of the best habitat for this species within the Northwest Forest Plan area.

Tetraphis geniculata reproduces asexually by means of gemmae cups; when raindrops hit the cups, the gemmae are ejected out of the cups. The species also reproduces sexually though the production of capsules and spores. The success of the species in establishing itself on new substrate probably depends on propagules landing on large decaying wood that remains moist.

Threats to this species include disturbance of the coarse woody debris substrate, and alteration of the microclimate of the site through opening of the surrounding forest canopy (i.e. increasing solar and wind penetration, with subsequent dessication of coarse woody debris substrate) (Harpel and Helliwell 2005).

Alternative A – No Action
Direct, Indirect, and Cumulative Effects
Alternative A, the "No Action" alternative for this project, will have **no impact** upon this species because there will be no disturbance to coarse woody debris or alteration of the microclimate surrounding the species.

Alternative B – Proposed Action
Direct and Indirect Effects
Within the Wildcat Timber Sale, 5 new sites for this species were located in 5 units, including units 5, 13, 21, 31, and 32. Under the proposed action units are proposed for variable density thinning to an averaged residual canopy cover of approximately 40 – 50%, incorporating skips and gaps. The action alternative proposes using ground based logging systems to harvest the unit. These activities will open the canopy across these units, and disturb unoccupied coarse woody debris habitat. However, the proposed action incorporates project design features designed to minimize the impact of project activities upon the known *Tetraphis geniculata* sites, by: (1) maintaining the moist shaded microclimate around known sites through implementation of site buffers (see Table 3 for buffer specifications); (2) maintaining no cut buffers within riparian reserves along most streams (where many of the sites were found); (3) preserving existing coarse woody debris as much as possible by designating skips where concentration of such legacy features are found, and (4) providing large woody debris for potential future substrate through the creation of snags.

In summary, this species is well distributed across the Gifford Pinchot National Forest, with many occurrences identified from within and outside Wildcat Timber Sale project boundaries. There are likely many additional occurrences of this species located within the Muddy and Swift Reservoir 5th field watersheds. Occurrences within the project area will be protected through the measures outlined above. Although surveys for this species revealed new locations within the project area, it is recognized that other sites and habitat for this species may exist within the project area. For these reasons, the proposed action **may impact** individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole.

Peltigera pacifica
Four new sites for this species were located in the Wildcat Timber Sale during 2008 surveys (Table 3). An ISMS query (2005) showed that there were 114 sites for this species recorded from across the range of the Northwest Forest Plan; at least 23 of these sites are reported from the Gifford Pinchot National Forest. In addition, 4 additional occurrences were discovered during surveys of Tee Timber Sale in 2005, 9 new sites were discovered during surveys of Canyon Timber Sale in 2006, and 7 new sites were discovered during surveys of WinThin Timber Sale in 2007, for a total of 57 sites known from the Gifford Pinchot National Forest.

Peltigera pacifica is a foliose lichen species that often grows on soil, duff or woody debris, and occasionally on tree or mature shrub bases. It is generally a distinctive species with copious lobules produced at the edge of lobes, giving the species the appearance of "frilly" edges. These lobules provide a method of asexual reproduction for this species, while apothecia (rare) produce spores for sexual reproduction. *Peltigera pacifica* is a Pacific Northwest endemic, found from

coastal Alaska to Oregon, and inland to northwestern Idaho, at elevations up to approximately 2200 ft. (Stone 2007). Surveys on the Gifford Pinchot National Forest have located this species in abundance spread throughout stands regenerated after fire, growing on mineral soil and woody debris. The species has also been found in managed stands, as well as within late-successional habitat, and is commonly found in moist, riparian areas. *Peltigera pacifica* appears to be well distributed across the Forest.

Because *Peltigera pacifica* is often found in riparian zones, ground disturbance caused by timber harvest within riparian zones poses a particular threat to this species.

Alternative A – No Action
Direct, Indirect, and Cumulative Effects
Alternative A, the no action alternative for this project, will have **no impact** upon this species because there will be no disturbance to soil, duff or woody debris. In addition no riparian harvest will occur.

Alternative B – Proposed Action
Direct and Indirect Effects
Under the proposed action (Alternative B) units are proposed for variable density thinning to an average residual canopy cover of approximately 40-50%, incorporating skips and gaps. Units 5, 7, 25, and 33 which host *Peltigera pacifica*, have no-cut riparian buffers prescribed, ranging from 60 ft. to a site potential tree height (120 ft.). The action alternative proposes using ground based logging systems to harvest the unit. These activities will open the canopy across these units, and disturb unoccupied habitat.

The proposed action for the Wildcat Timber Sale incorporates project design features designed to minimize the impact of project activities upon the known *Peltigera pacifica* sites, by: (1) maintaining the moist shaded microclimate around known sites through implementation of site buffers (see Table 4 for buffer specifications); and (2) maintaining no cut buffers within riparian reserves along most streams (where some of the sites, and additional potential habitat are found).

In summary, this species is well distributed across the Gifford Pinchot National Forest, with many occurrences identified from within and outside Wildcat project boundaries. Based on current understanding of habitat, there are likely many additional occurrences of this species located within the Muddy and Swift Reservoir 5th field watersheds. Occurrences within the project area will be protected through implementing no cut buffers designed to protect occurrences, and preserve microclimate (Table 4). By buffering riparian zones, and by utilizing a harvest prescription with skips and gaps, potential future habitat is being maintained and/or created. Although surveys for this species revealed new locations within the project area, we recognize that other sites and habitat for this species may exist within the project area. For this reason, the proposed action **may impact** individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole.

Pseudocyphellaria rainierensis

One new occurrence for *Pseudocyphellaria rainierensis* was found during surveys in Wildcat Timber Sale in 2008; this occurrence was located outside the boundary of Unit 3. This species is an epiphytic, foliose lichen species found in humid, late successional/ old-growth forests, or associated with legacy features in younger stands. It is most often found growing within conifer canopies and on boles, in the Western Hemlock or lower Pacific Silver Fir Zones. This species is endemic to the Pacific Northwest and is found in southeastern Alaska, British Columbia, Washington and Oregon in areas with oceanic influence (west of the Cascades in Washington and Oregon). According to data available from the Forest Service Geobob database in 2006, there are 289 *Pseudocyphellaria rainierensis* occurrences across the range of the Northwest Forest Plan (49 from the Gifford Pinchot National Forest); Current Vegetation Survey data reported an additional 6 occurrences (2 from the Gifford Pinchot National Forest).

Threats to this species are described in Lesher et al. 2003:
"The main threat to *P. rainierensis* is loss of populations resulting from activities that affect the habitat or the population, including changes in microclimate and removal of colonized substrate. As a nitrogen-fixing species, *P. rainierensis* may be sensitive to air pollution, as has been documented for other nitrogen-fixing lichens. *P. rainierensis* appears to be restricted to old forests. The limited distribution and abundance of these older age-classes in the landscape limit potentially suitable habitat, as well as contributing to the isolation of populations."

Lesher et al. (2003) also report that "the major viability consideration for *P. rainierensis* is loss of populations resulting from management activities that affect populations or their habitat", and stress that this species is closely associated with old forests, likely indicating specific ecological requirements and limited ability of this species to establish and/or maintain viable populations in younger forests. Research has indicated that this lichen is likely highly dispersal limited (Sillett et al. 2000), and thus dependent on late successional/old-growth forests as habitat and propagule sources. Late successional/old-growth habitat is in decline across the range of this species, as a result of timber harvest and other human-generated disturbances (such as hazard tree control in popular riparian campgrounds, road building, etc.), and natural attrition of old trees through disease and other natural disturbances.

Timber harvest may impact *Pseudocyphellaria rainierensis* by altering forest microclimate through the removal of canopy adjacent to the occurrences. Microclimatic parameters that may be of particular importance in influencing distribution of *Pseudocyphellaria rainierensis* include moisture, light and temperature (Nash 1996; McCune & Geiser 1997; Hitch & Stewardt (1973) and Kallio, Suhonen & Kallio (1972) *as cited in* Kelly & Becker 1975; Esseen & Renhorn 1998), although research has shown that the distribution of this species is likely most strongly influenced by dispersal limitations (Sillett et al. 2000).

Although the Northwest Forest Plan attempts to provide for future habitat of old-growth associated species through the late successional reserve land allocation (LSR), much of the LSR designated within the Northwest Forest Plan area will take a century or more to mature and develop late successional/old growth characteristics. In the mean time, *Pseudocyphellaria rainierensis* may not be able to successfully disperse and establish to new suitable habitat from

its remnant old-growth habitat without effective dispersal corridors and a long time (decades to centuries).

Alternative A – No Action
Direct, Indirect, and Cumulative Effects
Alternative A, the no action alternative for this project, will have **no impact** upon this species because there will be no timber harvest and therefore no alteration of microclimate by the removal of forest canopy.

Alternative B – Proposed Action
Direct and Indirect Effects
Under the proposed action (Alternative B) units are proposed for variable density thinning to an average residual canopy cover of approximately 40-50%, incorporating skips and gaps. Although the *Pseudocyphellaria rainierensis* occurrence is not within a harvest unit, removal of canopy adjacent to the occurrence within Unit 3 is likely to result in a change to forest microclimate in the adjacent old-growth stand by causing an increase in solar radiation and wind penetration, resulting in increased temperature and decreased moisture at the sites, particularly on hot and/or windy days.

The proposed action for Wildcat Timber Sale incorporates project design features designed to minimize the impact of project activities upon the *Pseudocyphellaria rainierensis* occurrence by: (1) maintaining the moist shaded microclimate around known sites through implementation of a 100 ft. no-cut buffer centered on the occurrence. In addition, by maintaining no cut buffers within riparian reserves in Unit 3 and other units found within this general area, undisturbed disbursal corridors will be maintained through time; this could assist this dispersal limited species to colonize new suitable habitat over the long term.

In summary, this species is well distributed across the Gifford Pinchot National Forest, with many occurrences identified from within and outside Wildcat project boundaries. Based on current understanding of habitat, there are likely many additional occurrences of this species located within the Muddy and Swift Reservoir 5th field watersheds. Occurrences within the project area will be protected through implementing a no-cut buffer designed to protect the occurrence and preserve microclimate (Table 1). By buffering riparian zones, and by utilizing a harvest prescription with skips and gaps, potential future habitat is being maintained and/or created. Although surveys for this species revealed new locations within the project area, we recognize that other sites and habitat for this species may exist within the project area. For this reason, Alternative B **may impact** individuals or habitat for this species, but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species as a whole.

Survey-impractical Sensitive & Other Rare and Uncommon Species
Within all units of Wildcat Timber Sale there is potential habitat for a number of sensitive species, including 11 fungi species and 1 lichen species, that were not specifically targeted during surveys, due to being survey impractical (i.e. – are too cryptic, or surveys are otherwise poor indicators of presence). These species are all thought to be associated primarily with late-successional/old growth forests (USDA & USDI 1994, 2001), though some of these species have

been located in forests less than 80 years old. Because fungi "fruit" (produce visible sporocarps) unpredictably (i.e. may not fruit each year, vary in fruiting timing from year to year), surveys are not reliable indicators of presence or absence (absence of evidence is not evidence of absence). In addition, many fungi species require laboratory examination by a taxa expert for reliable identification. As a result, it is probable that many Sensitive fungi species are under-reported and under-collected across their ranges. In addition, the habitat requirements for many of the species are too broad or too poorly understood to allow for reasonable mitigations at a project scale, particularly when no sporocarps have been located within the project area.

It is unknown whether the survey impractical Sensitive species occur within the project's area of impact. For the purpose of analysis, we assume that there is potential for occurrence within the project area and estimate whether the likelihood of occurrence is low, moderate or high (these estimates are detailed in Table 1 of the Botanical Resource Report), using guidelines set by Region 6 of the Forest Service (USDA Forest Service 2004c); the impact analyses (see below) reflect this assumption.

Lichens

Chaenotheca subroscida

This species is an epiphytic "pin lichen". It grows on conifer bark, and occasionally on wood, in humid, intermontane old-growth forests at lower and middle elevations (Goward 1999, *as cited in* Helliwell 2007). In Montana, Hauck and Spribille (2005) (*as cited in* Helliwell 2007) found the species to be fairly common on *Picea engelmanni* (Engelmann Spruce), *Larix occidentalis* (larch), and *Abies lasiocarpa* (subalpine fir). It is also found on the bark of *Thuja* (cedar), *Pinus* (pine), and rarely on *Quercus* (oak) or *Betula* (birch). On the Gifford Pinchot National Forest, there is one known site for this species on the Cowlitz Valley Ranger District (ISMS Query, 2005). The site is located at 4600 ft. elevation, just SE of the junction of Killen Creek and Forest Service Road 2329, in a mixed stand of *Picea englemannii*, true firs and pine in an area of the 1918 Cispus Burn. The species was found growing on a mountain hemlock (*Tsuga mertensiana*) at this site.

Wildcat Timber Sale is located at approximately 1600-3200 ft. elevation, and the plant community type is quite different from the site which hosts this species on the Cowlitz Valley District, i.e. homogeneous conifer stands dominated by Douglas-fir and western hemlock. Because the habitat within Wildcat Timber Sale is quite dissimilar to the site from which the species is known on the Gifford Pinchot National Forest, and the project area is located at considerable distance from any known site for this species, the potential for occurrence within the project area is estimated to be low.

Alternative A – No Action

Direct, Indirect, and Cumulative Effects

Alternative A, the no action alternative for this project, will have **no impact** upon this species because it is not suspected in the area and there will be no timber harvest.

Alternative B – Proposed Action
Direct and Indirect Effects
Since *Chaenotheca subroscida* is a small, cryptic species that takes specialized knowledge to identify accurately (for these reasons this species is considered survey impractical), it is likely under-reported and under-collected. Based on the known site habitat description from the Gifford Pinchot National Forest, we presume that the montane habitat located within the mountain hemlock zone (such as that located on the slopes of Mt.Adams, within the Mt. Adams Wilderness area) will continue to provide undisturbed habitat for this species outside of the project area. Although the likelihood of occurrence is estimated to be low, there is some potential (albeit small) for the species to occur within the project area, or that there is potential habitat there. For this reason, the determination was made that Alternatives B **may impact** *Chaenotheca subroscida* individuals or habitat, but will not likely lead to a trend towards federal listing or a loss of viability to the species.

Fungi

Alternative A – No Action Alternative
Direct, Indirect and Cumulative Effects
Alternative A, the no action alternative for this project, will have **no impact** upon any fungi because there will be no timber harvest or ground or canopy disturbance.

Alternative B – Proposed Action
Direct and Indirect Effects
Timber harvest has demonstrated negative effects upon fungi (Amaranthus & Perry 1994; Byrd et al. 2000; Kranabetter & Kroeger 2001; Kranabetter & Wylie 1998; Perry et al. 1989; and others). Direct effects include removal of host trees necessary to sustain mycorrhizae, and destruction of mycelial networks. Indirect impacts include a reduction in the moisture retention capability of soils, duff, and woody debris that provide habitat for fungal species, as a result of increased solar and wind penetration into stands. In addition, land based harvest techniques result in soil compaction that can harm mycelia in the soil. The same techniques also tend to disturb existing woody debris and duff layers that support sabrobic species of fungi. Because land-based harvest techniques result in soil distubance and compaction, these methods may be more impactful on fungi than alternatives such as skyline yarding or helicopter logging, from the perspective of fungal diversity, and preservation of rare fungal species.

<u>Moderate Likelihood of Occurrence</u>
As detailed in the botanical resource report and biological evaluation, the following fungal species have a moderate likelihood of occurrence in the project area:

Leucogaster citrinus
Data suggests that the species may be fairly well distributed across the Gifford Pinchot National Forest. Because it is a sequestrate (below ground) fungus, it is likely under-reported. If *Leucogaster citrinus* grows within the project area, it is likely associated with the *Pseudotsuga menziesii*, *Tsuga heterophylla* or other conifer species that grow there. Based on the high level of random grid detections, and the apparent availability of suitable habitat, there appears to be a moderate likelihood of occurrence within the project area. The prescriptions for thinning within

the project area will retain and increase (through selective thinning which favors retention of minor species) conifer species diversity within the stands. Presumably, this will result in the maintenance of some of the mycelial networks that may currently exist within these stands, and create future conditions more conducive to mycelial diversity than currently exist. In addition, many riparian zones and other "skips" will not receive treatment, and could presumably provide refugia for the species if it is found within the stand. In addition, since the species does appear to be well distributed across the Forest, suitable habitat is likely available in allocated reserve areas (riparian reserves, Late Successional Reserves, Wilderness areas and Administratively Withdrawn areas) which will continue to provide undisturbed habitat for this species on the Forest. Therefore, Alternative B **may impact** *Leucogaster citrinus* individuals or habitat, but will not likely lead to a trend towards federal listing or a loss of viability to the species.

Low to Moderate Likelihood of Occurrence

As detailed in the botanical resource report and biological evaluation, the following fungal species have a low to moderate likelihood of occurrence in the project area:

Ramaria gelatiniaurantia, Spathularia flavida

It is unknown whether the project area provides suitable habitat for these species. Lacking further information about these species it is estimated that the likelihood of occurrence is low to moderate. The prescriptions for thinning within the Wildcat project area will retain a diverse mixture of species within the stands, incorporate "skips", and many riparian zones will remain untreated. It is presumed that harvest selectivity, and maintenance of undisturbed habitat within stands will help maintain the diversity of mycelial networks that currently exist. Similar habitat located adjacent to the project area will presumably continue to provide undisturbed habitat for these species, if it is present in the area.

From the wide variety of reported areas where *Spathularia flavida* has been found, it appears to have a rather wide ecological amplitude and environmental tolerance. Stands within the project area are mostly re-generated from clearcuts, and most were broadcast burned after harvest. This has resulted in soils with little duff build up or incorporated woody debris. Some of the best large woody debris habitat within the stands overlaps closely with sites where the Sensitive bryophyte species *Tetraphis geniculata* was located (*Tetraphis* grows on decomposing large woody debris, particularly the cut ends of old logs), and within riparian zones, where large woody debris is often concentrated. The sites for *Tetraphis geniculata* that are found within the project area will be buffered in order to preserve the moist microclimate, and physically protect sites from damage. These buffered areas, along with riparian reserves, will probably provide some of the best habitat for *Spathularia flavida* in these stands. Retention of large woody debris (where it is found within harvested stands), will presumably result in the maintenance of some of the mycelial networks that may currently exist within these stands. In addition, snags will be created in some stands, creating a future source of woody debris.

Therefore, the determination was made that Alternative B **may impact** individuals or habitat, but will not likely lead to a trend towards federal listing or a loss of viability to the species.

Low Likelihood of Occurrence

As detailed in the botanical resource report and biological evaluation, the following fungal species have a low likelihood of occurrence in the project area:

Albatrellus ellisii, Cordyceps capitata, Gomphus kauffmanii, Gyromitra californica, Mycena monticola, Otidea smithii, Ramaria cyaneigranosa, Ramaria rubrievanescens, Sarcodon fuscoindicus, Sowerbyella rhenana

It is unknown whether the area encompassing the Wildcat Timber Sale hosts these species, but the likelihood of occurrence within the area is estimated to be low. It is presumed that similar habitat located adjacent to the project area will continue to provide undisturbed habitat for these species, if they are present in the area. In addition, the prescriptions for thinning within the project area will retain a diverse mixture of species within the stands, including some "skips" where the forest structure will remain undisturbed, and undisturbed riparian areas. It is presumed that harvest selectivity, and maintenance of undisturbed habitat within stands will help maintain the diversity of mycelial networks that currently exist.

Although the likelihood of occurrence is estimated to be low, there is some potential (albeit small) for the species to occur within the project area, or that there is potential habitat there. For this reason, the determination was made that Alternative B **may impact** individuals or habitat, but will not likely lead to a trend towards federal listing or a loss of viability to the species (Table 20).

The full rationale to the effects determinations can be found in the botanical resource report in the project file.

TABLE 20: Summary of Effects Determinations for Sensitive Botanical Species

Species	Alt A: No Action	Alternative B
1. *Tetraphis geniculata*	No impact (NI)	May impact individuals or habitat, but will not likely lead to a trend towards federal listing (MIIH)
2. *Peltigera pacifica*	No impact (NI)	May impact individuals or habitat, but will not likely lead to a trend towards federal listing (MIIH)
3. *Pseudocyphellaria rainierensis*	No impact (NI)	May impact individuals or habitat, but will not likely lead to a trend towards federal listing (MIIH)
5. Survey impractical species (likelihood of presence estimated, as described above).	No impact (NI)	May impact individuals or habitat, but will not likely lead to a trend towards federal listing (MIIH)

Alternative B – Proposed Action
Cumulative Effects

Tetraphis geniculata*, *Peltigera pacifica* and *Pseudocyphellaria rainierensis
Project design features designed to protect identified occurrences of *Tetraphis geniculata*, *Peltigera pacifica,* and *Pseudocyphellaria rainierensis* have been incorporated into the Wildcat Timber Sale. Other watershed projects implemented since 1998 incorporated Northwest Forest Plan "survey and manage" mitigations, leading to regular protection of *Tetraphis geniculata* and *Pseudocyphellaria rainierensis* occurrences. Other projects occurring in the watershed since 2004 have similarly managed for *Peltigera pacifica*. This does not preclude the possibility that undetected sites and suitable habitat for these species have been impacted by past actions or will be impacted by future actions. *Tetraphis geniculata* and *Peltigera pacifica* are both species that are frequently found, and widely distributed across the Gifford Pinchot National Forest, with many other occurrences reported from throughout the Northwest Forest Plan area. *Pseudocyphellaria rainierensis* is also known from many sites across the Forest, but the distribution of this species is more patchy, and always within or in close proximity to old-growth forest or legacy stand elements. There are undoubtedly many occurrences of these species that remain undetected on the Forest, including occurrences within protected land allocations, such as Wilderness. Based on current understanding, these species are neither so limited in distribution, habitat, or number that project activities (with incorporated design features), in combination with past or reasonably forseeable future actions on nearby federal land and adjacent private land, are likely to lead to a trend towards federal listing for these species, or threaten the viability of entire populations or species as a whole.

Survey-impractical Species
Cumulative effects of timber harvest upon survey impractical species sites and habitat quality are unknown. Project design attempts to minimize impacts upon these species. It is assumed that, by practicing variable density thinning, incorporating "skips" in the harvested landscape, buffering riparian zones, retaining a high degree of species diversity within stands, maintaining woody debris substrate (for sabrobes), and live trees (for mycorrhizal species), that this project, together with other timber sales across the Forest, while impacting species, will not devastate entire mycelial networks and colonies. Though project level mitigations attempt to preserve potential habitat or analyze risk associated with particular projects upon these species, a true understanding of the impacts of these projects will require more complete understanding of habitat associations, distribution, and abundance of these species across their ranges. Currently, there are multiple efforts proceeding across Region 6 of the Forest Service to gain more information about the habitat associations, distribution and abundance of these species (compilation of the results and statistical inferences based on the CVS random grid study is one example). Additional information gained through these surveys and studies will help us better identify potential habitat, judge risk, and mitigate for impacts in the future. In summary, none of the sensitive botanical species that were located within the project area, or that are (for the sake of analysis) presumed to exist within the project area (survey impractical species) are either so limited in distribution, habitat, or number that project activities (with incorporated design features), in combination with past or reasonably foreseeable future actions on nearby federal land and adjacent private land, are likely to lead to a trend towards federal listing for these species, or threaten the viability of entire populations or species as a whole.

Noxious Weeds/Invasive Plants

Non-native plants include those species introduced intentionally or unintentionally to areas where they do not naturally occur. Invasive non-native plants in the Pacific Northwest most often originate from Europe and Asia. Problems can arise when the associated natural predators and diseases that controlled these species in their native habitats are not present in the habitat where they are introduced. If a species is unchecked by predators, it may become invasive, dominating the site and altering ecosystem balance. The results may include changes in biodiversity, fire frequency, soil erosion and hydrology of a site. Other effects include poisoning of livestock and reducing the quality of recreational experiences. There are an estimated 2,000 invasive and noxious weed species in the U.S and 130 class A, B & C weeds listed in Washington State in 2006.

Under Wildcat Timber Sale Alternative B, there will be a substantial amount of ground disturbance and opening of the canopy during the course of timber harvest activities. Ground disturbance exposes available habitat for noxious weeds, while timber harvest exposes newly created disturbed areas to increased solar radiation, ideal conditions for early seral, weedy species. Areas experiencing ground disturbance within the timber sales will, therefore, be highly susceptible to noxious weed and invasive plant colonization, particularly since there are already invasive species growing along access roads to the units. In order to control noxious weed colonization and spread under Alternative B, weed-spread prevention and weed eradication activities should be implemented before, during and after project activities.

Noxious weeds (shown with approximated occurrence level of low, medium, high) that are known to occur within or adjacent to the project area include:

Class A Weeds—None

Class B Weeds

Centauria stoebe ssp. micranthos (spotted knapweed) – low
Scattered occurrences along Forest Roads 83 and 25.

Centaurea debeauxii (meadow knapweed) – low
Scattered occurrences along Forest Road 83.

Centauria diffusa (diffuse knapweed) – low
Scattered occurrences along Forest Road 25

Cytisus scoparius (scotch broom) –moderate
Scattered, patchy occurrences along Forest Roads 8322, 25, 2588.

Hypochaeris radicata (cat's ear) – low to moderate
Distributed in low-moderate concentrations within units 16, 22, and along roads 83 (and likely others).

Leucanthemum vulgare (oxeye daisy) – moderate
Reported from along Forest Road 83. Likely much more widely distributed throughout Muddy and Swift Reservoir 5th field watersheds.

Senecio jacobaea (tansy ragwort) – high
Distributed in low-moderate concentrations within units 1, 16, 7, 13, 10, 2, 4, 8, 9, 3, 14, 12, 21, 22, 29, 25, 27, 18, 19, 33, 32, 30, 31, 32, and along roads 83, 8322, 25, 2573,

2588, and many other secondary and tertiary roads in the Muddy and Swift Reservoir 5th field watersheds.

Class C Weeds

Hypericum perforatum (St. John's wort) –moderate

Distributed in low-moderate concentrations along most roads within the Muddy and Swift Reservoir 5th field watersheds, including Forest Roads 25 and 83.

Circium arvense (Canada thistle) – light to moderate in

Unit 1, Unit 33, Unit 30, along Forest Roads 25, 2573 (and likely others).

Rubus laciniatus (cutleaf blackberry) – light

Found within Unit 31.

Other undesirable invasive plants known to occur in the project area include:

Lotus corniculatus (bird's foot trefoil) – low

Located scattered along roads near Unit 16.

Digitalis purpurea (foxglove) – low –moderate

Scattered occurrences from roadsides throughout the Muddy and Swift Reservoir 5th field watersheds.

Of the three types of weed classifications in Washington state, Class A weeds require immediate eradication efforts. Class B weeds require active control. Class C weeds require monitoring, and project work, with the eventual goal of elimination.

Noxious Weed and Invasive Non-Native Species Risk Assessment

Forest Service Manual direction requires that Noxious Weed Risk Assessments be prepared for all projects involving ground-disturbing activities. For projects that have a moderate to high risk of introducing or spreading noxious weeds, recent Forest Service policy requires that decision documents must identify noxious weed control measures that will be undertaken during project implementation (FSM 2081.03, 11/29/95). In addition, the Pacific Northwest Region Invasive Plant Program Record of Decision for Preventing and Managing Invasive Plants (USDA 2005) provides invasive plant prevention and treatment/restoration standards and direction on all National Forest Lands within Region 6.

The Wildcat Timber Sale would have a "high" ranking because there are known noxious weeds in close proximity to project area that may foreseeably invade the project area; the project operation would be occurring within known noxious weed populations; and, heavy equipment would be used, soil/gravel would need to be imported for temporary road building; and vehicles would be entering the project area. Project design criteria and mitigation measures are included in Chapter 2 to prevent the further spread and introduction of invasive species within the project area.

Wildlife

A complete Wildlife Biological Evaluation (BE) was completed for this project and is located in the project file. The purpose of the biological evaluation was to determine the effects of the project on federally listed species, and their critical habitats, and to determine the need for consultation or conferencing with the U.S. Fish and Wildlife Service. The examination also included analysis of and impacts to Forest Service Pacific Northwest Region Sensitive species and wildlife species. The BE is summarized below and incorporated by reference.

The analysis area used for this effects analysis consists of the Clear Creek, Clearwater Creek, Muddy River, and Pine Creek sixth-field sub-watersheds of the Muddy River, and Swift Reservoir fifth-field watersheds. This analysis area consists of about 68,560 acres of National Forest System lands, and all of the proposed Wildcat timber sale units are within this area.

Table 21 lists the Threatened, Endangered and Forest Service, Pacific Northwest Regional Forester's Sensitive species (TES) considered in the biological evaluation, and summarizes the effect to those species from implementation of the proposed action.

Only those species that were identified in the table above as being affected/impacted by this project are discussed in detail in this EA. A complete discussion of all of the species, their habitat, and the rationale for why they project would have no effect/impact on the species or their habitat is included in the Wildlife Biological Evaluation, located in the project file.

Table 21. Summary of effects to threatened, endangered, proposed, and sensitive species

SPECIES NAME	SPECIES STATUS D: Documented S: suspected	Species habitat present within or adjacent to the analysis area?	Species documented in analysis area?	Effect/Impact summary
Mammals				
Gray Wolf *Canis lupus*	Threatened (D)	No	No	No Effect
Grizzly Bear *Ursus arctos*	Threatened (S)	No	No	No Effect
Townsend's Big-eared Bat *Corynorhinus townsendii*	USFS Sensitive (D)	No	No	No Impact
California Wolverine *Gulo gulo*	USFS Sensitive (D)	No	No	No Impact
Keen's Myotis Myotis keenii	USFS Sensitive (S)	No	No	No Impact
Birds				
Marbled Murrelet *Brachyramphus marmoratus*	Threatened (D)	No	No	No Effect
Critical Habitat for the Marbled Murrelet	Designated	No	No	No Effect

SPECIES NAME	SPECIES STATUS D: Documented S: suspected	Species habitat present within or adjacent to the analysis area?	Species documented in analysis area?	Effect/Impact summary
Northern Spotted Owl *Strix occidentalis caurina*	Threatened (D)	Yes	Yes	LAA
Critical Habitat for the Northern Spotted Owl	Designated	Yes	Yes	No Effect
American Peregrine Falcon *Falco peregrinus anatum*	USFS Sensitive (D)	Yes	Yes	MIIH
Common Loon *Gavia immer*	USFS Sensitive (D)	No	No	No Impact
Bald Eagle *Haliaeetus leucocephalus*	USFS Sensitive (D)	Yes	Yes	No Impact
Harlequin Duck *Histrionicus histrionicus*	USFS Sensitive (D)	Yes	Yes	No Impact
Great Gray Owl *Strix nebulosa*	USFS Sensitive (S)	No	No	No Impact
Reptiles & Amphibians				
Sharptail Snake *Contia tenuis*	USFS Sensitive (D)	Yes	No	No Impact
Cope's Giant Salamander *Dicampton copei*	USFS Sensitive (D)	Yes	No	MIIH
Larch Mountain Salamander *Plethodon larselli*	USFS Sensitive (D)	Yes	No	No Impact
VanDyke's Salamander *Plethodon vandyke*i	USFS Sensitive (D)	Yes	Yes	MIIH
Oregon Spotted Frog *Rana pretiosa*	USFS Sensitive (D)	No	No	No Impact
Cascade Torrent Salamander *Rhyacotriton cascadae*	USFS Sensitive(D)	Yes	Yes	MIIH
Butterflies				
Barry's Hairstreak *Callophrys gryneus barryi*	USFS Sensitive (S)	No	No	No Impact
Johnson's hairstreak *Callophrys johnsoni*	USFS Sensitive (D)	Yes	No	No Impact
Golden Hairstreak *Habrodais grunus*	USFS Sensitive (D)	No	No	No Impact
Mardon Skipper *Polites mardon*	USFS Sensitive	No	No	No Impact

SPECIES NAME	SPECIES STATUS D: Documented S: suspected	Species habitat present within or adjacent to the analysis area?	Species documented in analysis area?	Effect/Impact summary
	(D)			
Great Basin Fritillary *Speyeria egleis*	USFS Sensitive (S)	No	No	No Impact
Mollusks				
Puget Oregonian *Cryptomastix devia*	USFS Sensitive (D)	Yes	Yes	No Impact
Columbia Gorge Oregonian *Cryptomastix hendersoni*	USFS Sensitive (S)	No	No	No Impact
Evening Fieldslug *Deroceras hesperium*	USFS Sensitive (S)	Yes	No	MIIH
Western Ridged Mussel *Gonidea angulata*	USFS Sensitive (S)	No	No	No Impact
Warty Jumping Slug *Hemphillia glandulosa*	USFS Sensitive (D)	Yes	Yes	MIIH
Malone's Jumping Slug *Hemphillia malonei*	USFS Sensitive (D)	Yes	Yes	MIIH
Panther Jumping Slug *Hemphillia pantherina*	USFS Sensitive (D)	Yes	No	MIIH
Barren Juga *Juga hemphilli hemphilli*	USFS Sensitive (S)	Yes	No	No Impact
Oregon Megomphix *Megomphix hemphilli*	USFS Sensitive (S)	Yes	No	MIIH
Crowned Tightcoil *Pristiloma pilsbryi*	USFS Sensitive (S)	Yes	No	MIIH
Shiny Tightcoil *Pristiloma wascoense*	USFS Sensitive (D)	No	No	No Impact
Blue-gray Taildropper *Prophysaon coeruleum*	USFS Sensitive (D)	Yes	No	No Impact

- **LAA** – Likely to adversely affect.
- **NLAA** – May Affect, Not likely to adversely affect.
- **MIIH** - May impact individuals or habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species.

Northern Spotted Owl

Existing Condition:

The northern spotted owl (*Strix occidentalis caurina*) was listed as a threatened species throughout its range in Washington, Oregon and northern California effective July 23, 1990 (USDI, 1990a). Loss of late-successional forest habitat from timber harvest was the primary reason for the listing.

The status review for the northern spotted owl (NSO) completed in 2004 found that the major threats at this time include effects of past and current timber harvest, loss of habitat from fire, and competition with barred owls. Of the threats identified at the time of listing, only one (predation linked to forest fragmentation) does not now appear well supported (Courtney et al. 2004).

Disturbance History - Historically, spotted owl habitat in the analysis area was affected by large stand-replacing fires. In 1902 the Lewis River Fire burned the part of the analysis area east of Forest Road 25 along Clear Creek. Part of the affected area was re-burned in the 1920 Copper Creek Fire. Most of the unmanaged stands that burned in the analysis area in 1902 have recovered to the point that they now provide suitable spotted owl foraging habitat.

More recently, suitable habitat in the analysis area has been altered by timber harvest on private and National Forest system lands, and by the effects of the 1980 eruption of Mount St. Helens. Much of the southwestern part of the analysis area is private land, where logging is commonly in the form of very large clear-cuts. The National Forest system lands were also extensively harvested with smaller clear-cuts that were up to about 40 acres in size. The northern part of the analysis area in the Clearwater Creek subwatershed is within the devastated area that was destroyed during the 1980 Mount St. Helens eruption. Much of what was devastated inside the analysis area was replanted in the early 1980s, and now supports large stands of sapling to pole-sized conifer trees.

Current Habitat Condition - The amount of suitable spotted owl habitat in the analysis area is shown in Table 23. The data used for this analysis is from the 1999 version of the vegetation GIS database for the Gifford Pinchot National Forest. It was apparent from the data however that many of the stands that had been mapped as spotted owl foraging habitat were mistyped. These mistakes were corrected for this analysis based on aerial photo interpretation combined with some field inspection. The corrected data is reflected in the spotted owl habitat map (Figure 21). In addition, the vegetation database understates the number of acres of spotted owl dispersal habitat because of tree growth since 1999. For this analysis the 1999 version of the vegetation database was used, and an assumption was made that conifer stands with an average dbh of at least 8 inches in 1999 would meet the minimum requirements for spotted owl dispersal in 2008. The number of acres of dispersal habitat alone is not displayed, but the total number of acres through which spotted owls could disperse is shown. The acreage estimates in Table 23 do not include acres of habitat on other ownerships, or areas on National Forest that are not capable of producing suitable habitat (rock or similar non-forest areas).

Table 22. Spotted Owl Habitat in the Analysis Area

Suitable Nesting Habitat	8,121 acres	15%
Suitable Foraging Habitat	11,551 acres	22%
Dispersal Habitat **Total Suitable for Dispersal**	**24,519**	**46%**

To determine if spotted owls are able to disperse across a landscape, an analysis of habitat capable of allowing dispersal by sixth-field watershed (subwatershed) is necessary. In order to provide for spotted owl dispersal, a landscape should have at least 50 percent of the area in conifer stands that are at least 11 inches dbh and that have at least 40 percent canopy cover. The amount of habitat available for owls to disperse through (nesting, foraging and dispersal) ranges from 32-71% in each subwatershed in the analysis area (Table 23). The estimates exclude habitat on other ownerships and areas that are not capable of growing habitat.

Table 23. Habitat Capable of Allowing Spotted Owl Dispersal by Subwatershed

Subwatershed	Acres of NF capable of growing habitat.	Acres of habitat with stands >= 8 inches dbh	Percent of subwatershed
Clearwater Creek	25,374 acres	8,117 acres	32%
Clear Creek	12,377 acres	8,834 acres	71%
Muddy River	11,202 acres	5,812 acres	52%
Pine Creek	4,723 acres	1,756 acres	37%

An additional analysis of potential dispersal habitat was done for the proposed units using the definition developed by the Washington Department of Natural Resources (WAC 222-16. 2001). In that definition, in addition to minimum tree size and canopy cover, dispersal habitat has a total tree density of fewer than 300 trees per acre. It is assumed that stands with more than 300 trees per acre would be too dense for spotted owls to easily fly through, and that these stands would be avoided. Table 24 depicts the current habitat value of each of the proposed units.

Spotted owl movement is likely hampered within the Clearwater Creek and Pine Creek subwatersheds due to lack of dispersal habitat, 32 and 37% of the subwatershed contains dispersal habitat (Table 24). The suitable habitat in the Clearwater Creek subwatershed however, is arranged in such a way that allows owls to move north and south through the east side of the sub-watershed to access habitat outside of the sub-watershed. The fact that there are historic spotted owl activity centers in this part of the sub-watershed is evidence that it is useable by spotted owls. Habitat in the west side of the sub-watershed was destroyed in the 1980 Mount St. Helens eruption, and it will likely be another 10 to 20 years before the replanted stands are suitable for spotted owl dispersal. The area west of the Clearwater Creek sub-watershed is inside the National Volcanic Monument and was not replanted. It will likely be several decades before habitat inside the Monument is suitable.

Although not reflected in Table 24, the private land in the southern half of the Pine Creek watershed is owned and managed by a timber company. Typical harvest pattern is large clear-

cuts, and likely, short rotations. Private lands in the area are considered unlikely to support suitable spotted owl habitat in the future.

Historic Activity Centers - Several historic spotted owl activity centers occur within the analysis area, and several more that are outside the analysis area, but close enough that the home ranges of owls located there would overlap a part of the analysis area. Spotted owl surveys have not been conducted in the area for many years, so it is unknown if any of these activity centers still support spotted owls, but historic activity centers can be indicators of current or future spotted owl occupancy. Of the four subwatersheds in the analysis area, only the Pine Creek sub-watershed has no known historic spotted owl nest sites, reflecting the fact that there is very little suitable habitat.

The historic activity centers represent core areas around nest sites, and it's likely that if there are still spotted owls nesting in the analysis area, they would be within the same general core areas (Vince Harke, USFWS pers.com. 1/28/09). For this analysis, an assumption is made that if spotted owls are nesting in the analysis area, they would likely be nesting in suitable nesting habitat somewhere within 0.7 mile of these historic activity centers.

Competition with Barred Owls - Based on other areas of the Gifford Pinchot National Forest, it is likely that barred owls inhabit significant portions of the analysis area, including many of the historic spotted owl activity centers. It has been documented on the Cowlitz Valley District that barred owls nest more commonly on lower elevation flatter areas associated with valley bottoms, while spotted owls are nesting on higher elevation areas with steeper slopes (Pearson and Livezey 2003). In the same study, nest sites for both spotted owls and barred owls contained more forest at least 180 years old, and less forest between 50 and 79 years old than random. Both species are known to nest in second growth conifer stands, but only where there are remnant large trees and snags that provide nest sites. The data indicate however, that barred owls will persist in areas with less old forest than spotted owls (Herter et al. 2000). In general though, this study indicates older forest is important for both these species, and forest less than 80 years old is not used as much, especially if there are no remnant features. Due to the ability of barred owls to prey on a wider variety of species than spotted owls however, it is possible that they are better able to forage in thinned stands.

Spotted Owl Critical Habitat, Managed Owl Conservation Area, and Late-Successional Reserve

About half of the analysis area is located within Critical Habitat, a Managed Owl Conservation Area (MOCA) and within the Lewis Late Successional Reserve (LSR). The boundaries of the Critical Habitat unit and the Managed Owl Conservation Area (MOCA) were established with the 2008 spotted owl recovery plan, and in this area, coincide with the boundary of the LSR established in the Northwest Forest Plan. Most of the suitable spotted owl habitat in the analysis area is inside the Critical Habitat (CH)/LSR.

Snags and Down Wood – See the effects analysis for cavity excavating birds in the Management Indicator Species sections.

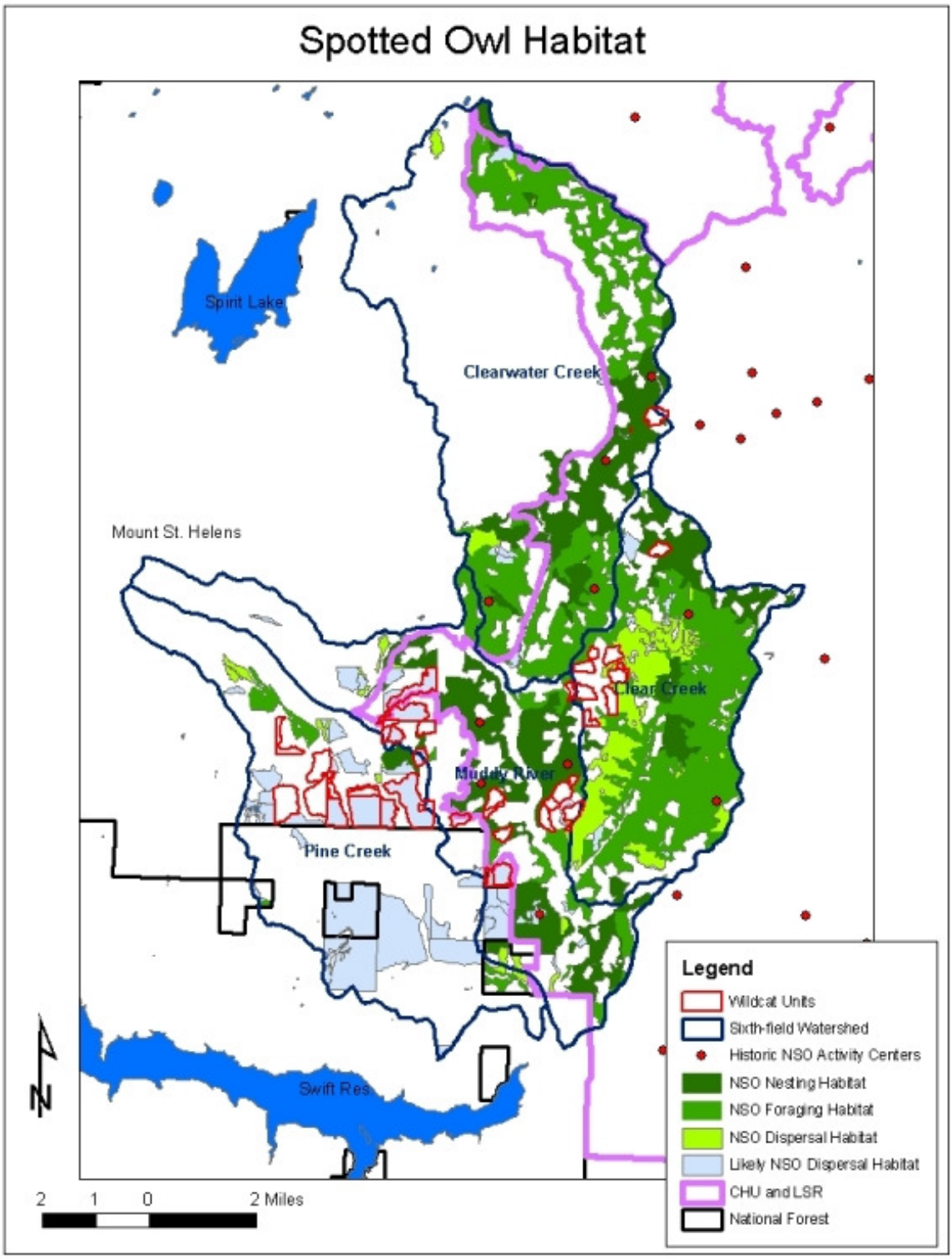


Figure 21. Spotted owl habitat in the analysis area.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

With this alternative none of the proposed units would be treated. In the short-term, no spotted owl dispersal habitat would be degraded or downgraded to non-habitat, or improved by thinning stands that are too dense for spotted owls. The opportunity to accelerate the development of late-successional habitat in even-aged timber stands in the analysis area would be forgone at this time. It is likely that, in the absence of commercial thinning, suitable habitat would develop over time as normal forest stand dynamics result the death of overtopped trees. This would result in natural thinning of the stands, but this process, and the time needed to reach the desired future condition would take longer without the treatment. The natural thinning would result in numerous small snags and logs created over time as overtopped trees die from suppression mortality, but due to their small size, these structures would not last very long in the stands.

There would be no cumulative effects.

This alternative would have **no effect** to spotted owls or to critical habitat but opportunities would be forgone.

Alternative B—Proposed Action

Direct and Indirect Effects

The potential to effect spotted owls can result from changes in habitat structure (positive and negative), and from potential harassment due to noise disturbance near active nests.

Changes in Habitat: Spotted owls have been known to forage in forest stands that are less than 80 years old, but generally only if the younger stands contain structural characteristics of older forests or remnant large snags and logs from the previous stands that would provide habitat for a prey base (Buchanan et al 1999). Spotted owls use younger forests (trees of 8 to 20 inches average dbh with at least 60 percent canopy closure) less often than expected based on this habitat's availability in the western Washington Cascades (U.S. Fish and Wildlife Service 2008).

None of the proposed Wildcat units is suitable spotted owl habitat, so thinning as proposed would not result in any loss of nesting or foraging habitat. In addition, the proposed units are all 30 to 58 years old, and contain none of the structural characteristics found in older stands, including many remnant large snags and logs. As such, they are not likely to be used by spotted owls for foraging.

Seventeen of the proposed units currently minimally meet the definition of spotted owl dispersal habitat. These units have an average dbh of 11 to 12 inches, fewer than 300 trees per acre, and a canopy closure of more than 85 percent. The small tree size, simple stand structure, and lack of large remnant live or dead trees that would support a prey base, are what make these stands minimally suitable for dispersal.

Dispersal habitat conditions (dispersal or non habitat) would change from treatment in eight of the 32 units (Table 24). Units shown as non-habitat either currently have trees that are too small in diameter or too dense to be dispersal habitat.

Table 24. Spotted owl habitat by unit

Unit Number	Total Unit Acres (rounded)	Acres to be Thinned (including skips that are part of the prescriptions)	Habitat Before Thinning	Target Canopy Cover After Thinning	Habitat After Thinning
1 LSR/CH	67	57	Non-habitat	60%	**Dispersal**
2 LSR/CH	0.7	0.7	Non-habitat	NA	Non-habitat
3 LSR/CH	46	32	Dispersal	40%	Dispersal
4 LSR/CH	22	19	Non-habitat	40%	**Dispersal**
5 LSR/CH	44	41	Dispersal	50%	Dispersal
6 LSR/CH	19	18	Non-habitat	NA	Non-habitat
7 LSR/CH	65	56	Dispersal	60%	Dispersal
8 LSR/CH	56	14	Dispersal	40%	Dispersal
9 LSR/CH	60	39	Dispersal	40%	Dispersal
10 LSR/CH	63	62	Non-habitat	50%	**Dispersal**
11 LSR/CH	36	34	Dispersal	50%	Dispersal
12 LSR/CH	14	13	Non-habitat	50%	Non-habitat
13 LSR/CH	66	37	Non-habitat	60%	**Dispersal**
14 LSR/CH	28	24	Non-habitat	50%	Non-habitat
15 LSR/CH	56	51	Dispersal	40%	Dispersal
16 LSR/CH	55	46	Dispersal	40%	Dispersal
17 LSR/CH	7	7	Non-habitat	50%	Non-habitat
18 LSR/CH	37	36	Dispersal	50%	Dispersal
19 LSR/CH	80	73	Non-habitat	50%	**Dispersal**
21 Matrix	118	115	Dispersal	50%	Dispersal
22 Matrix	41	33	Non-habitat	60%	Non-habitat
23 Matrix	63	57	Non-habitat	50%	Non-habitat
24 Matrix	49	10	Non-habitat	30%	Non-habitat
25 Matrix	146	56	Dispersal	30%	**Non-habitat**
26 Matrix	18	10	Dispersal	30%	**Non-habitat**
27 LSR/CH	157	96	Non-habitat	50%	**Dispersal**
29 Matrix	41	36	Dispersal	40%	Dispersal
30 Matrix	295	69	Dispersal	50%	Dispersal
31 Matrix	367	353	Dispersal	50%	Dispersal
32 Matrix	414	413	Dispersal	40%	Dispersal
33 Matrix	166	112	Dispersal	40%	Dispersal
34 Matrix	66	63	Non-habitat	50%	Non-habitat
Totals	**2,743** ac. Comm. Thin, **20** ac. PCT	**2,064** ac. Comm. Thin, **19** ac. PCT			

Effects to Dispersal Habitat - The units in the LSR that currently meet the definition of dispersal habitat would continue to meet the definition after thinning since the average residual canopy cover would be 40 to 60 percent depending on the unit. The dispersal habitat would be degraded somewhat due to the reduction in the overstory canopy cover, but this minor effect would be relatively short-term since the overstory is expected to close back in at a rate of about 2 percent per year. On average, the canopy cover in a stand with a residual 40 percent canopy cover would increase to 60 percent in 10 to 15 years after thinning.

Units 1, 4, 10, 13, 19, and 27 (344 acres) are currently non-habitat due to high tree density. After these units are thinned, they would have a residual canopy cover of 40 to 60 percent depending on the unit, and an average dbh of at least 11 inches and be considered marginally suitable for spotted owl dispersal. Units 25 and 26 (66 acres) in Matrix currently provides marginal dispersal habitat, but would be thinned to a residual canopy cover of about 30 percent to promote forage production for ungulates. Reducing canopy cover to less than 40 percent means that spotted owls are not likely to be able to use these stands for dispersal or movement within their home range until the canopies fill in again (ten to fifteen years).

The proposed thinning would result in a net increase in dispersal habitat of 196 acres in the Muddy River subwatershed (units 13, 19, 25, and 27 added and units 25 and 26 lost). Similarly, there would be a net increase of 81 acres of dispersal habitat in the Clear Creek subwatershed (units 4 and 10), and a net increase of 57 acres of dispersal habitat in the Clearwater Creek sub-watershed (unit 1).

Since barred owls appear no more likely to use pole and small tree sized stands without remnant structures than do spotted owls, the proposed Wildcat units are probably not important for barred owls either. It is possible that barred owls could forage in the stands after thinning since they have a more diverse prey base than do spotted owls, but there is no scientific data that suggests the thinning would favor barred owls over spotted owls.

The proposed thinning would improve spotted owl habitat in the long-term by accelerating growth of the retained trees, promoting deeper crowns on overstory trees, and increasing the structural diversity within the stands. Leaving unthinned patches in the units, as proposed, would maintain islands where normal stand dynamics, including suppression mortality would continue. These patches would be sources of small diameter snags and logs in the short-term.

Indications exist that thinning as proposed would benefit the spotted owls' prey base. Douglas squirrels and other small mammals that eat conifer seeds, are species that are preyed on by spotted owls. Conifers have been found to produce more cones when they are growing in a more open condition (Ransome 2002), and thinning would not affect the ability of these prey species to utilize the stands.

In summary, the thinning would accelerate development of existing dispersal habitat into foraging habitat (1,447 acres), create dispersal habitat in stands that are currently too dense (344 acres), and accelerate development of dispersal habitat in the units that are currently non-habitat (207 acres).

Danger Trees – As part of this project, an unknown number of danger trees would be felled along the haul routes. All dead trees that are within 150 feet of the road and that would likely hit the road if they fell could be cut. Much of Forest Roads 25 and 83 have already been treated under previous contracts, and there doesn't appear to be any large-tree stands that would be expected to contain danger trees along the portion of the 8322 that would be the haul road. For these reasons, it is not likely that a large number of danger trees would need to be felled for this project.

About 6.7 miles of the haul roads within the analysis area pass through suitable nesting habitat inside LSR/CHU. Another 7 miles pass through suitable foraging habitat in LSR/CHU. About 1.25 miles pass through suitable nesting habitat in Matrix.

Based on the number felled in the previous contracts, the number of trees that would need to be felled for this project is expected to average less than 5 large trees (greater than about 14 inches diameter) per mile of road that passes through stands with larger timber, which is equivalent to about 1 per seven acres. At this rate, is it expected that up to about 68 danger trees would be felled in suitable habitat in LSR/CHU and 6 in suitable habitat in Matrix.

Since these trees would be mostly or totally dead, they are not likely to be removed as part of the timber sale. They may be subject to fuelwood cutting.

Noise Disturbance: Proposed units 1, 12, 13, 14, 19, and 22 are adjacent to suitable nesting habitat, and within 0.7 mile of an historic activity center (Table 25). As such, they are potentially near active spotted owl nests. Noise generated near nest sites during the early nesting season can cause adults to flush from the nest or miss one or more feeding of the juveniles, making it somewhat less likely that the juvenile owls would survive in the year that the disturbance took place. None of these six units appear to be dispersal habitat due to the small tree size and/or overly dense trees in the stands, and none would be used by owls for foraging.

Units 3, 7, 14, 15, 18, and 29 also are adjacent to suitable nesting habitat, but farther than 0.7 mile from an historic activity center.

Based on the disturbance thresholds for spotted owls, the effect of the noise disturbance would extend about 65 yards into the adjacent nesting habitat. Given this distance, there would be a total of about 165 acres of suitable nesting habitat subject to noise disturbance during the early nesting season.

Table 25 Summary of disturbance to unsurveyed nesting habitat

Unit	Probable days needed for harvest and yarding	Acres nesting habitat affected
1	34 days	19 acres
12	12 days	15 acres
13	26 days	11 acres
14	17 days	4 acres
19	41 days	25 acres
22	22 days	8 acres
3	41 days	25 acres
7	21 days	7 acres
14 and 15	12 days	16 acres
18	35 days	20 acres
29	12 days	15 acres

In reality, it is highly unlikely that all of these units would be harvested within the early spotted owl nesting season, and in fact access to 1 and 3 is limited by snow during normal years until early June. In addition, requirements to limit harvest activity until soils have dried sufficiently to minimize damage makes it likely that no harvest activity could take place until late May of early June at the earliest.

Danger Tree Felling – It is likely that any danger trees that need to be felled would be cut in the late spring after snowmelt to minimize potential hazards to the general public.

Determination - The minimal effects anticipated to dispersal habitat, coupled with the long-term benefit to habitat would normally result in an effect determination for the project of "Not Likely to Adversely Affect". However, since harvest of units 1, 3, 7, 12, 13, 14, 15, 18, 19, and 22 would potentially result in noise disturbance adjacent to unsurveyed suitable nesting habitat, including 82 acres within 0.7 mile of historic activity centers, during the early nesting season, and since danger tree felling would likely occur in the spring, the project **May Affect and is Likely to Adversely Affect** spotted owls due to potential for harassment.

Effects to Critical Habitat – Potential effects to Critical Habitat are determined at the stand scale, and are based on the potential to affect the primary constituent elements of spotted owl habitat. The primary constituent elements are defined as forested lands that are used or potentially used by spotted owls for nesting, roosting, foraging, or dispersing.

Twenty of the proposed units are located within critical habitat. These units contain a total of about 737 acres that would be thinned. Of these, 349 acres are currently dispersal habitat and would remain dispersal habitat, 344 acres are currently non-habitat due to high tree density and would become dispersal habitat after thinning, and 44 acres are currently non-habitat due to small average diameter and, in the short-term, would remain non-habitat after thinning.

Effects to Critical Habitat are based on anticipated effects to primary constituent elements of critical habitat. Activities that would affect primary constituent elements include actions that would reduce the canopy closure of the stand, reduce the average diameter of the trees in the stand, appreciably modify the multi-layered stand structure, reduce the availability of nesting structures and sites, reduce the ability of the landscape to provide for safe movement, or reduce the abundance or availability of prey species.

Thinning the stands would reduce canopy cover from 85 to 100 percent to 40 to 60 percent, however the average diameter of the trees in the stands would increase, prey species would benefit through increased cone production, the treatment would not affect any stands with multi-layered stand structure, and the ability of spotted owls to move through the landscape within Critical Habitat would not be diminished. In the long-term, growth on the residual trees in all units would be accelerated.

The proposed thinning would cause a reduction in the number of small snags and logs that would have been recruited over time in the absence of thinning through suppression mortality, but this effect could be partially offset by mitigation to retain defective green trees that could become snags in a relatively short time, and with minor amounts of windthrow that can be expected to

occur. In addition, small snags would still be expected to be created naturally in the unthinned portions of the units and in Riparian Reserves.

The snags and logs that would have developed in the absence of thinning would have had marginal value for wildlife, due to their small size, and they would not remain on the landscape for very long. The proposed thinning would reduce the amount of time needed to achieve suitable spotted owl habitat in the treated stands. Development of large trees with deep crowns, multiple canopy layers, and structural diversity would be accelerated.

Determination – The Wildcat timber sale would result in relatively short-term detrimental as well as longer-term beneficial effects to Critical Habitat. As shown in Table 25, no dispersal habitat in the Critical Habitat Unit would be downgraded to non-habitat, but some existing dispersal habitat would be somewhat degraded due to reduced canopy cover. Some stands that are currently not dispersal habitat due to high tree density would become marginally suitable, and there would be long-term benefit to habitat as tree growth is accelerated and stand diversity is increased.

Danger tree felling along haul routes in Critical Habitat has the potential to remove 60 to 70 medium to large snags in Critical habitat, a rate of about 1 per seven acres.

Due to minor short-term degradation of dispersal habitat, and the minor loss of snags due to danger tree felling, the Wildcat timber sale **May Affect, but is not Likely to Adversely Affect** Critical Habitat

Cumulative Effects
Past timber harvest in the analysis area converted an unknown amount of suitable nesting and foraging habitat in the analysis area into non-suitable habitat. The results of that harvest are reflected in the amount of suitable habitat remaining in the analysis area today. There is no new regeneration harvest of suitable habitat planned or anticipated within the analysis area. In the future, Wildcat D, E, F is expected to commercially thin a similar number of acres in similar type stands as would this project. Since the stands to be treated with both projects are not likely to be important habitat for spotted owls, there would be minimal cumulative effects.

Peregrine Falcon
Existing Condition:
Peregrine falcons were delisted from the Federal Threatened and Endangered species list in August 1999. Any known nest sites are still protected under the Forest Service's Sensitive species program and under the Gifford Pinchot National Forest Land and Resource Management Plan. Peregrine falcons are managed in Washington under the State's Priority Species and Habitats Program, and the Department of Fish and Wildlife has prepared management recommendations in 1999 (Larson et al. 2004).

Management recommendations developed by the Depart of Fish and Wildlife include:

- Implementation of buffer zones of 0.5 mi. above the cliff rim, and 0.25 – 0.5 mi. below the cliff face from March through the end of June.
- Restrict logging activity during the breeding season within 0.5 mi. of the nest.

- Maintain large trees and snags that can serve as perches around the nest cliff.

Two known active peregrine falcon nests exist on the Forest, and one of these is in the Wildcat analysis area. This nest was found in 2007 and the pair produced at least one fledgling that year. Peregrines are sensitive to disturbance during all phases of the nesting season (March 1 to June 30), especially disturbance that occurs above the nest. Disturbance can cause desertion of eggs or young, and later in the breeding season, can cause older nestlings to fledge prematurely. The known nest was monitored in 2007 and the fledgling was observed flying near the nest on June 29th. It is located in an area where motorized traffic is normally blocked by snow until about late April, and access is generally poor, so the nest site is protected during the first half of the nesting season.

Peregrines feed on a variety of smaller birds that are usually captured in flight, and adults may forage as far as 15 miles from the nest. It's likely that the foraging area for this pair encompasses the Clear Creek drainage, Muddy River floodplain and Swift Reservoir.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

There would be **no impacts** to peregrine falcons with the no action alternative. There would be no cumulative effects.

Alternative B—Proposed Action

Direct and Indirect Effects

None of the proposed Wildcat units would be visible from the nest site. Two units are between 0.2 and 0.5 mile from the nest. The project design criteria for this project would require a limited operating period for the two units that are within 0.5 mile to minimize disturbance during the nesting season. No large trees or snags that may serve as perches near the nest cliff or in the foraging areas would be cut. Since there would be timber harvest activity in the vicinity of the nest, but after the nesting season, this alternative may result in minor impacts to the birds if the adults were still feeding the fledglings in the vicinity of the nest. There would be no change to the quality of the habitat. This alternative **may impact individuals or habitat, but would not contribute to a trend towards federal listing or loss of viability of the population or species**.

Cumulative Effects

The Clear Creek Roads road decommissioning project will decommission a road that runs near the nest site. Eliminating motorized traffic on this road will provide better protection to the nest site during the time of the breeding season when the area is normally accessible (May – June). A limited operating period to minimize the potential for noise disturbance during the nesting season was a part of the Decision for that project as well. The disturbance associated with the road decommissioning would be cumulative to the disturbance generated by the Wildcat project, but since the disturbance would occur after the nesting season, the cumulative effects are minimal.

Van Dyke's Salamander

Existing Condition:

Van Dyke's salamanders are often associated with rocky, steep-walled stream valleys. In the Cascade Range, they are usually found under cobble and sometimes wood, within a few meters of a stream. They are most often in loose rock piles, seeps in the valley wall with loose rock or gravel, splash zones at the base of waterfalls, or adjacent to chutes and cascades. Van Dyke's salamanders have persisted at numerous locations that were severely disturbed by the 1980 eruption of Mount St. Helens (Jones et al. 2005). In addition, this species can be found in upland talus sites similar to Larch Mountain salamander.

There are no known sites near any of the proposed units, however there are at least 10 sites documented along small tributaries to Clearwater Creek inside the analysis area. Other small high-gradient unsurveyed streams in the analysis area may be suitable habitat where this species could also be found.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

The No Action alternative would have **no impacts** to this salamander because no suitable habitat would be impacted. Over time the Riparian Reserves inside the proposed units would accumulate more down wood as some trees become overtopped and die. Additional down wood would improve habitat, but the trees that would fall would be generally small diameter, and would not last long. The opportunity to increase stand diversity and accelerate the growth of large trees would be forgone at this time. There would be no cumulative effects.

Alternative B—Proposed Action

Direct and Indirect Effects

The proposed units do not contain upland habitat that would be suitable for this species. Riparian reserve thinning would occur with this alternative, however there would be a minimum no-cut buffer of 60 feet along small streams, and most larger perennial streams would receive a buffer of one site potential tree height (about 180 feet).

The no-cut buffers would protect the habitat that is most likely to be occupied from disturbance, and the residual canopy cover in the remainder of the riparian reserves would help to maintain microclimatic conditions near the stream edges. Thinning in the outer portion of the Riparian Reserves would add stand diversity and accelerate the growth of the retained trees. This would improve habitat in the long-term by creating large trees that would eventually become large logs in the riparian area.

Implementation of this alternative would require constructing temporary roads, including several with intermittent stream crossings. The majority of these would occur within the unit boundaries. Since the units don't contain suitable upland habitat, undocumented upland sites would not be impacted. If Van Dyke's salamanders exist in any of the streams, constructing temporary stream crossings has the potential to impact them at the construction site, and downstream of the site if excessive sediment is allowed to flow downstream. Best Management Practices that are designed to retain sediment at the site would mitigate impacts. However, there

would still be an increase in sediment released from these sites for a year after the crossings are constructed, and also after the crossings are removed. Since the stream crossings on temporary roads would be small and short-term, there would be only short-term impacts to habitat connectivity along the streams.

There are no known occurrences of this species near any of the proposed units, and the streamside habitat would be buffered, however since there is a potential to impact Van Dyke's salamander due to the construction of temporary stream crossings, this alternative **may impact individuals or habitat, but would not contribute to a trend towards federal listing or loss of viability of the population or species.**

Cumulative Effects
The Clear Creek Roads project will decommission several roads in the analysis area, including removing stream crossings. Wildcat D, E, F is a foreseeable future project that would likely have similar impacts as this Wildcat project. Normal road maintenance, including culvert cleaning, and flood repair has the potential to increase stream sedimentation as well. This Wildcat project would have minor short-term cumulative impacts, but the long-term impacts would be beneficial. The long-term impacts of the Clear Creek Roads project will be beneficial as well, as would the anticipated long-term impacts of the future Wildcat D, E, F project.

Since the long-term impacts of these projects would be beneficial to this species, the cumulative short-term impacts of sedimentation would be minor.

Cope's Giant Salamander and Cascade Torrent Salamander
Existing Condition:
Cope's giant salamanders are usually found in small rocky streams in coniferous or mixed forests, and are most abundant under large rocks in the pools in these streams. They are most abundant in undisturbed forests, but are somewhat resilient to logging and usually recover as the forest matures (Jones et al. 2005). Fully metamorphosed adults are uncommon for this species, so they are nearly always found in the streams and the streams need to be flowing year-round. Cope's giant salamander has not been documented in the analysis area, but there are 4 sites that have been documented in the Elk Creek subwatershed just east and north of the analysis area.

Cascade torrent salamanders are found in similar habitats. They require cool, wet environments. Both larvae and metamorphosed individuals occur along high-gradient, cold, rock-dominated stream courses and near seeps. The aquatic larvae are associated with valley and headwall seeps and spray zones at the base of waterfalls and cascades, where gravel and cobble are present with shallow (<1 cm), low-velocity flows. Adults are often interspersed among the larvae or on stream banks under rocks or wood. They are usually within 3 to 4 feet of the water, but during prolonged rain they may be found more than 30 feet away. This species has persisted in streams impacted by the 1980 eruption of Mount St. Helens, suggesting that forest cover may not be a critical habitat feature at higher elevations (Jones et al. 2005).

Cascade torrent salamanders have been documented in the analysis area near Smith Butte in small tributaries to Clearwater Creek, and in the Elk Creek subwatershed.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

The No Action alternative would have **no impacts** to these salamanders because no suitable habitat would be impacted. Over time the Riparian Reserves would accumulate more down wood as some trees become overtopped and die. The opportunity to increase stand diversity and accelerate the growth of large trees would be forgone at this time. No cumulative effects would occur.

Alternative B—Proposed Action

Direct and Indirect Effects

Effects to these species would be similar to those described for Van Dyke's salamander above. The no-cut buffers would protect the habitat that is most likely to be occupied from disturbance, and the residual canopy cover in the remainder of the riparian reserves would help to maintain microclimatic conditions near the stream edges. Since Cope's giant, and Cascade torrent salamanders are tied more closely to water than Van Dyke's salamander, the no-cut buffers along streams should be more effective in protecting them and their habitat.

The mitigations described that would be in place to minimize sediment delivery would benefit salamanders, and only a very small amount of the suitable habitat would be impacted.

This alternative **may impact individuals or habitat but will not likely contribute to a trend towards federal listing or cause a loss of viability to the population or species**.

Cumulative Effects

The cumulative effects would be the same as described for Van Dyke's salamander.

Mollusks

Existing Condition:

Under the 2001 Record of Decision for Survey and Manage Species the following species are Category A (pre-disturbance surveys, manage known sites): *Cryptomastix devia, Cryptomastix hendersoni, Hemphillia burringtoni, Monadenia fidelis minor*, and *Prophysaon coeruleum*. The following species is Category C (pre-disturbance surveys, manage high-priority sites): *Hemphillia malonei* and *Hemphillia glandulosa*. In addition to these species, additional mollusk species have been added to the Regional Forester's Sensitive Species list for the Gifford Pinchot National Forest (2008) These recently added Sensitive species are: *Deroceras hesperium, Hemphillia pantherina, Megomphix hemphilli*, *Pristiloma pilsbryi, Pristiloma wascoense,* and two aquatic mollusk species: *Gonidea angulata,* and *Juga hemphilli hemphilli.*

Blue-gray taildropper (*Prophysaon coeruleum*) is only known on the Forest from four sites, all are in late-successional habitat on the Cowlitz Valley District. Columbia Gorge Oregonian snail (*Cryptomastix hendersoni)* is known from both sides of the Columbia River from The Dalles east to Rufus, and more recently from the Clackamas River, and Hood River Ranger Districts on the Mount Hood National Forest. Management recommendations for this species report that there is no reason to expect this species on the Gifford Pinchot N.F., but that surveyors should be able to recognize it. Shiny tightcoil (*Pristiloma wascoense)* is known from sites that are east of the

Gifford Pinchot National Forest, and are generally in Ponderosa pine/Douglas-fir plant associations at moderate to high elevations. This plant association does not occur in the analysis area.

It is unlikely that these three species exist within any of the proposed units and unlikely that they would be affected by any of the alternatives.

Terrestrial Species: Mollusk surveys, done to protocol have not been done for this project, but have been conducted in the analysis area for other projects, and as part of purposive surveys. Of the proposed Wildcat units, only part of Unit 31, which at one time was part of an earlier timber sale that was never completed, has been surveyed. Since all of the proposed units are plantations under 80 years old, pre-disturbance surveys are not required for this project.

Species that have been found in the analysis area are: Malone's jumping slug (*Hemphillia malonei*), warty jumping slug (*Hemphillia glandulosa*), and Puget Oregonian (*Cryptomastix devia*). No Sensitive species were found during surveys done in Unit 31.

Puget Oregonian (*Cryptomastix devia*) and Oregon megomphix (*Megomphix hemphilli*) are snails closely associated with mature big-leaf maple trees. They are usually found under moss on the trunk or under leaf litter within the drip line of the canopy. The other terrestrial species are generally found in moist microsites under logs or other woody debris, leaf litter, moss, and rocks. In general, stands that are in the Large Tree, Closed Small Tree and Hardwood structure stages are likely suitable habitat for most of the terrestrial mollusks that could occur in the analysis area. These structure stages comprise a total of about 28 percent of the analysis area (19,070 acres).

The proposed units are generally poor mollusk habitat currently, especially those in the Pine Creek sub-watershed. All of the units were clear-cut and burned and contain few remnant features that would support mollusks. The last stand-replacement harvest probably wiped out any mollusks that would have inhabited the stands at that time. Many of the proposed units are adjacent to older timber stands from which mollusks could disperse into the units as the habitat becomes suitable, but the general lack of remnant down logs and other features, and the slow dispersal rate probably mean that mollusks have not yet repopulated the stands in the units.

The units in the Pine Creek sub-watershed have well-drained pumice soils that are somewhat compacted, and have very little herbaceous or shrub cover. Mollusk surveys that were done in Unit 31 in 1999 and 2001 found very few individuals, and no Survey and Manage or Sensitive species.

Aquatic Species: Barren juga (*Juga hemphilli hemphilli*) is known from near the Columbia Gorge in Clark and Skamania Counties in Washington, and Multnomah County in Oregon. No known sites for these species exist on the Gifford Pinchot National Forest. It is found in small to medium-sized, moderate velocity streams at low elevations. The streams have a level bottom with a stable gravel substrate and highly-oxygenated cold water.

Western ridged mussel (*Gonidia angulata*) is known entirely from within Pacific drainages from southern California to British Columbia, east to Idaho and Nevada. They have limited distribution west of the Cascades in Washington and Oregon, but include sites in the Rogue, Umpqua, and Willamette Rivers. It seems to be most common in large tributaries of the Snake and Columbia Rivers in Washington, Idaho, and Oregon (http://web.or.blm.gov/mollusks/).

They are found in streams of all sizes in low to mid-elevation watersheds. They inhabit mud, sand, grave, and cobble substrates. They can withstand moderate amounts of sedimentation, but are usually absent from streams with highly unstable or very soft substrates. The life cycle of mussels includes a juvenile stage when they parasitize fish. Fish such as native or non-native trout need to be present in a stream for this species to occur.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

With this alternative there would be **no direct or indirect impacts** to the mollusks that may occur in the proposed Wildcat units. Smaller logs would be recruited in the stands over time, benefiting mollusks, as trees become over-topped and die. Without the thinning treatment though, it will take longer to develop large logs to replace the few well-decayed remnants. Over time, as the habitat improves, mollusks will likely repopulate the stands due to dispersal from adjacent mature timber habitat. Due to the well-drained pumice soils in the Pine Creek sub-basin, these stands may never support high numbers of mollusks. There would be no cumulative effects.

Alternative B—Proposed Action

Direct and Indirect Effects

Terrestrial Mollusks—Due to the disturbance history and current condition of the proposed units, and due to the relatively young age of the stands, they are not likely to support many of the Sensitive mollusks.

In the short-term, the proposed thinning would reduce habitat quality in the proposed units by reducing overstory shading, resulting in warming and drying at the surface. However, in the long-term, the treatment would improve habitat by increasing the cover and diversity of shrubs and herbaceous understory plants, which is often an indicator of good mollusk habitat in other parts of the Forest, and by accelerating the development of large trees and late-successional habitat.

The proposed units do not contain big-leaf maple, so *Cryptomastix devia* and *Megomphix hemphilli* would not be found in any of the units and would not be impacted. It's possible that some individual jumping slugs have dispersed into the units from adjacent late-successional habitat, and these would be impacted by the proposed thinning, and possibly be lost from the stands. However, the adjacent suitable habitat would not be affected and populations would likely persist in those areas. As the units become more suitable for mollusks over time, they would again disperse into the available habitat.

All of the proposed units, except for unit 6, are mapped in the 1999 version of the vegetation database as Closed Sapling/Pole or Open Sapling/Pole structure stages. These structure stages make up about 51 percent of the analysis area, making sapling/pole is the most common structure stage. Since 1999, all of the proposed units have developed into the Small Tree structure stage, and it is assumed that many of the other sapling/pole sized stands would now be mapped as Small Tree as well, making Small Tree likely the most common structure stage in the analysis area.

With this alternative, a total of about 2,064 acres would be commercially thinned. This represents about 11 percent of the total habitat in the analysis area that is at least marginally suitable. Mollusks that may exist within the units may be impacted, but the majority of suitable habitat, including the best habitat in the analysis area would be unaffected.

The impacts of thinning the overstory would be relatively short-term, and mitigation to protect existing large down wood to the extent possible means that some or all of these mollusks could recolonize the thinned units from adjacent suitable habitat. Assuming that these mollusks occupy the suitable habitat in the analysis area this alternative **may impact individuals or habitat, but would not likely contribute to a trend towards federal listing or cause a loss of viability to the population of species.**

Aquatic Mollusks – Based on where these species have been found, it is very unlikely that they occur in the analysis area. For this reason, there would be **no impacts** to these aquatic species.

Cumulative Effects
The anticipated Wildcat D, E, F timber sale would thin a similar amount of acres of similar habitat. If the two sales were combined into one analysis area the total acres thinned would amount to 10 to 15 percent of the likely suitable habitat. Since the majority of suitable habitat would not be affected, and only marginally suitable habitat is proposed for thinning, the Wildcat timber sale would have minimal cumulative effects.

MANAGEMENT INDICATOR SPECIES

Cavity Excavators
Existing Condition:
Cavity excavators represent species requiring snags and down logs. Little quantitative or qualitative snag data is available for the analysis area. The second iteration of the Muddy River Watershed Analysis however, contains some information about snags in the Muddy River fifth-field watershed, which includes all of the analysis area except for the Pine Creek sub-watershed.

Natural snag and down wood development occurring within the watershed is typical of other areas on the Forest. The watershed analysis reported that the majority of snags being created in the watershed are predominately the result of root rots and black bear damage. The snags created by these organisms tend to be relatively small. Armillaria root rot, which is the most common of the root rots in the watershed, generally is creating small diameter snags and down wood by killing trees within plantations that are between 10 and 25 years old. Bears tend to

girdle trees that are 15 to 40 years old, so mortality is occurring in trees with a diameter of 8 to 14 inches. Since 1997 almost 14,000 acres have been impacted by bears, increasing from 52 acres impacted in 1997 to almost 8,500 acres impacted in 2003. In addition, snow and wind damage that has broken the tops of smaller trees is common in some areas.

An analysis of snags greater than 12 inches diameter was done in the Watershed Analysis utilizing Current Vegetation Survey (CVS) data for the watershed. Based on this, the following is estimated for snags within the watershed (Table 26).

Table 26. CVS snag data for the Muddy River Watershed

	Snags greater than 12 in. dbh	Snags greater than 30 in. dbh
Mean	2.7 per acre	.12 per acre
Range	0 – 13.3 per acre	0 – 1.1 per acre

Old forest stands in the analysis area contain relatively more and larger snags, and younger stands, which tend to be old clear-cuts or areas devastated by the 1980 eruption of Mount St. Helens, have the smallest snags. The snags in younger stands can range from few to many depending on the amount of root rot, bear damage, and suppression mortality occurring.

The mean figures in Table 5 are averages across the watershed. Late-successional and old-growth stands (older than 150 years) comprise about 28 percent of the analysis area, and are where the most numerous and largest snags and logs can be found. Stands that are between 80 and 150 years old comprise about 15 percent of the analysis area. These are late-successional fire-regenerated stands that have a combination of old snags that are remnants from the fire, and younger smaller snags that have died due to inter-tree competition or disease. The remainder of the analysis area (58 percent) is stands less than 80 years old, where the snags tend to be smallest, generally less than 12 inches diameter, and where density varies.

The stands older than 150 years are probably providing for cavity excavating birds to the 80% tolerance level as described in DecAID (Mellen et al. 2006), and the stands that are 80 to 150 years old probably provide habitat at the 50% tolerance level. These levels would meet or exceed Forest Plan standards for snag density. The stands younger than 80 are probably at the 30% tolerance level or less, and would be below Forest Plan standards at this time.

The Land and Resource Management Plan for the Gifford Pinchot National Forest (Amendment 11) provides guidelines for retention of snags and logs in areas of regeneration harvest in Matrix. In areas of partial harvest, such as proposed with this project, the guidelines are to be modified to reflect the timing of stand development cycles where partial harvest is practiced (Amendment 11, 6-2). In other words, the number and size of snags should approximate what would be expected in a stand of that age and average diameter. Increasing the number of acres that provide habitat at least at the 50 percent tolerance level would benefit cavity excavating birds. Designing the thinning prescription to allow snags to be created naturally would be beneficial in the stands that currently only provide habitat at the 30 percent tolerance level.

Wildcat Units - The Wildcat units are all young plantations (average diameters ranging from 8 to 14 inches) that resulted from clear-cut harvesting. The existing snags in the units are from the few small trees that have died due to suppression mortality or root disease. Some of the units have large well-decayed logs that are left from the previous stands, and small logs that are from the young trees that have fallen over. Many of the units contain overstory trees that have broken tops due to snow damage, or that have multiple tops and boles. These trees could be retained to provide future snags in the near term.

Danger Trees – As part of this project, an unknown number of danger trees would be felled along the major haul routes (25, 83, 8322 Roads). All dead trees within 150 feet of the road that would likely hit the road if they fell could be cut. Much of the 25 and 83 Roads have already been treated under earlier contracts, and there doesn't appear to be any large-tree stands that would be expected to contain danger trees along the portion of the 8322 that would be the haul road. For these reasons, it is not likely that a large number of danger trees would need to be felled for this project. Based on the number felled in the previous contracts it is expected that the number of trees that would need to be felled for this project would average less than 5 large trees (greater than about 14 inches diameter) per mile of road that passes through stands with larger timber, which is equivalent to about 1 per seven acres.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

With this alternative, no effects to existing snags and down wood would occur, and suppression mortality would continue to occur in the proposed units. The tolerance level in the analysis area and in the watershed would gradually rise as the smaller trees die. However, since this mortality would primarily consist of small diameter trees, the overall benefit to cavity excavators would be questionable. These trees would be too small to be nest trees for many of the species, and they likely would not remain standing for long. They would become small logs that would provide a short-term benefit, but would decay relatively quickly.

The opportunity to more quickly develop large trees by thinning within the analysis area with this project would be forgone.

Danger trees along the major roads in the analysis area would continue to be felled as the hazards are identified.

Alternative B—Proposed Action

Direct and Indirect Effects

With this alternative a total of 2,064 acres in the small tree structure stage would be thinned, which is about 3 percent of the analysis area, and 15 to 20 percent of the conifer habitat in the analysis area that is in the small tree structure stage. The thinning treatment would affect some of the existing snags however, as some may need to be felled for safety reasons. These snags are small diameter, and likely would not stand for very long if left alone. These felled snags would be added to the percent down wood cover in the stands. A small portion of the retained trees in the units is expected to be blown over in wind storms, and many of the trees that are not of commercial size would be knocked over during harvest. For these reasons, the amount of down wood cover will likely be greater a few years after harvest than what currently exists.

Unthinned patches would be left in all units, including in Riparian Reserves and in the "skips" that are part of the silvicultural prescription. These are areas where small snags would likely continue to be created through natural processes. Mitigation to retain defective green trees and potential new bear damage in the units would help to provide future snags in the short-term.

The thinning treatment would reduce the number of small diameter snags in the units that would be expected to develop over the next few decades because it would reduce natural mortality resulting from suppression of the smaller trees, and reduce the potential for insect and disease mortality. The tolerance level in these stands would likely remain near 30 percent or less for snag density and diameter after thinning. At a watershed scale, the condition would be within the natural range of variability, with the Wildcat units representing the portion of the habitat type that has 0 to 6 snags per acre. Suppression mortality would continue to occur in the majority of the habitat type in the analysis area that is not managed, so the tolerance level at the watershed scale would gradually increase.

The thinning would accelerate the development of large trees in the units, and in the long-term these stands would be a source of large snags and logs.

Cumulative Effects

Clearcutting and short rotations on private timber lands in the analysis area is expected to continue, meaning that few large snags are likely to develop or persist on private land. Wildcat D, E, and F will likely thin a similar number of acres in young plantation stands as this project. It will be in sub-watersheds immediately east of this project. The impacts of Wildcat D,E,F are likely to be the same as this project in that the snags that would be lost are primarily the small diameter snags that would have developed in the absence of thinning.

Since both projects would have minimal impacts to important snag habitat, and would likely result in a fairly immediate increase in down wood cover, albeit small diameter wood, and since both projects would increase habitat diversity and accelerate development of large trees, this project would have minimal cumulative effects.

Pileated Woodpecker and Pine Marten

Existing Condition:

Pileated woodpecker and pine marten represent species that require old-growth and mature forest conditions. Canopy closure in optimal habitat for pileated woodpecker and pine marten is 75% and 50% respectively, and both species require abundant large down wood and snags to provide habitat for their prey species, and nest sites (Allen 1982, and Schroeder 1983). Currently, about 28 percent of the analysis area (19,050 acres) supports stands that are in the large tree and closed small tree structure stages. These areas are likely to provide habitat for these species. About 15 percent of the analysis area (10,050 acres) is in the large tree multi-story structure stage, and would provide the best nesting/denning habitat. In addition, some of the stands regenerated after the fires in 1902 are suitable foraging habitat due to the presence of large soft snags and down wood. Almost all the suitable habitat in the analysis area is located within LSR.

Several sightings of both pine marten and pileated woodpeckers are recorded for the analysis area in the NRIS Wildlife database. The sightings are largely within the Clearwater and Clear Creek subwatersheds, where the majority of the suitable habitat is found.

The stands proposed for thinning are plantations regenerated in the 1960s and 1970s and are largely unsuitable habitat for sustaining these species due to the lack of large trees, tall hard snags, abundant down wood, and multi-story tree canopy. Many of the proposed Wildcat units are adjacent to suitable habitat however, especially those that are in LSR, and the units may provide sufficient cover to enable these species to move between patches of suitable habitat.

Effects Analysis:

Alternative A—No Action–

Direct, Indirect and Cumulative Effects

With this alternative the Wildcat units would remain unsuitable habitat for these species. Habitat suitability would improve over time, but at a slower pace that with the action alternative. Suppression mortality among the trees would mean that there would be more small snags in the analysis area over time, but these would be too small to be useful by these species. No immediate impacts to these species would occur but the opportunity to accelerate habitat development would be forgone.

Alternative B—Proposed Action

Direct and Indirect Effects

None of the proposed units are currently suitable habitat, or they only provide marginal dispersal cover, so the proposed thinning would have little to no impact to these species. The short-term effect of the thinning would be to reduce canopy cover in the proposed units making it less likely that marten and pileated woodpeckers would utilize the stands to move through until the crowns of the residual trees close in again. The canopy cover is expected to remain between 50 and 60 percent in seventeen of the proposed units. Fifty percent and higher is optimum for marten and sixty percent is about 80 percent of optimum for pileated woodpeckers. For units where the residual canopy cover would be 30 to 40 percent after thinning, it would take ten to fifteen years to recover to 50 percent or more canopy cover.

Thinning would reduce the number of smaller snags and logs that would otherwise develop in these stands over the next few decades since it would reduce suppression mortality, however this effect is minor since the snags and logs that would have been created would have been too small to provide important habitat structures. In addition, this effect is minor in the context of the whole analysis area because the best habitat is not being thinned.

In the long-term, habitat in the thinned stands would be improved for these species as growth on residual trees is accelerated, reducing the time needed to produce large trees and eventually large snags and logs. In addition, thinning would produce a more diverse understory that what currently exists, likely increase the amount of small diameter wood on the ground, and may help initiate development of a second canopy layer.

The short-term reduction in the ability to move through the stands is insignificant, and on a landscape scale, the requirements of these species are provided for by the standards and guidelines of the Northwest Forest Plan. The Wildcat timber sale would not cause a loss of viability of the populations of these species on the Forest.

Cumulative Effects

No new regeneration harvest of suitable large tree habitat on National Forest is planned at this time in the analysis area, however past regeneration timber harvest on National Forest as well as private land removed suitable habitat and fragmented what was left. Large clear-cuts are still being implemented on private timber land in the analysis area. The total amount of new clear-cuts on private land was measured using 2006 aerial photos. Within the last 10 to 15 years, a total of about 1,063 acres have been harvested in the Pine Creek sub-basin, and 210 acres in the Muddy River sub-basin. These new clear-cuts average about 50 acres in size, but range up to about 240 acres. In addition, about 137 acres in the Pine Creek sub-watershed, and 17 acres in the Muddy River sub-watershed have been converted to residential development. These private land stands appear to have been single story small tree stands, and were not good habitat for marten or pileated woodpeckers, but the large openings may somewhat impact the ability of these species to move across the landscape.

The proposed action would treat habitat that is currently unsuitable, or is very low quality, and the long-term effect would be beneficial. The short-term effect to the ability of these species to move within the landscape would be cumulative to the management that has occurred on private land. The provisions in the Northwest Forest Plan that provide habitat for late-successional species will maintain viable populations of marten and pileated woodpecker across the Forest, and the cumulative effect of this project would be insignificant.

Deer and Elk

Existing Condition:

Historically, elk and deer numbers in the western Cascades probably increased in response to large disturbance events, such as stand-replacing fires, because the disturbances resulted in increased forage availability. These populations likely declined again as conifers grew and eventually shaded out the forage plants in the disturbed areas. In general on the Gifford Pinchot National Forest, and especially in winter range areas, the reduction in regeneration timber harvest since the mid-1990s has reduced the amount of high quality forage available to the elk and deer herds, and populations are thought to be declining. The Washington Department of Fish and Wildlife considers the lack of forage to be a more limiting factor to the Mount St. Helens elk herd than thermal cover.

Conditions in the analysis area for large ungulates reflect what is happening on the Forest in general. Clear-cut timber harvest in the 1950s through 1980s created dispersed forage patches, and unharvested late-successional conifer habitat provided optimal thermal cover. In addition, the 1980 eruption of Mount St. Helens created open foraging in a large part of the Clearwater Creek sub-basin. Today, most of the clear-cut patches have regenerated into stands that provide thermal and hiding cover, but very little forage. By far most of the open foraging habitat in winter range in the analysis area is currently found on private land in the southwestern part of the analysis area, and along the Muddy River floodplain (Figure 22). The majority of forage habitat on National Forest in the analysis area is currently found in higher elevation areas in the Clearwater Creek Subwatershed and Clear Creek subwatershed. The Forest Service has attempted to partially address the forage limitation in the analysis area by precommercially thinning to a wide spacing in young stands to promote forage production.

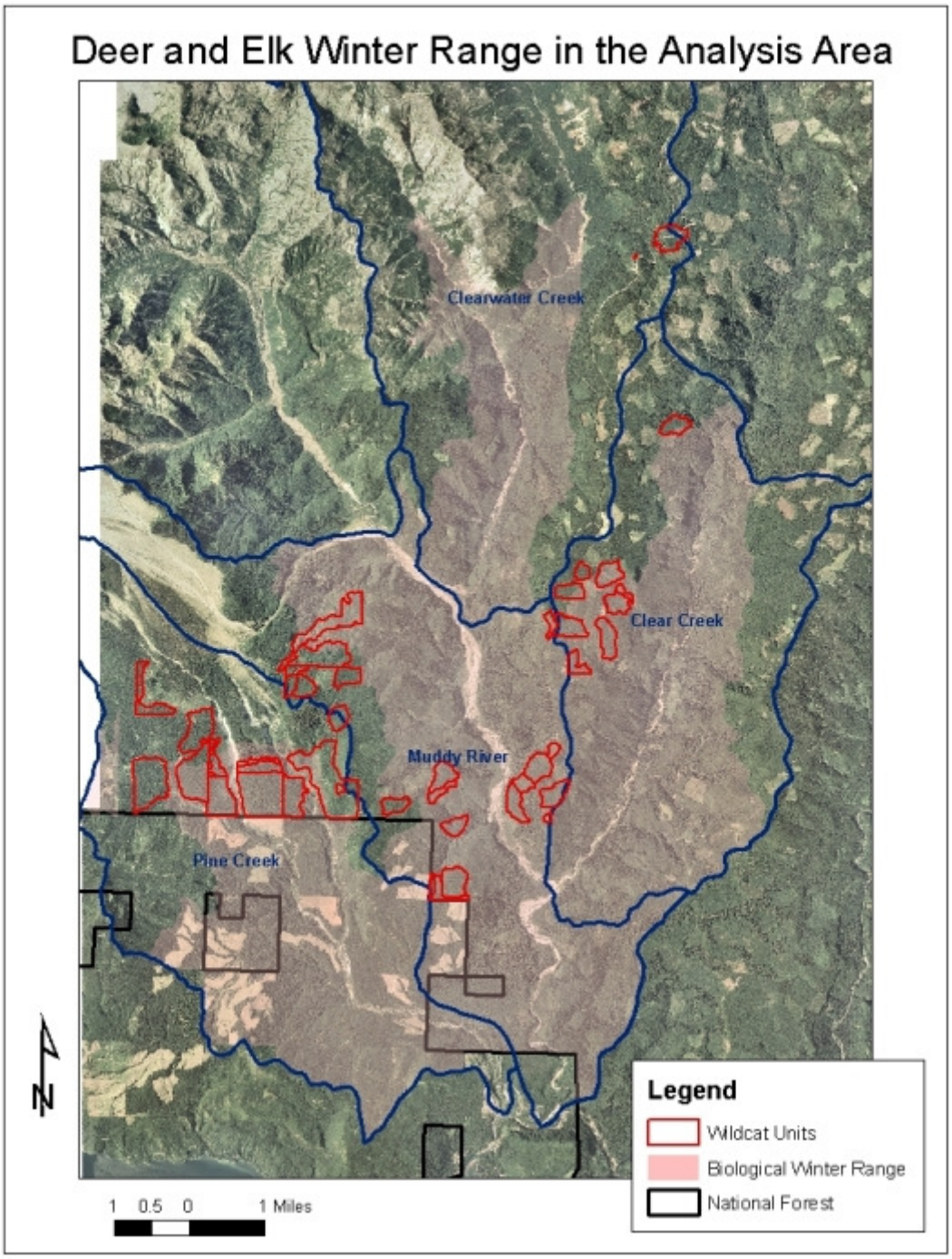


Figure 22. Deer and Elk Winter Range in the Analysis Area.

The standard in the Forest Plan for winter range states that 44 percent of the area should be in optimal thermal cover. Optimal thermal cover consists of multi-story conifer stands that have a high canopy closure with deep crowns to intercept snow, and an open understory and small openings where forage plants can grow. The biological winter range in the analysis area consists

of about 17 percent optimal thermal cover. Creating additional forage while accelerating development of optimal thermal cover would benefit deer and elk.

In the past, clear-cut harvest created forage areas, but these areas are providing less forage as the trees mature into dense single-story stands, and this type of harvest that would open large areas on National Forest in the analysis area is not anticipated at this time. The recent clear-cuts on private land, totalling of about 1,273 acres, after an initial period of several years for forage to establish, will likely provide forage for 20 years. Additional private land harvest is likely to occur in the analysis area over time.

Commercial thinning has the potential to increase forage to a lesser degree by reducing the overstory shading, thereby increasing the cover and diversity of understory vegetation. The degree of understory response is dependant on the degree of overstory removal.

The Wildcat units currently provide thermal cover and hiding cover for elk and deer, but do not provide much forage due to shading of the forest floor. Forage plants that can still be found in the units include vine maple, huckleberry, swordfern, and various forbs.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

None of the proposed units would be treated with this alternative. The existing forage, if any exists, in the proposed units would continue to be shaded. Forage production on National Forest in the analysis area will decline until openings are created by natural mortality of the overstory trees, as well as other potential natural disturbances. The opportunity to accelerate the development of optimal thermal cover would be forgone at this time.

Alternative B—Proposed Action

Direct and Indirect Effects

No stands that currently provide optimal thermal cover would be affected. Proposed thinning on about 2,064 acres would result in a moderate increase in forage production in the areas that are thinned. These acres represent about 3 percent of the current thermal cover acres. Creating small gaps as part of the variable density thinning would increase the diversity and cover of browse and herbaceous forage plants in these areas. Increased forage production resulting from overstory thinning in the proposed units should last for 15 years or more. The units that are thinned heavily would sustain an increase in forage production for 5 to 10 years longer. There would be no new system roads constructed.

In the long-term, growth on the residual trees in the thinning units would be accelerated, and these areas that are in LSR would become optimal thermal cover in the future. This would probably take 100 years or more.

In the short-term, this alternative would impact elk and deer by increasing noise disturbance and human activity during the harvest process. This activity would likely cause animals to move away from the activity. In the long-term the alternative would benefit elk and deer by increasing forage production, while accelerating development of optimal thermal cover.

Cumulative Effects
The benefit of increased forage production in the thinned units of Wildcat would be cumulative to the acres that have been cut on private land, and future likely commercial thinning on National Forest (Wildcat D,E,F) The cumulative effects would be beneficial since forage production would be increased in an area where forage is becoming limited, while accelerating development of optimal thermal cover.

Neotropical Migratory Birds
Existing Condition
A conservation strategy for land birds in coniferous forests in western Oregon and Washington was prepared in 1999 by Bob Altman of American Bird Conservancy for the Oregon-Washington Partners in Flight. The strategy is designed to achieve functioning ecosystems for land birds by addressing the habitat requirements of 20 "focal species". By managing for a group of species representative of important components of a functioning coniferous forest ecosystem, it is assumed that many other species and elements of biodiversity will be maintained. Table 27 displays the focal species potentially positively or negatively affected changes in habitat, and the forest conditions and habitat attributes they represent. Table 28 displays the number of acres in the major structure stages in the analysis area. Data is from the 1999 vegetation database.

Table 27. Focal Bird Species

FOREST CONDITIONS	HABITAT ATTRIBUTE	FOCAL SPECIES
Old-growth	Large snags	Vaux's swift *
Old-growth/Mature	Large trees	Brown creeper *
Old-growth/Mature	Conifer cones	Red crossbill
Mature	Large snags	Pileated woodpecker
Mature	Mid-story tree layers	Varied thrush *
Mature/Young	Closed canopy	Hermit warbler
Mature/Young	Deciduous canopy trees	Pacific-slope flycatcher
Mature/Young	Open mid-story	Hammond's flycatcher
Mature/Young	Deciduous understory	Wilson's warbler
Mature/Young	Forest floor complexity	Winter wren
Young/Pole	Deciduous canopy trees	Black-throated gray warbler
Pole	Deciduous subcanopy/understory	Hutton's vireo
Early-seral	Residual canopy trees	Olive-sided flycatcher *
Early-seral	Snags	Western bluebird
Early-seral	Deciduous vegetation	Orange-crowned warbler
Early-seral	Nectar-producing plants	Rufous hummingbird *

* Significantly declining population trends in the Cascade Mountains physiographic areas.

Since the 1999 version of the vegetation database was used for this analysis, the amount of sapling/pole habitat is probably overstated, and the amount of small tree habitat is probably understated. It is likely that many of the sapling/pole stands in 1999 have by now grown into small tree stands. The proposed Wildcat units are in the closed small tree structure stage, which

is defined as having an average of between 9 and 20 inches dbh. These stands would currently provide habitat for birds species found in mature/young stands represented by hermit warbler, Wilson's warbler and winter wren. There are no species associated with this habitat type from the Partners in Flight report that are thought to be declining.

Table 28. Structure Stages in the Analysis Area

Structure Stage	Percent of Analysis Area
Large Tree, Single and Multiple Canopy	16%
Closed Small Tree	12%
Open Small Tree	5%
Hardwood Small Tree and Hardwood Sap/Pole	0.2%
Open and Closed Sapling/Pole	51%
Shrub/Seedling/Grass/Forb/Wet/Mesic/Rock	16%

Most of the Wildcat units have very simplified understories that generally lack a well-developed shrub layer or deciduous understory trees. Increasing these habitat features would improve habitat for species that are represented by winter wren, Wilson's warbler, and Hutton's vireo.

Effects Analysis:

Alternative A—No Action

Direct, Indirect and Cumulative Effects

Since no thinning would occur with this alternative, the opportunity to increase habitat diversity would be forgone. There would be no long-term benefit to bird species that depend on mature and old-growth habitat and that are thought to be declining.

Alternative B—Proposed Action

Direct and Indirect Effects

The proposed thinning would convert closed small tree stands into open small tree stands, and open the stands enough to encourage growth of understory deciduous shrubs such as vine maple, and huckleberry. Opening the mid-story, and increasing the deciduous understory and forest floor complexity would improve habitat conditions for Hammond's flycatcher, Wilson's warbler and winter wren.

In the long-term, thinning these stands would accelerate development of late-successional habitat in the treated stands, and eventually they will provide suitable habitat for species represented by brown creeper and Vaux's swift, which are thought to be declining. Since much of the analysis area is in LSR, habitat for these late-successional species will increase over time.

These alternatives would treat habitat that is common in the analysis area, and improve conditions in the short-term by adding complexity and structural diversity. For these reasons, these alternatives would not result in significant effects to neotropical migratory bird populations. In the long-term, the treatment would accelerate development of habitat that is more limited in the analysis area (large tree), and improve habitat for Vaux's swift, red crossbill, pileated woodpecker, and varied thrush in the proposed units.

Cumulative Effects
Conversion of closed small tree habitat to another habitat type with this project would be cumulative to other activities that are expected to do the same. The clear-cutting on private land in the analysis area is converting closed small tree habitat to seedling/grass/forb habitat. Currently, this type of habitat is uncommon on the National Forest in the analysis area. In the future, Wildcat D,E,F is anticipated to thin a similar number of acres of closed small tree habitat as this project. Early-successional habitat created on private land may increase habitat for species represented by orange-crowned warbler and rufous hummingbird. Future projects on National Forest would likely reduce acres of closed small tree habitat and increase acres of open small tree habitat, and accelerate the development of mature and old-growth habitat in the long-term. Both of these prescriptions treat habitat that is common in the analysis area, and create habitat that is less common. More bird species, including some that are thought to be declining, would benefit by these habitat conversions than would be negatively impacted by them.

Scenery

This section evaluates the potential effects of the Wildcat Thinning Project on the visual quality along the Forest Road 2500, 8300, and 8322 travel corridors in order to determine consistency with current land and resource management direction for meeting visual quality objectives in the various management area categories within the project area. Each unit will be analyzed for how well it meets the visual quality standards for being seen from these road corridors.

Visual Quality Objective Requirements
The Gifford Pinchot Land and Resource Management Plan has identified Visual Quality Objectives (VQOs) for each management area designation on the forest. The VQOs for this project area are defined in the following three paragraphs.

Management area category, Timber Emphasis/General Forest (TS) has a VQO of “modification”. This VQO allows management activities to dominate the natural landscape, but at the same time they need to follow the naturally established form, line, color, and texture.

Management area categories Visual Emphasis (VM) and Deer and Elk Winter Range (EM) have a VQO of “partial retention.” This VQO requires activities to remain visually subordinate to the characteristic landscape.

Management area categories Visual Emphasis (VL) and Late Successional (LS) have a visual quality objective (VQO) of “retention.” This VQO requires that management activities should not be evident to the casual Forest visitor.

Gifford Pinchot Forest Plan also has a requirement that limits the percent of openings at any one time along all major road corridors. However, this requirement only applies to clearcutting, shelterwood harvest, and seed tree harvest. All units in this project are thinning units (except the small portion of salvage in unit 21), and are not considered openings. Therefore this requirement does not apply to this project.

Management Area Category TS (Timber Emphasis/General Forest)
Units 23, 24, 29, 31, 32, and 33 are all located within the TS management area category. All units meet the description of modification. The prescription to thin these units, their location and size, the riparian buffers, screening from roads with other stands, and use of un-thinned clumps allow these units to follow the naturally established form, line, color, and texture.

Management Area Categories VM (Visual Emphasis) and EM (Deer and Elk Winter Range)
Units 21, 22, 30 all are located within either VM or EM management area categories. These units all meet the description of partial retention. None of these units are located along the visual emphasis travel corridors and are screened from view.

Management Area Categories VL (Visual Emphasis) and LS (General Late Successional)
Units in 1, 5, 6, 7, 12, 13, 14, 15, 16, 17, 19, 25, 26, 27, and 34 are located within the VL management area category. Units 3, 4, 7, 8, 9, 10, 11, and 18 are located with the LS management area category. These management area categories both have a VQO of retention.

Units 3, 4, 5, 7, 8, 9, 10, 11, 13, 14, 15, 18 and 19 are all screened from the three visual emphasis travel corridors, Forest Roads 2500, 8300 and 8322, by adjacent stands and will meet the VQO of retention. The only portions of these units that may be seen would be the upper portions of their canopies. They would appear as natural variations in the density of the canopy to the casual visitor.

Units 1, 6, 7, 12, 17, 27, and 34 are all adjacent to Forest Roads 2500, 8300, or 8322. They will all meet the VQO standard of retention by maintaining a minimum of a 50 percent canopy cover, with a relatively small portion of the units adjacent to the road, and riparian buffers breaking up the contiguity of the stand. These units will appear as natural variations in density of the stand to the casual visitor as they drive by the units.

Units 16, 25, and 26 are also adjacent to Forest Roads 2500, 8300, or 8322. Unit 16 will have a canopy cover of 40 percent left after harvest and units 25 and 26 will have a canopy cover of 30 percent. These units will meet a VQO of retention by utilizing variable spacing and un-thinned clumps to blend the new units into the surrounding landscape. These units also have riparian buffers that will help the units match the natural line and form of the existing landscape. These units will also appear as natural variations in density of the stand to the casual visitor as they drive by the units.

Alternative A—No Action
Direct, Indirect and Cumulative Effects
There would be no change to visual quality of any of the proposed units; therefore, there would be no effects to visual quality.

Alternative B—Proposed Action
Direct, Indirect and Cumulative Effects
All units along the visual emphasis travel corridors would have a short term (one to three years) visual impact due to the logging activities. Slash and damaged understory vegetation may be

seen from the roadway, but should be visually subordinate to the landscape character. The understory vegetation should fill in quickly with the additional sunlight reaching the forest floor restoring a naturally appearing landscape.

The long term impact of this project would be to develop larger diameter trees along the travel corridors. There will be more of a variation in size of trees as well as density. Most visitors considered this to be more aesthetically pleasing.

Heritage Resources

Heritage resource inventories for the Wildcat group A and B units were completed under contract by Willamette Cultural Resource Associates and Lower Columbia Research and Archaeology during September of 2007. Heritage resource surveys for Wildcat group C units were completed by Forest Service Heritage Specialists between July and October of 2008. Per Stipulation III.B.1. of the 1997 *Programmatic Agreement Among the USDA Forest Service (Region 6), The Advisory Council on Historic Preservation, and the Washington State Historic Preservation Officer Regarding Cultural Resources Management on National Forest in the State of Washington*, reports documenting these surveys were approved by the Forest Heritage Specialist, since "no property(s) which could possibly meet the criteria for the National Register of Historic Places (36 CFR 60.4) are found within an undertaking's Area of Potential Effect". Copies of these Heritage Resource Survey Reports were provided to the Washington State Historic Preservation Office, the Yakama Nation, and the Cowlitz Tribe. The entire heritage report can be found in the project file. The results are summarized below.

No Action and Proposed Action
Direct, Indirect and Cumulative Effects
No heritage resource properties which meet the criteria for inclusion in the National Register of Historic Places were documented in the Area of Potential Effect (APE) for units within group ABC of the Wildcat Thin Timber Sale project. No effects to heritage resources are anticipated as a result of implementation of any alternative of this project.

Economic Analysis

A financial and economic analysis of the single action alternative including mitigation measures was prepared to display anticipated costs and revenues.

Most of the project is assumed to be implemented within a five year time span. No inflationary rate, discount rates, or changes in real value were used for implementation costs and benefits. These rates and changes are assumed to be offsetting within this relatively short time span. All values displayed below are in present dollars.

Project Preparation and Administration

The project preparation and administration costs are considered first. These are up-front costs, typically not subject to any reimbursement from project revenue. Environmental survey and analysis costs are considered spent and not included.

Table 29. Project Preparation and Administration Costs			
Activity	**$/Unit**	**Alternative B**	
		Units	**Value**
Timber Sale Preparation	($60)/ac	2,066	($123,960)
Timber Sale Administration	($35)/ac	2,066	($72,310)
Pre Timber Sale Weed Control	($48)/mile	37.5	($1,800)
Total Costs			**($198,070)**

Timber Sale

The treatment units in Alternative B – Proposed Action that would yield commercial quantities of timber were considered together as a single project. Most elements of the timber sale would be completed by the purchaser, but some would be completed by the Forest Service. The Forest Service elements are typically funded through deposits from sale revenue.

Table 30. Timber Sale Revenue and Costs			
Purchaser Elements	**$/Unit**	**Alternative B**	
		Units	**Value**
Temporary Road Construction	($20,000)/mile	11	($220,000)
Road Reconstruction	($388,048)/total	1	($388,048)
Road Maintenance	($63,643)/total	1	($63,643)
Fell and Buck (not in logging cost)	($27)/mbf	3,523	($95,121)
Logging – Ground Based	($80)/mbf	25,810	($2,064,800)
Logging – Skyline	($175)/mbf	3,523	($616,525)
Log Haul	($43)/mbf	29,333	($1,261,319)
Slash Piling/Cover – Machine	($400)/acre	27	($10,800)
Erosion Control (landings & temp roads)	($400)/acre	51.5	($20,600)
Timber Value – Douglas-fir	$228/mbf	23,466	$5,350,248
Timber Value – Hemlock / Silver fir	$171/mbf	5,867	$1,003,257
Subtotal Sale Revenue			**$1,612,649**
Purchaser Competition Factor (30%)			**($483,795)**
Subtotal Sale Revenue			**$1,128,854**
Forest Service Elements			
Minimum Deposit to National Forest Fund	($0.50)/mbf	29,333	($14,667)
Road Maintenance Deposits (Rd 25, 83, 90)	($17)/mbf	29,333	($498,661)
Brush Disposal Deposits – Burn Landing Piles	($204)/landing	126	($25,704)
Brush Disposal Deposits – Burn Unit Piles	($164)/acre	27	($4,428)
Required K-V Reforestation	($462)/acre	11	($5,082)
Total FS Required Deposits			**($548,542)**
Total Sale Net Value			**$580,312**
Total Sale Net Value per MBF			**$20**

For Alternative B, the timber sale portion appears to be profitable to a purchaser and would yield revenue in excess of that needed to cover Forest Service required deposits.

Historically, timber values have increased in real dollars over time, but they are currently declining and well below historical highs. Fuel prices are also an important variable that have lately been volatile. Fuel prices affect nearly all logging cost centers. These two elements,

timber value and fuel costs, will have a strong influence on the revenue generated by this sale. With a net value of only $20 per MBF, this sale does not have much cushion.

If there are excess receipts, they could be used to fund other service projects that were identified in the project proposal and mitigation. Excess receipts can also be shared with the counties (25% Fund Act), used for road and trails (10% Fund Act), or finance the Forest's salvage sale program.

Service Projects

Excess timber receipts could be used to fund service projects that implement other treatments. Additional funds from other sources would likely be needed. The costs of these service projects are listed in the following table.

Table 31. Service Projects

Activity	$/Unit	Alternative B	
		Units	Value
Invasive Weed Control (3 years)	($180)/ac	149	($26,820)
Reforestation Enhancement	($462)/ac	103	($47,586)
Precommercial Thinning	($240)ac	17	($4,080)
Road 25 Clearing Limit Thinning	($12,900)/mile	9	($116,100)
Road 2575 Decommission MP 1.5 to 1.67	($12,000)/each	1	($12,000)
Road 2586170 Decommission	($3,000)/each	1	($3,000)
Road 8322560 Decommission	($3,000)/each	1	($3,000)
Road 8300380 Crossing Rehab and Closure	($3,500)/each	1	($3,500)
Old Logging Road and Steam Crossing Rehab	($68,000)/each	1	($68,500)
Total Costs			**($284,586)**

Economic Measures

The timber benefit, less competition factor, is $5,869,710. Costs total $5,757,397. Thus, the present net value is $112,323, and the benefit to cost ratio is $1.02:1.

Other Environmental Consequences

This section addresses those effects for which disclosure is required by National Environmental Policy Act regulations, Forest Service policy or regulation, various Executive Orders, or other laws and direction covering environmental analysis and documentation. In some cases, the information found here is also located elsewhere in the document.

Irreversible and Irretrievable Commitment of Resources
Irreversible Commitments
Irreversible impacts result from the use or modification of resources that are replaceable only over a long period of time.

Soil Productivity Soil productivity would be lost or reduced to some degree on temporary roads and landings due to soil displacement. Full recovery of productivity on these areas would not be anticipated despite efforts to reclaim these lands. The losses in productivity from the above would occur on a small part of the planning area (about 2.3 percent of the activity area). Also

soil losses due to extensive erosion or mass failures resulting from timber harvest and road building activities would be an irreversible impact. However, this is not expected to occur considering the design features and mitigation measures included with the action alternative; principally, by not locating harvest units or other activities in unstable or potentially unstable areas.

Rock Resource The rock that is removed from quarries or rock pits and used during construction of roads for surfacing and other needs would not be replaceable.

Old-Growth No late-successional or old-growth stands or trees are proposed for harvest in the action alternative.

Irretrievable Commitments
Irretrievable commitments are opportunities for resource uses that are forgone because of decisions to use that land in another way. For example:

Timber Production – Generally, management activities, such as thinning, improve timber production. However, opportunities to increase net production of timber would be forgone in those areas not thinned at this time to protect other resources.

Relationship between Short-term Uses and Long-term Productivity
Long-term impacts to site productivity from soil being lost from the site are discussed above in the Irreversible Commitments of Resources.

Effects on Prime Farm Land, Range Land, and Forest Land
There are no prime farm lands or prime range lands within the Canyon Timber Sale planning area. Prime forest land is a term used only for non-public lands and does not apply to any land within the planning area.

Effects on Environmental Justice
Executive Order 12898 (February 11, 1994) directs federal agencies to focus attention on the human health and environmental condition in minority and low-income communities. The purpose of the Executive Order is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations. The principle behind Environmental Justice is that people should not suffer disproportionately because of their ethnicity or income level.

While the sale of National Forest timber would create or sustain jobs and provide consumer goods, neither of the alternatives would have a disproportionately high or adverse human health or environmental effect on minority and low-income populations.

Effects on Wetlands and Floodplains
There would be no effects to wetlands or floodplains due to the implementation of project design criteria and mitigation measures included with the action alternative.

CHAPTER 4. CONSULTATION AND COORDINATION

Consultation with Other Agencies and Jurisdictions _____

The Washington State Department of Ecology (DOE) is responsible for enforcing the Clean Water Act of 1972. A Memorandum of Understanding prepared and agreed to by the Forest Service and DOE states that Best Management Practices, used by the Forest Service to control or prevent non-point sources of water pollution, would meet or exceed State water quality standards and other requirements, as outlined in the Washington State Forest Practices Rules. The project design criteria and mitigation measures in would comply with the Memorandum of Understanding.

The Washington State DOE is also responsible for enforcing the Clean Air Act of 1977. The State Smoke Implementation Plan provides guidelines for compliance which are intended to meet the requirements of the Clean Air Act. All burning plans for activities associated with this project would comply with this Plan.

The United States Department of Interior, Fish and Wildlife Service (USFWS) is responsible for protection and recovery of threatened and endangered species.

The United States Department of Commerce, National Marine Fisheries Service (NMFS) is responsible for the protection and recovery of Threatened and Endangered anadromous fish species.

All steps in the cultural resource process are coordinated with the Washington State Historic Preservation Office. Cultural Resource Site Reports are filed with and approved by the Washington State Historic Preservation Officer. Based on the information documented in the Cultural Resource Report, there would be no adverse effects to cultural resources by implementation of either alternative, and consultation is not required.

List of Preparers

In October of 2008 Tom Mulder, Mount St. Helens Monument Manager, drew together a team of Forest Service employees to develop the proposed action, develop alternatives, and complete the effects analysis for the Wildcat Timber Sale Environmental Assessment. Member of the team were:

NAME	POSITION
Ruth Tracy	Team Leader and Hydrologist
Aldo Aguilar	Soil Scientist
Stephanie Caballero	Fisheries Biologist
Kevin Parkinson	Logging Systems (trainee)
Erin Black	Writer/Editor/NEPA Specialist
Jon Nakae	Silviculturist
Cheryl Mack	Archaeologist
Andrea Ruchty	Botanist
Ben Scott	Transportation Planner
Mitch Wainwright	Wildlife Biologist
Jessica Hudec	Fuels Specialist

REFERENCES

Allen, A.W. 1982. Habitat suitability index models: Marten. USDI, Fish and Wildlife Service. FWS/OBS-82/10.11. 9 pp.

Altman, B. 1999. Conservation strategy for landbirds in coniferous forests of western Oregon and Washington. Oregon-Washington Partners in Flight. 83 pp.

Amaranthus, M.P. and D.A. Perry 1994. The functioning of ectomycorrhizal fungi in the field: linkages in space and time. Plant and Soil 159: 133-140.

Anderson, P.D., D. J. Larson, and S. S. Chan. 2007. Riparian buffer and density management influences on micrclimate of young headwater forests of western Oregon. Forest Science. 53(2): 254-269.

Arora, D. 1986. Mushrooms Demystified. A Comprehensive Guide to the Fleshy Fungi. Second Edition. Ten Speed Press, Berkeley.

Bellrose, Frank C. 1980. Ducks, geese and swans of North America (third edition). Stackpole Books.540 pp.

Bilby, R.E. 1985. Contributions of road surface sediment to a western Washington stream. Forest Science, Vol. 3, No. 4 1985 pp 827-838

Buchanan, Joseph B., Jeffrey C. Lewis, D. John Pierce, Eric D. Forsman, and Brian L. Biswell. Characteristics of young forests used by spotted owls on the western Olympic Peninsula, Washington. 1999. Northwest Science, Vol. 73, No. 4, 1999

Burles, Douglas W., and David W. Nagorsen. 2003. COSEWIC Assessment and update status report on the Keen's Long-eared Bat (*Myotis keeni*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 34 pp.

Busskohl, C. B. 2009. Email Comm. Forest Soils Scientist. Umatilla National Forest. 2517 S.W. Hailey Avenue, Pendleton, Oregon 97801.

Byrd, K.Bl, V.T. Parker, D.R. Vogler, and K.W. Cullings. 2000. The influence of clear-cutting on ectomycorrhizal fungus diversity in a lodgepole pine (*Pinus contorta*) stand, Yellowstone National Park, Wyoming, and Gallatin National Forest, Montana. Canadian Journal of Botany 78: 149-156.

Castellano, M.A., E. Cazares, B. Fondrick, and T. Dreisbach, 2003. Handbook to Additional Fungal Species of Special Concern in the Northwest Forest Plan. USDA General Technical Report PNW-GTR-572. January 2003.

Chan, Samuel S., David J.Larson, Kathleen G. Maas-Hebner, William H. Emmingham, Stuart R. Johnston, and Daniel A. Mikowski. Overstory and understory development in thinned and underplanted Oregon Coast Range Douglas-fir stands. Can. J. For. Res. 36:2696-2711. 2006.

Chen, J., T. Spies, and J. Franklin. 1990. Microclimatic and Biological Pattern at Edges of Douglas-fir Stands: A Preliminary Report to USDA Forest Service and University of Washington, April 4, 1990.

Chen, J., J.F. Franklin and T. A. Spies. 1992. Vegetation Responses to Edge Environments in Old-Growth Douglas-fir Forests. Ecological Applications 2(4): 387-396.

Chen, J., J. F. Franklin and T. A. Spies. 1993. Contrasting Microclimates Among Clearcut, Edge, and Interior of Old-growth Douglas-fir Forest. Agricultural and Forest Meterology 63: 219-237.

Chen, J., J. F. Franklin and T. A. Spies. 1995. Growing-Season Microclimatic Gradients from Clearcut Edges into Old-Growth Douglas-fir Forests. Ecological Applications 5(1): 74-86.

Christner J., and R. D. Harr, 1982. Peak streamflows from the transient snow zone, Western Cascades, Oregon, paper presented at Western Snow Conference, Reno, Nev., April 19-23, 1982.

Cook C., and A. Dresser, 2004. Erosion and Channel Adjustments following Forest Road Decommissioning, Six Rivers National Forest.

Corkran, Charlotte C., and Chris Thoms. 1996. Amphibians of Oregon, Washington, and British Columbia. Lone Pine Publishing.

Corkran, Charlotte C., and Christina R. Thoms. 2007. Amphibians of Oregon, Washington and British Columbia. Lone Pine. 176 pp.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, L. Sztukowski. Scientific evaluation of the status of the Northern Spotted Owl. Sustainable Ecosystems Institute. Portland, OR. September 2004.

Current Vegetation Survey (CVS), Random Grid Surveys. 2005. Data available at www.or.blm.gov/surveyandmanage.

Curtis, Edward S. 1911. *The North American Indian*. Plimpton Press, Norwood.

Dalrymple, Byron W. North American Game Animals. 1978. Book Division, Times Mirror Magazines, New York. 516 pp.

Esseen, P. and K. Renhorn 1998. Epiphytic Lichen Biomass in Managed and Old-Growth Boreal Forests: Effect of Branch Quality. Ecological Applications 6(1): 228-238.

Forest Sciences Laboratory Fungi Database. 2005. http://mgd.nacse.org/fsl/survey.

Franklin, J. F. and C. T. Dyrness 1973. Natural Vegetation of Oregon and Washington. Oregon State University Press.

Froehlich, H. A.; Miles, D. W. R.; Robbins, R. W. 1985. Soil bulk density recovery on compacted skid trails in central Idaho. Soil Science Society of America journal. 49:1015-1017.

GEOBOB database. 2006. GEOBOB database replaced the ISMS database in 2005.

Gibbs, George 1855. Report of Mr. George Gibbs to Captain McClellan, on the Indian Tribes of the Territory of Washington. In *Report of Explorations and Surveys to Ascertain the Most Practicable and Economic Route for a Railroad from the Mississippi River to the Pacific Ocean,* 1:402-434. Executive Document No. 78, 2nd Session, 33rd Congress, 1853-1854.

Gifford Pinchot National Forest Land and Resource Management Plan, Amendment 11. 1995. Gifford Pinchot National Forest, Vancouver, WA.

Goward, T. 1999. The Lichens of British Columbia, Illustrated Keys. Part 2, Fruticose Species. Victoria, BC, Canada: British Columbia Ministry of Forests Research Program. 319 p.

Hagerty, S. 2008. Pers. Comm. Forest Soil Scientist. Olympic National Forest. 295142 Highway 101 S., Quilcene, Washington 98376.

Hallock, L.A. and McAllister, K.R. 2005. Sharptail Snake. Washington Herp Atlas. http://www.dnr.wa.gov/nhp/refdesk/herp/

Harke, Vince. USFWS. Personal Communication. 1/28/09

Harpel, J. and R. Helliwell. 2005. Conservation Assessment for *Tetraphis geniculata*. USDA Forest Service, Region 6 andUSDI Bureau of Land Management, Oregon and Washington.

Harr, R. D., 1981. Some characteristics and consequences of snowmelt during rainfall in western Oregon, Journal of Hydrology, 53, 277-304, 1981.

Hastings, W.G. 1914. *Land Classification Area of Township 7 North Ranges 5&6 East, Willamette Meridian, Columbia National Forest, Washington.* On file, Gifford Pinchot National Forest, Vancouver, Washington.

Hauck M. and T. Spribille. 2005. The Significance of Precipitation and Substrate Chemistry for Epiphytic Lichen Diversity in Spruce-Fir Forests of the Salish Mountains, Northwestern Montana. Flora 200: 547-562.

Herter, Dale R., Lorin L. Hicks. Barred owl and spotted owl populations and habitat in the central Cascade Range of Washington. Journal of Raptor Research. 34(4):279-286.

Helliwell, R. 2007. Species Fact Sheet for *Chaenotheca subroscida*. Posted on the Interagency Special Status/Sensitive Species Program webisite. Accessible at: http://www.fs.fed.us/r6/sfpnw/isssp/documents/planning-docs/species-guides.shtml

Hitchcock, C.L., Cronquist, A., Ownbey, M., and Thompson, J.W. 1969. Vascular Plants of the Pacific Northwest. (5 Vols). University of Washington Press. Seattle, WA.

Howell, Donna J. Dr., Lew Becker, David Ek, James Nieland, Jim Villegas. Management guidelines for known sites of the big-eared bat *Plecotus townsendii* within the range of the northern spotted owl (draft). Undated

Interagency Species Management System (ISMS). http:isms.r6.fs.fed.us. Replaced by GEOBOB website in 2006.

Jacobson, John E., Jeffery C. Lewis, and Michelle C. Snyder. 2003. Assessment of Fisher Habitat in Washington State. Washington Department of Fish and Wildlife.

Jensen, W.F., T.K. Fuller, and W.L. Robinson. 1986. Wolf, *Canis lupus*, distribution on the Ontario-Michigan border near Sault St. Marie. Can. Field-Nat. 100(3):363-366.

Jones, J.A. and G.E. Grant, 1996. Peak flow responses to clearcuttting and roads in small and large basins in western Cascades, Oregon. *Water Resources Research* **32**:959-974.

Jones, Lawrence L.C., William P. Leonard, and Deanna H. Olson (editors). 2005. Amphibians of the Pacific Northwest. Seattle Audubon Society.

Kelly, B.B. & V.E. Becker 1975. (Hitch and Stewardt (1973), Kallio, Suhonen and Kallio (1972) as cited in). Effects of Light Intensity and Temperature on Nitrogen Fixation by *Lobaria pulmonaria*, *Sticta weigelii*, *Leptogium cyanescens* and *Collema subfurvum*. Bryologist 78(3): 350-355.

Kranabetter, J.M. and P. Kroeger. 2001. Ectomycorrhizal mushroom response to partial cutting in a western hemlock-western redcedar forest. Canadian Journal of Forest Research 31: 978-987.

Kranabetter, J.M. and T. Wylie. 1998. Ectomycorrhizal community structure across forest openings on naturally regenerated western hemlock seedlings. Canadian Journal of Botany 78: 189-196.

Larsen, E. M., J. M. Azerrad, and N. Nordstrom, eds. 2004. Management Recommendations for Washington's Priority Species, Volume IV: Birds. Washington Department of Fish and Wildlife, Olympia. 268pp

Lawton, Elva. 1971. Moss Flora of the Pacific Northwest. The Hattori Botanical Laboratory, May 1971.

Leonard, William P., Herbert A. Brown, Lawrence L.C. Jones, Kelly R. McAllister, Robert M. Storm. Amphibians of Oregon and Washington. Seattle Audubon Society. 1993. 168 pp.

Lesher, R., C. Derr & L. Geiser. 2003. Natural History and Management Considerations for Northwest Forest Plan Survey and Manage Lichens Based on Information as of the Year 2000. USDA Forest Service Pacific Northwest Region Natural Resources Technical Paper, Portland, OR, R6-NR-S&M-TP-03-03. 211 pp.

Lindh, B. C., and P. S. Muir. 2004. Understory vegetation in young Dougas-fir forests: does thinning help restore old-growth composition. Forest Ecology and Management 192: 285-296.

Management Recommendations for Bryophytes, Version 1.1. 1997. Available at Forest Service website: http://www.or.blm.gov/surveyandmanage

Management Recommendations for Lichens, Version 2.0. 2000. Available at Forest Service website: http://www.or.blm.gov/surveyandmanage

McAllister K.R. and Leonard W.P. 1997. Status of the Oregon Spotted Frog (*Rana pretiosa*) in Washington. Washington Department of Fish and Wildlife.

McCune, B. & L. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

Mech, L.D. 1988. Wolf distribution and road density in Minnesota. Wildl. Soc. Bull. 16:85-87.

Meiman, Susan, Robert Anthony, Elizabeth Glenn, Todd Bayless, Amy Ellingson, Michael C. Hanson, and Clint Smith. Effects of commercial thinning on home-range and habitat-use patterns of a male northern spotted owl: a case study. 2003. Wildlife Society Bulletin 2003, 31(4):1254-1262.

Mellen, Kim, Mark Huff, and Rich Hagestedt. 1995. Interpreting landscape patterns: a vertebrate habitat relationships approach.

Mellen, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2006. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.0. USDA Forest

Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon.

Mullineaux, Donal R. 1996. *Pre-1980 Tephra-Fall Deposits Erupted from Mount St. Helens, Washington*. US. Geological Survey Professional Paper 1563.

Mullineaux, Donal R., and D.R. Crandell 1981. The Eruptive History of Mount St. Helens. In *The 1980 Eruptions of Mount St. Helens, Washington*, edited by P.W. Lipman and D.R. Mullineaux, pp. 3-15. U.S. Geological Survey Professional Paper 1250.

Nakae, Jon. 2009. Personal Communication. South Zone Silviculturist, Gifford Pinchot National Forest, Mt. Adams Ranger District.

Nakae, Jon. 2009. Wildcat Silvicultural Report. South Zone Silviculturist. Gifford Pinchot National Forest, Mt. Adams Ranger District.

Nash, T.H. 1996. Lichen Biology. Cambridge University Press.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available http:www.natureserve.org/explorer. (Accessed: February 20, 2008)

Neitlich, P., and B. McCune. 1997. Hotspots of epiphytic lichen diversity in two young managed stands. Conservation Biology 11: 172-182.

Oregon Natural Heritage Information Center (ORNHIC). 2004.

Pearson, R.R., and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. Journal of Raptor Research. 37:265-276.

Perez, Diana. 2009. Personal Communication. Deputy District Ranger, Mt. St. Helens National Volcanic Monument, Gifford Pinchot National Forest.

Perry, D.A., M.P. Amaranthus, J.G. Borchers, S.L. Borchers, and R.E. Brainerd. 1989. Bootstrapping in ecosystems; internal interaction largely determine productivity and stability in biological systems with strong positive feedback. BioScience 39: 230-237.

Pojar, J. and MacKinnon, A. 1994. Plants of the Pacific Northwest Coast, Washington, Oregon, British Columbia, and Alaska. B.C. Ministry of Forests and Lone Pine Publishing.

Pyle, Robert Michael. The Butterflies of Cascadia. Seattle Audubon Society. 2002. 420 pp.

Quintana-Coyer, Deborah L., Richard P. Gerhardt, Matthew D. Broyles, Jeffrey A. Dillon, Cheryl A. Friesen, Steven A. Godwin, and Shane D. Kamrath. Survey protocol for the

great gray owl within the range of the Northwest Forest Plan, version 3.0, January 12, 2004.

Ralph, C. John; Hunt, George L. Jr.; Raphael, Martin G.; Piatt, John F., Technical Editors. 1995. Ecology and Conservation of the Marbled Murrelet. Gen. Tech. Rep. PSW-GTR-152. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 420 pp.

Ransome, Douglas B. and Thomas P. Sullivan. 2002. Short-term population dynamics of *Glaucomys sabrinus* and *Tamiasciurus douglasii* in commercially thinned and unthinned stands of coastal coniferous forest. Canadian Journal of Forest Resources 32: 2043-2050 (2002).

Reid, L.M., and T. Dunne. 1984. Sediment production from road surfaces. Water Resources Res. 20:1753-1761.

Ruediger, Bill, Jim Claar, Steve Gniadek, Byron Holt, Lyle Lewis, Steve Mighton, Bob Naney, Garry Patton, Tony Rinaldi, Joel Trick, Anne Vandehey, Fred Wahl, Nancy Warren, Dick Wenger, and Al Williamson. 2000. Canada Lynx Conservation Assessment and Strategy. USDA Forest Service, USDI Bureau of Land Management, and USDI National Park Service. Forest Service Publication #R1-00-53, Missoula, MT. 142 pp.

Richardson, S., D. Hays, R. Spencer, and J. Stofel. 2000. Washington State status report for the common loon. Washington Department of Fish and Wildlife, Olympia. 53 pp.

Schroeder, R.L. 1983. Habitat suitability index models: Pileated woodpecker. USDI Fish and Wildlife Service. FWS/OBS-82/10.39. 15 pp.

Sidle, R. C. 1985. Factors Influencing the Stability of Slopes. In: Swanston, Doug ed. Proceedings of a Workshop on Slope Stability: Problems and Solutions in Forest Management. U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Government Technical Report PNW-180.

Sillett, S. B., B. McCune, J. E. Peck, T. R .Rambo and A. Ruchty. 2000. Dispersal Limitation of Epiphytic Lichens Result in Species Dependent on Old-Growth Forests. Ecological Applications 10(3): 789-799.

Stone, D. 2007. Species Fact Sheet for *Peltigera pacifica*. Posted on the Interagency Special Status/Sensitive Species Program webisite. Accessible at: http://www.fs.fed.us/r6/sfpnw/isssp/documents/planning-docs/species-guides.shtml

Storm, Robert M., William P. Leonard, Herbert A. Brown, R. Bruce Bury, David M. Darda, Lowell V. Diller, and Charles R. Peterson. Reptiles of Oregon and Washington. 1995. Seattle Audubon Society. 176 pp.

Survey and Manage Forest Sciences Laboratory database. 2004. Accessible at: http://mgd.nacse.org/fsl/survey

Swanson, F.J.; Benda, L.E.; Duncan, S.H. and others. 1987. Mass failures and other processes of sediment production in Pacific Northwest forest landscapes. In: Salo, E.O.; Cundy, T.W. (eds.). Streamside Management: Forestry and Fishery Interactions. University of Washington Institute of Forest Resources Contribution 57. 9-38. 471 p.

Thiel, R.P. 1985. Relationship between road densities and wolf habitat suitability in Wisconsin. Am. Midl. Nat. 113(2):404-407.

Thomas, Jack Ward, and Dale E. Toweill. Elk of North America, ecology and management. 1982. U.S Department of Agriculture, Forest Service. Stackpole Books. 698 pp.

Tugel, A. J. and Lewandowski, A. M. eds. Soil Biology Primer [online]. Available: http://soils.usda.gov/sqi/concepts/soil_biology/biology.html [February 4, 2009]

USDA. Forest Service, Rocky Mountain Forest and Range Experiment Station. The scientific basis for conserving forest carnivores American marten, fisher, lynx, and wolverine in the western United States. 1994. General Technical Report RM-254.

USDA Forest Service 2008. Regional Forester's Sensitive/Special Status Species List. January 2008. Accessible at: http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/

USDA Forest Service 2005. Pacific Northwest Region Invasive Plant Program Record of Decision for Preventing and Managing Invasive Plants.

USDA Forest Service and USDI Bureau of Land Management 2004a. Record of Decision To Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines in Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.

USDA Forest Service 2004b. Regional Forester's Sensitive Species List update. April and July. http://www.or.blm.gov/ISSSP/

USDA Forest Service 2004c. Likelihood of Occurrence Key. http://www.or.blm.gov/ISSSP/

USDA Forest Service and USDI Bureau of Land Management 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines.

USDA Forest Service and USDI Bureau of Land Management 2001. Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Measures. Forest Service National Forests in Regions 5 and 6 and the Bureau of Land Management Districts in California, Oregon, and Washington Within the Range of the Northern Spotted Owl. January 2001.

USDA Forest Service and USDI Bureau of Land Management 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. April 1994.

USDA Forest Service, 2008. *Clear Creek Roads Project Environmental Analysis*. Mount St Helens National Volcanic Monument, Gifford Pinchot National Forest.

USDA Forest Service, Gifford Pinchot National Forest. 1999. Geologic hazards (gpghz). [online]. Available: http://www.fs.fed.us/gpnf/forest-research/gis/listings/c050.html. [February 4, 2009].

USDA Forest Service, Gifford Pinchot National Forest. 1999b. Landtype Association (gplta). [online]. Available: http://www.fs.fed.us/gpnf/forest-research/gis/listings/t0995.html or http://mercury.ornl.gov/metadata/nbii/html/wsgc/wa-node.gis.washington.edu_waf_uw_r6pnw_gp_c757.html [February 4, 2009].

USDA Forest Service, Gifford Pinchot National Forest. 1999c. Potential natural vegetation zones (gppvg). [online]. Available: http://www.fs.fed.us/gpnf/forest-research/gis/listings/c022.html. [February 4, 2009].

USDA Forest Service, 1996. *Lower Lewis River Watershed Analysis*. Mount St Helens National Volcanic Monument, Gifford Pinchot National Forest.

USDA Forest Service, Gifford Pinchot National Forest, Mount St. Helens National Volcanic Monument. 1997. *Muddy River Watershed Analysis*. Amboy, Washington.

USDA Forest Service, Pacific Northwest Region. 1998. Forest Service Manual, Chapter 2520, R-6 Supplement No. 2500.98-1.

USDA Forest Service, 1993. A First Appproximation of Ecosystem Health National Forest Lands. Pacific Northwest Region.

USDA Forest Service, Gifford Pinchot NF. 1992. Sensitive Plants and Noxious Weeds of the Gifford Pinchot National Forest. Compiled by Nancy Fredricks. USDA Forest Service, Pacific Northwest Region.

U.S. Department of Interior. Fish and Wildlife Service. Pacific Coast Recovery Plan for the Peregrine Falcon. 1982.

U.S. Department of the Interior. 1987. Northern Rocky Mountain wolf recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. 119 pp.

U.S. Department of Interior. 1990a. Endangered and Threatened Wildlife and Plants; determination of threatened status for the northern spotted owl. Fed. Reg. Vol. 55, No. 23: 26114-26194. June 26, 1990.

U.S. Fish and Wildlife Service. 2008. Final Recovery Plan for the Northern Spotted Owl, *Strix caurina*. U.S. Fish and Wildlife Service, Portland, Oregon. xii + 142 pp.

USDA Natural Resources Conservation Service. 1997. Introduction to Microbiotic Crusts. Soil Quality Institute; Grazing Lands Technology Institute.

USDA Natural Resources Conservation Service Soil Quality Institute. Soil Biology: Key Educational Messages. [online]. Available: http://soils.usda.gov/sqi/publications/publications.html#btn [February 4, 2009].

USEPA. 2007. Climate Change – Health and Environmental Effects – Forests [online]. Available: http://www.epa.gov/climatechange/effects/forests.html#tree [February 4, 2009]

Wade, J.; Herman, L.; High, C. T.; Couche, D. 1992. Soil Resource Inventory. Gifford Pinchot National Forest. Vancouver, Washington.

Wade, J.; High, C. T. 1992b. NEPA Assistance for the Soil Resource. Gifford Pinchot National Forest. Vancouver, Washington.

Waitt, Richard B., Jr., and Daniel Dzurisin 1981. Proximal Air-Fall Deposits from the May 18 Eruption—Stratigraphy and Field Sedimentology. In *The 1980 Eruptions of Mount St. Helens, Washington*, edited by P.W. Lipman and D.R. Mullineaux, pp. 601-616. U.S. Geological Survey Professional Paper 1250.

Waitt, Richard B., Jr., Vicki L. Hansen, Andrei M. Sarna-Wojcicki, and Spencer H. Wood 1981. Proximal Air-Fall Deposits of Eruptions between May 24 and August 7, 1980—Stratigraphy and Field Sedimentology. In *The 1980 Eruptions of Mount St. Helens, Washington*, edited by P.W. Lipman and D.R. Mullineaux, pp. 617-628. U.S. Geological Survey Professional Paper 1250.

Wallmo, Olof C. Mule and black-tailed deer of North America. 1981. U.S. Department of Agriculture, Forest Service. Univ. of Nebraska Press. 605 pp.

Washington Department of Natural Resources, 2001. Washington Administrative Code (WAC) Chapter 222-16.

Washington Forest Practices Board, 1997, Board Manual: Methodology for Conducting Watershed Analysis under Chapter 222-22 WAC. Version 4.0, Nov. 1997. Washington Dept. of Natural Resources, Forest Practices Division, Olympia, WA. Single volume.

Washington Department of Wildlife. 1993. Status of the western pond turtle (*Clemmys marmorata*) in Washington. Unpubl. Rep. Wash. Dept. Wildlife, Olympia.

Washington Department of Wildlife. 1993. Status of the Larch Mountain salamander (*Plethodon larselli*) in Washington. Unpubl. Rep. Wash. Dept Wildl., Olympia.

Washington State Department of Natural Resources, Washington Natural Heritage Program, Washington Herp Atlas. www.dnr.wa.gov/nhp/refdesk/herp/speciesmain.html

Washington Natural Heritage Program. 1981. An Illustrated Guide to the Endangered,Threatened and Sensitive Vascular Plants of Washington. Washington Natural Heritage Program.

Washington Natural Heritage Program. 1999. Field Guide to Washington's Rare Plants. A cooperative project between Washington Natural Heritage Program, Department of Natural Resources and USDI, Bureau of Land Management, Spokane District.

Wemple, B. C., J. A. Jones, and G. E. Grant, 1996. Channel network extension by logging roads in two basins, western Cascades, Oregon, Water Resources Research, 32(6), 1195-1207.

Wessel, S. J. 2005. Biodiversity in Managed Forests of Western Oregon: Species Assemblages in Leave Islands, Thinned, and Unthinned Forests. Master of Science Thesis, 17 June 2005, Department of Wildlife Science, Oregon State University, Corvallis, Oregon.