United States Department of Agriculture

Forest Service

April 20, 2007

Environmental Assessment

Cowlitz Thin Timber Sale

Cowlitz Valley Ranger District, Gifford Pinchot National Forest
Lewis County, Washington

T 14 N, R 9 E Sections 25, 26, 35, 36; T 13 N, R 9 E Sections 2, 4, 7, 8, 17, 18, 19, 20; T 13 N, R 8 E Sections 3, 11, 12, and 13; Willamette Meridian

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1.0 SUMMARY

The Cowlitz Valley Ranger District of the Gifford Pinchot National Forest is proposing for sale during fiscal year 2007 the Cowlitz Thin Timber Sale, which is located approximately due north of the town of Packwood in T. 14 N., R. 9 E. Sections 25, 26, 35, 36; T. 13 N., R. 9 E. Sections 2, 4, 7, 8, 17, 18, 19, 20; T. 13 N., R. 8 E. Sections 3, 11, 12, and 13, Willamete Meridian, Skamania County, Washington.

The purpose of this project is to

1. Thin and harvest wood fiber from approximately 760 acres,
2. Thin and harvest 92 acres of riparian reserves,
3. Enhance growth and vigor of managed stands,
4. Enhance, restore and protect Riparian Reserves,
5. Retain and enhance key structural elements of suitable and potential Northern spotted owl habitat within plantations and naturally regenerated stands.

The action is needed (a) to meet Forest timber targets assigned through the Forest budgeting process, (b) to treat densely stocked managed stands to enhance vigor and growth, to (c) enhance late-successional structural elements of stands that regenerated naturally, but have been managed in the past, and to (d) treat one densely stocked managed stand that is located within an LSR to accelerate the development of late-successional characteristics.

The Forest Service evaluated the no-action alternative and action alternatives, which vary by degree of enhancement of late-successional features such as the placement of skips, gaps, down wood and snag creation, and by whether naturally regenerated stands are treated or not. The proposed action harvests thinned trees using skyline and ground-based yarding methods, and attempts to retain and restore structural elements that characterize late-successional and riparian forests, in addition to retaining features and structures that are representative of habitat important to northern spotted owls. It reduces the amount of soil disturbance that would occur with ground-based logging systems by utilizing existing skid trails and roads created during previous logging entries, and limits the amount of ground-based logging that would occur in proximity to streams. The placement of significantly-sized skips and gaps and the retention of existing legacy features is a key component of all alternatives. Additional projects would improve drainage conditions, treat roads and restore instream habitat within unit boundaries, treat illegal ATV roads and identifies future needs for road treatments within the project area that would require additional funding from other sources.

2.0 INTRODUCTION

2.1 Document Structure

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four parts:

- *Introduction:* The section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Comparison of Alternatives, including the Proposed Action:* This section provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes possible mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Environmental Consequences:* This section describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area, significant issues and environmental component. Additional detailed analysis is provide in specialist reports in the analysis file. Within each section, the affected environment is described first, followed by the effects of the No Action Alternative that provides a baseline for evaluation and comparison of the other alternatives that follow.
- *Agencies and Persons Consulted:* This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- *Appendices:* The appendices provide more detailed information to support the analyses presented in the environmental assessment.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Cowlitz Valley Ranger District Office in Randle, Washington.

2.2 Background

The Cowlitz Thin was derived from a planning effort undertaken in 1997, which identified nearly 2000 acres of thinning and regeneration harvest. The Cowlitz Thin took a new look at stands in the area and identified up to 1600 acres of potential commercial thinning opportunities. The final proposal treats 760 acres of young and mature previously managed stands and one mature unmanaged stand (unit 19).

The Cowlitz Planning Area is located within the Upper Cowlitz River Watershed, and the Middle Cowlitz River Watershed. The entire planning area lies within National Forest, but borders private lands to the south and southeast. The planning area is located approximately due north of Packwood, Washington. The planning area is located in

Township T. 14 N., R. 9 E. Sections 25, 26, 35, 36; T. 13 N., R. 9 E. Sections 2, 4, 7, 8, 17, 18, 19, 20; T. 13 N., R. 8 E. Sections 3, 11, 12, and 13. Elevations range from 1,200 (Unit 3) feet near the Cowlitz River confluence to 3,800 feet (Unit 20).

Much of the upper Cowlitz River valley was in a contiguous forest of fire regenerated grass/pole and small tree forest as of 1880. Between 1880 and 1997, forest vegetation structure shifted from grass-pole forest and small tree forest to a mix of small tree forest and large tree forest. During this period the forest became highly fragmented due to timber harvest and wildfire suppression, the two primary anthropogenic factors that have influenced forest vegetation structure within the watershed during the 20th century.

Extensive harvest activity in the watershed resulted in the loss of structural elements, including snags, large down coarse woody debris, and reduced duff layers. Young, previously managed stands are considered overstocked, and are believed to have the potential to benefit from stand treatments that not only enhance growth, but are designed to increase stand diversity and retain late-successional characteristics. Natural stands, while naturally regenerated were partially harvested, leaving portions of mature stands relatively uniform and lacking many structural elements associated with late-successional forests.

2.3 Purpose and Need for Action

The purpose of this project is to:

- Speed the development of and protect existing features representative of late-successional and old-growth forest characteristics of stands within the Late Successional Reserve (LSR) and suitable spotted owl habitat areas of the Cowlitz Planning Area.

This action is proposed because young, historically managed stands within the LSR lack the desired characteristics of late-successional and old-growth forests. The stands tend to be overcrowded, have reduced stand diversity and lack late-successional elements such as snags and downed woody debris. While stands may develop these late-successional characteristics over time, the process of thinning is expected to accelerate this process. Existing late-successional characteristics would be protected to the extent possible.

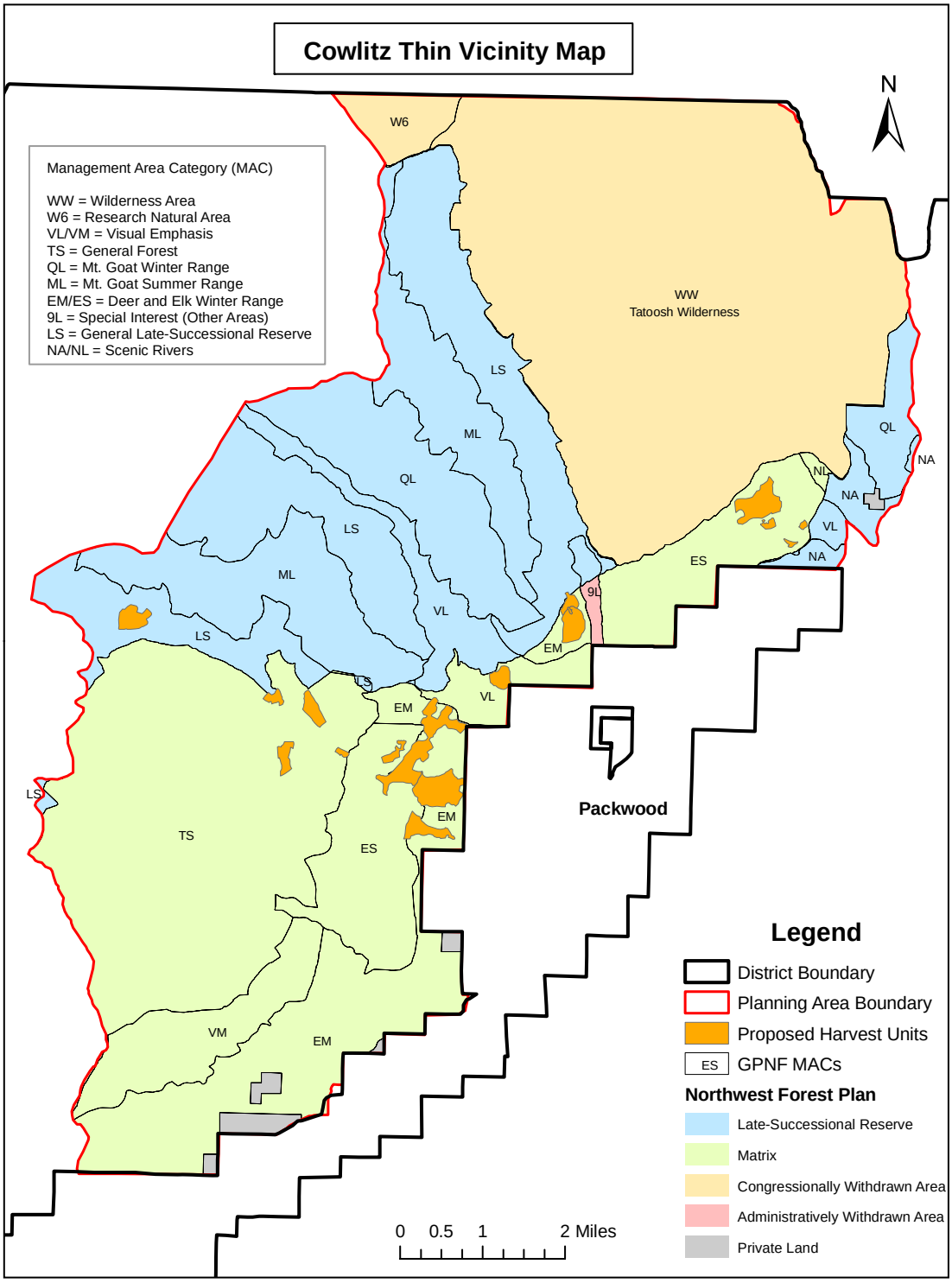

Figure 2.3.1. Cowlitz Thin Planning Area and Vicinity Map

- Increase the health, vigor and growth of stands with the Matrix areas of the Cowlitz Planning Area.

This action is proposed because historically managed and natural stands are experiencing a slowing of growth and increased mortality due to overcrowding. This overstocked condition results in reduced vigor, increased mortality, reduced diversity and increased wind damage susceptibility. While stands may differentiate over time, the process of thinning is expected to accelerate this process and promote greater stand growth. Alternatives and design features are intended to increase stand diversity, enhance stand growth, and retain late-successional characteristics that are lacking in previously managed young and mature stands.

- Provide forest products

This action is proposed because there is a need to supply forest products consistent with the Northwest Forest Plan goal of maintaining the stability of local and regional economies. The purpose of this project is to supply products and increase employment opportunities for the local timber industry and independent local contractors, allowing for the sustainable use of the forest's natural resources in a way that maintains options for habitat and resource use in the future.

Management Direction

The proposed action has been designed to meet the goals and objectives documented in the *Gifford Pinchot Naitonal Forest Land and Resource Management Plan (LRMP, USDA 1990), as amended by the Record of Decision for Amendments to Forest Service and Burequ of Land Management Planning Documents Within the Range of the Northern Spotted Owl (Northwest Forest Plan, USDA and USDI 1994, as amended).* The LRMP was amended in response to the NFP in a document referred to as *Amendment 11* (USDA 1995), which applies the NFP Record of Decision to the local conditions of the Gifford Pinchot National Forest.

This assessment is tiered to the following Environmental Impact Statements and plans, which are incorporated by reference:

- The Gifford Pinchot National Forest Land and Resource Management Plan and Environmental Impact Statement, as amended (LRMP, USDA 1990).
- The Northwest Forest Plan and Record of Decision 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 (USDA, USDI 1994) (hereafter referred to as the Northwest Forest Plan or NFP).
- The Gifford Pinchot National Forest Land and Resource Management Plan Amendment 11 (USDA 1995).
- The Forest Plan as amended by the 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 and USDI, 2001).

- The Forest Plan as amended by the 2004 Record of Decision and Standards and Guidelines to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines (USDA and USDI 2004b).
- The Environmental Impact Statement and Record of Decision for Preventing and Managing Invasive Plants (USDA 2005).
- Memorandum declaring the protection of known sites for 57 former survey and manage species. (USDA and USDI 2005).

The Gifford Pinchot National Forest LRMP and Amendment 11 provide management direction through the designation of specific management areas, and standards and guidelines specific to these designations. The following management areas and allocations have been applied to the portions of the Upper Cowlitz River Watershed within which the Cowlitz Thin is located.

Late Successional Reserve and Management Area Category LS. Unit 19 of the Cowlitz Thin Timber Sale lies within Late Successional Reserve (LSR) (see Amendment 11, p. 5-1 to 5.4). The objective of Late-Successional Reserves 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.

Matrix. Some Cowlitz Thin units lie in an area categorized as Matrix and *General Forest* (TS) in the LRMP (see Amendment 11, p. 6-25), where the goal is to produce a predictable and sustainable level of timber (and other resources) for sale where such activities do not degrade the environment. Several units lie within *deer and elk winter range* (EM/ES, pg. 6-21), areas managed to provide habitat for wintering deer and elk. One unit lies within a *visual emphasis* area (VL, p. 6-41), where the goal is to provide a visually natural or near-natrual landscape as viewed from the designated travel route or use area. One unit may be visible from the town of Packwood, and would be managed consistent with "retention" objectives, in which management activities remain visually subordinate to the landscape (Section 4.9).

Riparian Reserves. Portions of Cowlitz Thin units are within Riparian Reserves, where riparian dependent resources receive primary emphasis and special standards and guidelines apply (see Amendment 11, pages 2-4 to 2-10). Riparian Reserves are applied along all streams, wetlands, ponds, lakes and unstable and potentially unstable areas, and are a key component of the Aquatic Conservation Strategy provided in the NFP. The proposed action treats 92 acres of Riparian Reserves.

Other Natural Resource Management Guidance Documents

The *Upper Cowlitz River Watershed Analysis* (1997a) and the *Middle Cowlitz River Watershed Analysis* (1997b) are incorporated by reference. These watershed analyses represent one of the key components of the Aquatic Conservation Strategy as described in the Northwest Forest Plan. Each analysis provides a detailed reference to historical and existing conditions within the watershed.

The Gifford Pinchot National Forest Roads Analysis (2002) provides recommendations regarding Forest road maintenance objectives, and identifies long-term objectives in

order to manage forest transportation system facilities that provide user safety, convenience, and efficiency of operations in an environmentally responsible manner and to achieve road related ecosystem restoration with the limits of current and likely funding levels. The Roads Analysis recommends a variety of possible treatments including decommissioning, closing and stabilizing roads, improving road drainage systems and reconstructing crossings to protect aquatic and riparian resources.

2.4 Proposed Action

The action proposed by the Forest Service to meet the purpose and need is a timber sale that would commercially thin and harvest trees from of 613 of 760 acres. 3.3 miles of temporary road would be constructed and subsequently removed. Existing spurs and skid trails still evident from last harvest entry would be used to the extent possible, and obliterated. Treatments for stands in Matrix areas would be designed to improve the health, vigor, and species diversity while retaining late-successional characteristics that are lacking in previously managed (young and mature) stands. These treatment objectives are intended to improve the ability of stands to provide for future harvest and habitat needs. Treatments for one stand located in the LSR (unit 20) would be designed to facilitate the development of the stand towards late successional habitat conditions. The outer two-thirds of riparian reserves (total 92 acres) would also be commercially thinned to accelerate the development of late successional characteristics.

The preferred method of harvest is to utilize ground based and skyline harvest systems. The project would also create snags, down wood, and provide trees for future in-stream projects. Associated projects to be implemented with additional funding as available would treat noxious weeds, stabilize roads, precommercially thin young plantations and remove fish passage barriers. Thinning would be designed to enhance or restore diversity (see *Alternatives* section for additional detail). The proposed action is expected to be advertised in summer 2007, and implemented as early as Fall 2007 or Summer 2008.

2.5 Decision Framework

Given the purpose and need, objectives for developing an economically feasible timber sale, and issues raised by the interdisciplinary team and the public, agencies and tribes, the deciding official (Cowlitz Valley District Ranger) will review the proposed action and the other alternatives in order to make the following decisions:

- Select one of the alternatives 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.

2.6 Public Involvement

After considering the issues and objectives to be achieved by this project, a project proposal was developed. Scoping letters describing the proposed action and issues identified by the interdisciplinary team were sent to the public on August 25, 2006 to

solicit comments. Public comment on the proposed action was also solicited through the Gifford Pinchot's quarterly Schedule of Proposed Action (SOPA) website. A public meeting and field trip was held on October 23, 2006 in Packwood, Washington to identify public issues and concerns.

Representatives of the Gifford Pinchot Task Force, Conservation Northwest, Pinchot Partners collaborative working group, and members of the community of Packwood have visited the project area, and have provided recommendations related to proposed silvicultural treatments and potential restoration activities, and expressed concerns about components of the proposed action.

Several responses were received during the scoping period for the proposed Cowlitz Thin, and throughout the period of time preceding and following the public meeting. Comments within the scope of the Project and not covered by previous environmental review or existing regulations were reviewed for substantive content related to the Project. It was determined that concerns regarding management of natural stands and the proximity of units near local communities should be given further consideration. The interdisciplinary team identified issues, which also led to the development and design of alternatives. The proposed action has been significantly modified to address issues and concerns raised by the public and the interdisciplinary team.

2.7 Issues

Issues are separated into two groups: significant and non-significant issues. Significant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-significant issues are identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The following issues raised during the scoping process were considered significant because all are affected by implementation of the proposed action, and potential effects may vary between alternatives.

Significant Issues

As for significant issues, the Forest Service identified several topics raised during scoping.

Stand Health and Treatment of Stands with Significant Laminated Root Rot

Laminated root rot (caused by the fungus *Phellinus weirii*) is a common disease in Pacific Northwest forest stands. Laminated root rot infections are known to exist in 9 of the 16 stands being proposed for commercial thinning in the Cowlitz Thin timber sale. Root rot is most prevalent in two stands (Units 7 and 8). Two treatment alternatives to Units 7 and 8 are evaluated in this analysis. Methods used to measure the potential effects of laminated root rot depending on the type of treatment include: The amount of wood volume lost, in cu. ft. or bd. ft./acre/year, due to laminated root rot infection at 25 years in the future, and the number and extent of acres of laminated root rot infection at 25 years in the future.

Harvest of Mature and Naturally Regenerated Stands

Several units proposed for thinning under the proposed action are mature stands, regenerated following wildfires during the late 1880's. Several members of the public expressed concern regarding the harvest of mature stands, and are in general, opposed. Other members of the project are supportive. To address this issue, many stands and acres were dropped from consideration, including those with the highest quality late-successional habitat, and in particular, high quality spotted owl habitat. The original proposed action contained nearly 1680 acres, approximately 1190 acres of which were mature stands. Several units were dropped; the prevailing factor for the dropping of mature stands was the presence of high quality habitat. The resulting proposed action considered the thinning of a total nearing 1200 acres, approximately 770 acres of which were mature stands. The final proposed action presented in this analysis was designed to further protect late-successional and old-growth legacy features and would treat 615 acres of 760 acres, untreated acres representing no-cut portions of riparian reserves. 379 of 483 acres of mature stands, and 236 of 280 acres of younger, managed stands would be treated under the proposed action. All but one (Unit 9) of the mature stands within the proposal have been managed in the past, but are often referred to within this document as "natural" stands because they were naturally regenerated.

Natural and young, managed stands receive skips and gaps, the percentage of area in skips varies depending on the alternative. In addition to adjusting total acres treated throughout the analysis process, a separate alternative was considered and analyzed that only treats young, managed stands.

Effects on the Northern Spotted Owl Habitat and Critical Habitat

Several of the proposed Cowlitz Thin sale units are classified as suitable spotted owl habitat, and occur within the potential home ranges (i.e. 1.82 mile radius circle) of five historic spotted owl pair activity centers. Due to the lack of recent surveys to protocol standards, other, unknown pairs may exist as well. In addition, eleven sale units are entirely or partly within designated spotted owl Critical Habitat Unit WA-36, including three of the suitable owl habitat units. Harvest of suitable habitat areas have the potential to degrade suitable habitat conditions for individual owl pairs, and also adversely effect constituent habitat elements within Critical Habitat Unit WA-36 through the loss or breakage of features such as snags, coarse woody debris (i.e. down trees), as well as lowering canopy closure and changing forest understory species composition and abundance. Conversely, harvest of some younger "managed stand" units (presently classified as spotted owl dispersal habitat, or non-habitat) may result in long-term improvement of habitat conditions for northern spotted owls.

Barred owls, which compete with spotted owls for prey and territories, are also present in the sale area, and may be affected (positively or negatively) from the sale, which will ultimately affect northern spotted owls.

Other Issues

The following issues are considered non-significant because they are either fully mitigated through project standards and guidelines, project design criteria, or mitigation measures, or they did not contribute to the formulation of an alternative or were not alternative-driving. However, all were considered and contributed to the design of the Cowlitz Thin Timber Sale and are addressed in this document.

Deer and Elk Winter Range

A total of twelve proposed sale units are within biological deer and elk winter range, which extends to approximately 2400 feet in elevation. Thinning has the potential to adversely affect deer and elk habitat in some areas, and potentially benefit them in others. Effects from thinning include reduction in stand canopy closure, alteration of stand microclimate, accelerated tree growth, and stimulation of understory vegetation. In addition, there are potential short-term effects associated with disturbance and displacement of big game from the project area.

Survey and Manage and Sensitive Species

There are several "survey and manage" and Region 6 "sensitive" plant and animal species that are known or suspected to occur within the project area. These species will have buffers or occur in skips, or will be in protected Riparian Reserves where known sites will not be disturbed.

Federally Listed Wildlife Species

In addition to the northern spotted owl and designated spotted owl Critical Habitat Unit WA-36 cited above, other federally-listed wildlife species or critical habitats are known or suspected to occur within the project area. These include the northern bald eagle, the marbled murrelet, designated marbled murrelet critical habitat, and the gray wolf. Potential impacts to these species include disturbance and habitat effects associated with thinning, as they relate to future habitat development and conditions, or conditions for prey species.

Slope Stability and Productivity

The Cowlitz Thin planning area has some areas of slope instability. These locations have been eliminated from the sale, and riparian reserves with no cut buffers have been established that would further protect sensitive soils in the vicinity of streams. Soil productivity is analyzed to establish a baseline and provide direction in terms of project design and development of best management practices, which would be applied to all alternatives.

Water Quantity

Cowlitz Thin proposed timber harvest and associated activities have the potential to impact water quantity and peak flows. Road development and soil compaction may increase the surface drainage area network, decrease infiltration rates and consequently

increase the rate by which water reaches the stream channel. Physical alterations may modify the hydrograph timing and yield by increasing instantaneous peak flows and decrease the summer base flows to streams. An analysis is provided to examine the baseline and the potential for change with implementation of the alternatives. Peak flows are in general not expected to increase due to harvest or road related activities.

Water Quality

Proposed timber harvest activities including those associated with the utilization of skyline and ground based yarding systems, and log haul may cause surface soil displacement, mobilize fine particles and generate stream sediment. Removal of riparian vegetation has the potential to reduce shade and affect stream water temperatures. Project unit design, silvicultural prescriptions and best management practices will minimize potential effects to water quality across all alternatives.

Federally Listed Anadromous Salmon

The proposed action may affect instream habitat conditions for aquatic species, including listed Threatened and Endangered species known to exist downstream of the proposed project. Potential increases in the delivery of fine sediment to salmon-bearing streams may have deleterious impacts on the survival of life stages ranging from egg to fry. Stream sediment can impact other aquatic organisms on which salmonids depend for food (e.g. aquatic algae and insects), potentially compromising the health of fishes and other aquatic organisms.

Recreation Activities

Unit 14 is located near the southern Tatoosh Wilderness Boundary. Recreation concerns include the effects of the project on the Wilderness, either directly or by improving roaded access.

A second issue related to recreation includes illegal recreational use of ATVs. Several ATV trails may be found within and adjacent to Cowlitz Thin units, in particular near Unit 14.

The effect of log haul activities on snowmobile use is also of concern. Haul may need to occur via the 47 and 52 Roads because a bridge was damaged during heavy rains that occurred during November 2006. Winter hauling would impact popular snowmobile trails, while limiting of haul may impact the economic feasibility of the timber sale.

Packwood Viewshed and Public Safety

Local residents and recreation property owners have expressed concerns regarding the effects of logging on the scenic views in the vicinity of Packwood. Increased logging traffic on public safety and local traffic is also of concern.

Economic Feasibility of Timber Sale

Economic feasibility of the timber sale could be an issue given the large sale area, relatively low volume, and the costs associated with log transport. Post-sale snag and down wood treatments are also costly and may use most or all surplus or profit generated from the sale of timber.

3.0 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

This chapter describes and compares the alternatives considered for the Cowlitz Thin project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., helicopter logging versus the use of skid trails) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the amount of erosion or cost of helicopter logging versus skidding).

All alternatives have many design features in common. Snags and down-wood would be created, and minor species such as western red cedar, red alder, black cottonwood, big leaf maple would be favored and retained to promote and increase species diversity. Unit prescriptions are consistent between alternatives, and slash treatments are common to all alternatives. All alternatives would treat riparian reserves (see sections 4.7 and 4.8).

All temporary roads, landings would be rehabilitated. Many remnant skid trails (from first logging entry) are apparent on the landscape, and would be utilized to the degree possible unless it is determined that such use is more detrimental to the environment. Skid trails would also be rehabilitated. See Section 3.2 for a detailed listing of project design criteria and mitigation measures common to all alternatives.

Unconnected actions including restoration project proposals within the project action area would be similar under all alternatives, and implemented as funding becomes available.

3.1 Alternatives

Alternative 1 – No Action

Under the No-action alternative, current management plans would continue to guide management of the area. No timber harvest or other associated actions would be implemented to accomplish project goals at this time. If allowed to proceed without further management, self-thinning would occur over time, resulting competition-induced mortality. Tree mortality would not be captured and utilized as wood products. Natural mortality and stand differentiation would result in the natural accumulation of snags, down wood and the creation of openings in the stand, or gaps.

Restoration and road-related treatments would not occur in association with this analysis; however may be pursued under a separate analysis. Harvest-related transportation activities or ground disturbance would not occur at this time, such as the creation and subsequent rehabilitation of skid trails and landings, hauling along Forest roads.

Alternative 2 – The Proposed Action

Alternative 2 would treat a total of 760 acres (613 including skips and gaps), 277 (234) acres of which are younger, managed plantations ranging in age from 42 to 56 (Units 3, 4, 5, 7, 8, 15, 19, 20, 25 and 26), and 483 (379) acres of which are mature stands ranging in age from 112 to 137 (Units 6, 9, 14, 16 and 17). This alternative was driven primarily by the objective that treats matrix lands for the purposes of providing a predictable and sustainable level of timber (and other resources) for sale while maintaining and enhancing stand diversity and late-successional characteristics through the implementation of skips and gaps, and other conservation measures.

Skips, or no-cut leave areas would be located in 15% of the total acres in all units (managed and natural stands), except units 3, 4 and 19 where the size and/or presence of significant Riparian Reserve no cut areas are present. Natural stand skip size is one to 10 acres; managed stand skip size is one to five acres. Smaller skips of ¼ to ½ acre may be added to protect specific habitat features (snags, down wood, decadent trees, etc.). In managed stands, no-cut riparian reserve buffers, survey and manage sites, etc. are included in skips where possible, and where the skip is beneficial to habitat. Skips would be placed evenly across units as practical, considering habitat protection and effectiveness.

Gaps, which are small openings designed to increase light or "release" understory species and add structure to a stand, are present in all managed stand units except Units 7 and 8, with wider-thin gaps in Unit 20, the only unit within a Late-Successional Reserve (LSR). Approximately 5-10% of unit acres would occur in gaps. No gaps would be located in natural stands. Gap size is one-half acre or less, but would also include "daylighting" or individual tree culturing of individual leave trees or clumps, where the leave tree or clump would be retained in the center of a gap, and "released" or "daylighted" by harvesting surrounding trees. Units 3, 15 and 19 will have individual tree "daylighting gaps". This would have the effect of enhancing the growth of a single tree or clump. The largest, healthiest tree, or sometimes a clump of conifers or hardwoods would be selected.

One hard snag per acre would be created in all but units 3, 4, 15 and 20, all created post-sale. Two hard snags/acres would be created throughout Units 3, 4, 15 and 20 to meet long-term LSR and riparian reserve objectives. Snags would be created in treated (thinned) portions of natural stands only, not in skips. In Riparian Reserves of natural stands, 2.6 hard snags per acre would be created (post-sale). In managed stands, two hard snags would be created per acre, all created post-sale.

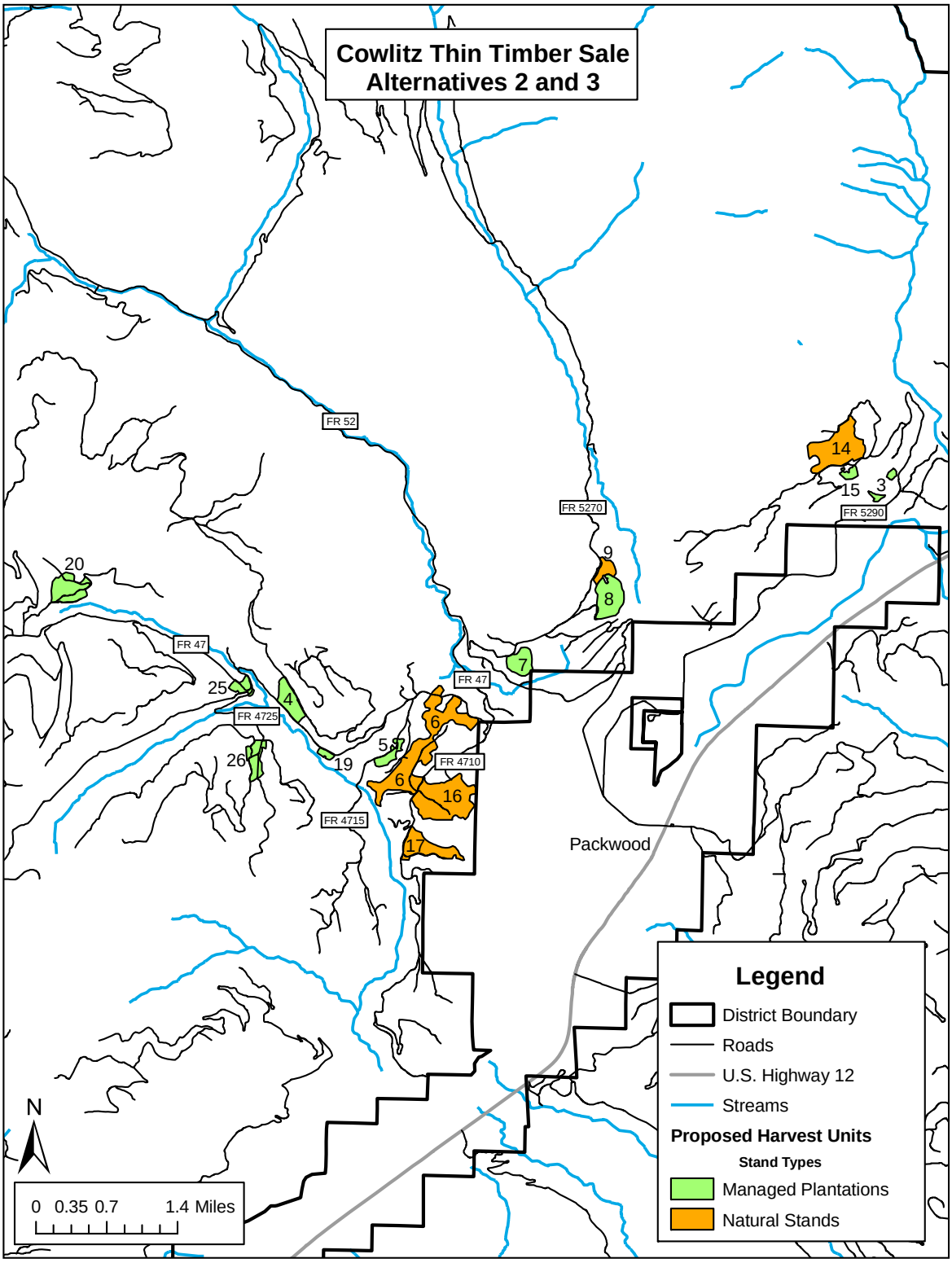

Figure 3.1.1. Cowlitz Thin Alternative 2, the Proposed Action.

Down wood would be added in managed and natural stands. 2-3 trees/acre of "sound material" would be created post-sale. Units 3, 4, 15 and 20 would receive 3% ground cover throughout. See below for riparian reserve Rx. Increased down wood levels in units 3, 4, 15 and 20 are designed to meet long-term LSR and riparian reserve objectives. Down wood will be created in treated (thinned) portions of natural stands only, not in skips. Exact number of trees to be felled would be based on post-sale down wood survey.

In Riparian Reserves, the goal for down wood is to achieve 5% ground cover throughout the reserve in natural stands, while 3% ground cover is the target for down wood in treated portions of Riparian Reserves of "managed" or young stands. The exact number of trees to be felled will be based on post-sale down wood surveys.

Streams will have no cut buffers, placed depending on stream class, and stability ratings (see Fisheries Biological Assessment). No cut buffers would extend to tops of topographic slope breaks, with minimum widths as follows: Class I streams, 120 feet; Class II streams, 90-100 ft; Class III streams, 60-110 ft; Class IV streams 30-60 ft.

The silvicultural prescription under Alternative 2 will be to thin from below using "Designation by Description" D x D to achieve variable density spacing. In units 7 and 8, root rot infected areas would be regenerated, and uninfected areas would be thinned. Average post-harvest relative densities range from 31 to 45 with canopy closure ranging from 53 to 70%. This alternative would produce approximately 6.8 mmbf.

504 acres would be treated with ground-based logging systems, and 111 acres would be ground-based harvested. Approximately 3.3 acres of temporary road would be constructed, in many cases utilizing existing skid trail features that were created and are still evident from the original entry in managed and natural stands. Ground-based systems would utilize existing skid trail remnants to the extent possible.

Slash would be left on skid trails and scattered throughout the unit. There would be no other fuels treatment except the hand piling and burning of incidental quantities of slash and debris at landings and along heavily used roads as specified in Table 3.1.1. In order to increase and promote species diversity, minor species such as western red cedar, red alder, black cottonwood, big leaf maple and other minor species would be retained.

Table 3.1.1. Alternative 2 – Proposed Action.

Unit	Total Acres	Harvest Type	Treated Acres	Acres by Log. Sys.	RD[1]	Canopy Closure %[1]	Volume (MBF)	Slash Disposal[2]
3	9	HTH	9	Grd. 9	43	58-63	111	LS
4	38	HTH	27	Sky. 27	41	65-70	314	LS**
5	19	HTH	16	Grd. 16	41	58-63	170	LS
6	177	HTH	149	Grd. 28	52	68-73	2651	LS**
				Sky. 21				
7	16	HTH	13	Grd. 13	35	55-60	126	LS**
	17	HLR	17	Grd. 17	0	<1	189	
8	38	HTH	31	Grd. 31	38	51-56	263	LS
	22	HLR	22	Grd. 22	0	<1	321	
9	18	HTH	15	Sky. 15	50	57-62	140	LS**
14	103	HTH	60	Grd. 60	38	61-66	311	LS**
15	9	HTH	7	Grd. 7	37	58-63	33	LS
16	129	HTH	108	Grd. 102	38	68-73	926	LS
				Sky. 6				
17	56	HTH	47	Grd. 47	43	69-74	592	LS
19	7	HTH	7	Sky. 7	40	58-63	75	LS**
20	54	HTH	45	Grd. 13	35	56-61	314	LS
				Sky. 32				
25	17	HTH	14	Grd. 14	33	58-63	72	LS**
26	31	HTH	26	Grd. 23	30	53-58	153	LS
				Sky. 3				
Sub-Total	721	HTH	574	Grd. 463			6251	
				Sky. 111				
	39	HLR	39	Grd. 39			510	
Grand Total	760		613	Grd. 504			6761	
				Sky. 111				

[1]The Relative Density (RD) and Canopy Closure % data represent only the treatment acres of each unit. If the no-cut skip and no-cut riparian reserve acres were included these numbers would be higher than what is shown.

[2]LS: Lop and scatter all units, pile and burn at landings. **Hand pile and burn 100 ft strip along 5290 (Unit 14), 5270 (Units 7 and 9), 4700 (Units 4, 6, 19, 25)

Alternative 3 – Modified Proposed Action

Alternative 3 was designed in response to concerns regarding potential effects to Northern spotted owls and their critical habitat. This alternative strives to maintain existing late-successional features and existing quality owl habitat through the placement of larger, carefully selected skips. Adverse effects to spotted owl habitat would be avoided under this alternative.

Alternative 3 would treat the same total acres as in Alternative 2, including the proportion of mature (natural) to young (managed) stands (Table 3.1.2). This alternative

continues to treat Matrix lands, while providing a prescription that minimizes potential effects to the Northern spotted owl and critical habitat. Standards for harvest prescriptions advance the development of late successional habitat, and protect existing features more deliberately and thoroughly than Alternative 2 by the placement of skips in particular locations that maximize habitat protection, rather than distributing skips evenly throughout units.

Skips would be located in 30% of the total acres in natural stands, and 15% in managed stands, except units 3, 4, 15 and 19 where the size and/or presence of significant Riparian Reserve no cut areas are present. Natural stand skip size is one to 15 acres; managed stand skip size is one to five acres. Smaller skips of ¼ to ½ acre may be added to protect specific habitat features (snags, down wood, decadent trees, etc.). In managed stands, no-cut riparian reserve buffers, survey and manage sites, etc. are included in skips where possible, and where the skip is beneficial to habitat. Skips would be placed evenly across managed stands as practical, considering habitat protection potential and effectiveness of the skip.

Gaps are present in all managed stand units except Units 7 and 8, with wider-thin gaps in Unit 20, the only unit within a Late-Successional Reserve (LSR). Approximately 5-10% of unit acres would occur in gaps. No gaps would be located in natural stands. Gap size is one-half acre or less, but would also include "daylighting" or individual tree culturing of individual leave trees or clumps. Units 3, 15 and 19 will have individual tree "daylighting gaps".

One hard snag per acre would be created in all but units 3, 4, 15 and 20, all created post-sale. Two hard snags/acres would be created throughout Units 3, 4, 15 and 20 to meet long-term LSR and riparian reserve objectives. Snags would be created in treated (thinned) portions of natural stands only, not in skips. In Riparian Reserves of natural stands, 2.6 hard snags per acre would be created (post-sale). In managed stands, two hard snags would be created per acre, all created post-sale.

In natural stands and Riparian Reserves, the goal for down wood is to achieve 5% ground cover, and in managed stands to achieve 3% ground cover. As discussed in Alternative 2, only thinned portions of units will receive down wood EXCEPT no cut portions of Riparian Reserves, which have a target of 5% cover. Exact number of trees to be felled will be based on post-sale down wood surveys.

Streams would have no cut buffers, placed depending on stream class, and stability ratings. No cut buffers would extend to tops of topographic slope breaks, with minimum widths as follows: Class I streams, 120 feet; Class II streams, 90-100 ft; Class III streams, 60-110 ft; Class IV streams 30-60 ft.

The silvicultural prescription under Alternative 3 would be to thin from below using "Designation by Description" (D x D) to achieve variable density spacing, with the utilization of individual tree marking techniques to achieve structural diversity outside of skips. In units 7 and 8, root rot infected areas would NOT be regenerated, a different prescription than Alternative 2. Infected and uninfected areas would be thinned through.

Average post-harvest relative densities range from 36 to 52 with canopy closure ranging from 59 to 71%. This alternative would produce approximately 4.5 mmbf.

435 acres would be treated with ground-based logging systems, and 105 acres would be ground-based harvested. Approximately 3.3 miles of temporary road would be constructed, in many cases utilizing existing skid trail features that were created and are still evident from the original entry in managed and natural stands. Ground-based systems would utilize existing skid trail remnants to the extent possible.

As with Alternative 2, slash would be left on skid trails and scattered throughout the unit. There would be no other fuels treatment except the hand piling and burning of incidental quantities of slash and debris at landings and along heavily used roads. In order to increase and promote species diversity, minor species such as western red cedar, red alder, black cottonwood, big leaf maple and other minor species would be retained.

Table 3.1.2. Alternative 3 – Modified Proposed Action

Unit	Total Acres	Harvest Type	Treated Acres	Acres by Log. Sys.	RD[1]	Canopy Closure %[1]	Volume (MBF)	Slash Disposal[2]
3	9	HTH	9	Grd. 9	43	58-63	111	LS
4	38	HTH	27	Sky. 27	41	65-70	314	LS**
5	19	HTH	16	Grd. 16	41	58-63	158	LS
6	177	HTH	123	Grd. 105	52	68-73	1608	LS**
				Sky. 18				
7	33	HTH	28	Grd. 28	26	41-46	176	LS**
8	60	HTH	50	Grd. 50	30	40-45	274	LS
9	18	HTH	13	Sky. 13	50	57-62	85	LS**
14	103	HTH	47	Grd. 47	38	61-66	166	LS**
15	9	HTH	7	Grd. 7	37	58-63	33	LS
16	129	HTH	89	Grd. 84	38	68-73	582	LS
				Sky. 5				
17	56	HTH	39	Grd. 39	43	69-74	414	LS
19	7	HTH	7	Sky. 7	40	58-63	69	LS**
20	54	HTH	45	Grd. 13	35	56-61	314	LS
				Sky. 32				
25	17	HTH	14	Grd. 14	33	58-63	57	LS**
26	31	HTH	26	Grd. 23	30	53-58	126	LS
				Sky. 3				
Total	**760**	**HTH**	**540**	**Grd. 435**			**4487**	**LS**
				Sky. 105				

[1]The Relative Density (RD) and Canopy Closure % data represent only the treatment acres of each unit. If the no-cut skip and no-cut riparian reserve acres were included these numbers would be higher than what is shown.

[2]LS: Lop and scatter all units, pile and burn at landings. **Hand pile and burn 100 ft strip along 5290 (Unit 14), 5270 (Units 7 and 9), 4700 (Units 4, 6, 19, 25)

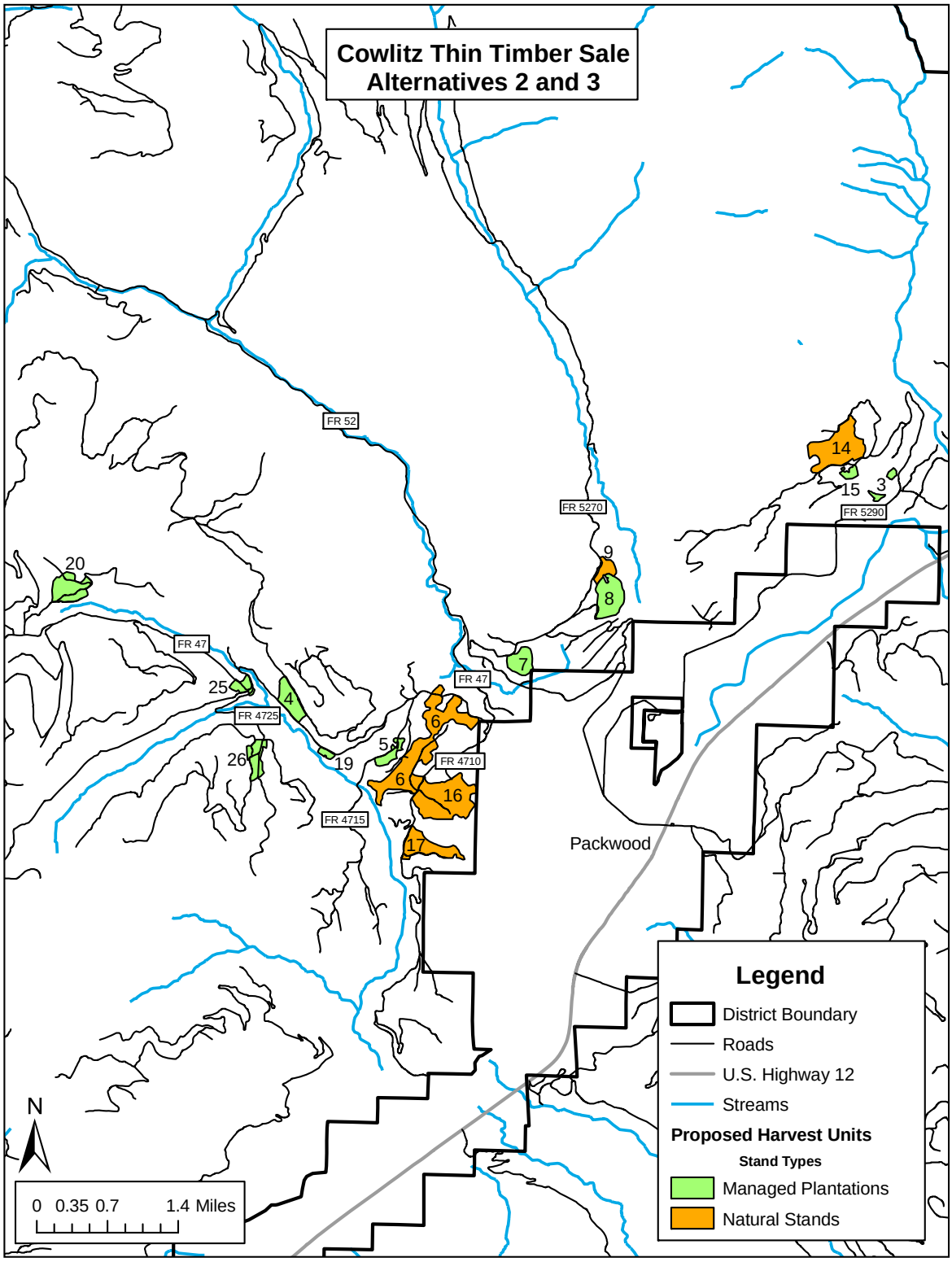

Figure 3.1.2. Cowlitz Thin Alternative 3, the "Modified Proposed Alternative".

Alternative 4 – Managed Plantations

Alternative 4 responds to public concerns regarding the harvest of older stands. All mature, naturally regenerated stands have been removed from this proposal (Table 3.1.3). 277 (234) acres of younger, managed plantations would be treated, ranging in age from 42 to 56. Treatment prescriptions are driven by matrix objectives of providing a predictable and sustainable level of timber (and other resources) for sale while maintaining and enhancing stand diversity and late-successional characteristics through the implementation of skips and gaps, and other conservation measures.

Skips would be located in 15% of the total acres in all units, except units 3, 4, 15 and 19 where the size and/or presence of significant Riparian Reserve no cut areas are present. Skip size is one to five acres. Smaller skips of ¼ to ½ acre may be added to protect specific habitat features (snags, down wood, decadent trees, etc.). No-cut riparian reserve buffers, survey and manage sites, etc. are included in skips where possible, and where the skip is beneficial to habitat. Skips would be placed evenly across units as practical, considering habitat protection and effectiveness.

Gaps are present in all managed stand units except Units 7 and 8, with wider-thin gaps in Unit 20, the only unit within a Late-Successional Reserve (LSR). Approximately 5-10% of unit acres would occur in gaps. Gap size is one-half acre or less, but would also include "daylighting" or individual tree culturing of individual leave trees or clumps. Units 3, 15 and 19 will have individual tree "daylighting gaps".

One hard snag per acre would be created in all but units 3, 4, 15 and 20, all created post-sale. Two hard snags/acres would be created throughout Units 3, 4, 15 and 20 to meet long-term LSR and riparian reserve objectives. In Riparian Reserves, two hard snags would be created per acre, all created post-sale.

Down wood would be added to all units. 2-3 trees/acre of "sound material" would be created post-sale. Units 3, 4, 15 and 20 would receive 3% ground cover throughout, the same treatment for Riparian Reserves (see below). Increased down wood levels in units 3, 4, 15 and 20 are designed to meet long-term LSR and riparian reserve objectives. Exact number of trees to be felled would be based on post-sale down wood surveys.

Three percent ground cover is the target for down wood in treated portions of Riparian Reserves of "managed" or young stands. The exact number of trees to be felled would be based on post-sale down wood surveys.

Streams would have no cut buffers, widths depending on stream class, and stability ratings. No cut buffers would extend to tops of topographic slope breaks, with minimum widths as follows: Class I streams, 120 feet; Class II streams, 90-100 ft; Class III streams, 60-110 ft; Class IV streams 30-60 ft.

Table 3.1.3. Alternative 4, managed stands.

Unit	Total Acres	Harvest Type	Treated Acres	Acres by Log. Sys.	*RD	*Canopy Closure %	Volume (MBF)	Slash Disposal
3	9	HTH	9	Grd. 9	43	58-63	111	LS
4	38	HTH	27	Sky. 27	41	65-70	314	LS**
5	19	HTH	16	Grd. 16	41	58-63	170	LS
7	16	HTH	13	Grd. 13	35	55-60	126	LS**
	17	HLR	17	Grd. 17	0	<1	189	
8	38	HTH	31	Grd. 31	38	51-56	263	LS
	22	HLR	22	Grd. 22	0	<1	321	
15	9	HTH	7	Grd. 7	37	58-63	33	LS
19	7	HTH	7	Sky. 7	40	58-63	75	LS**
20	54	HTH	45	Grd. 13 Sky. 32	35	56-61	314	LS
25	17	HTH	14	Grd. 14	33	58-63	72	LS**
26	31	HTH	26	Grd. 23 Sky. 3	30	53-58	153	LS
Sub-Total	238	HTH	195	Grd. 126 Sky. 69			1631	
	39	HLR	39	Grd. 39			510	
Grand Total	277		234	Grd. 167 Sky. 69			2141	

[1]The Relative Density (RD) and Canopy Closure % data represent only the treatment acres of each unit. If the no-cut skip and no-cut riparian reserve acres were included these numbers would be higher than what is shown.
[2]LS: Lop and scatter all units, pile and burn at landings. **Hand pile and burn 100 ft strip along 5270 (Unit 7), 4700 (Units 4, 19, 25)

The silvicultural prescription under Alternative 2 would be to thin from below using "Designation by Description" D x D to achieve variable density spacing. In units 7 and 8, root rot infected areas would be regenerated, and uninfected areas would be thinned. Average post-harvest relative densities range from 38 to 52 with canopy closure ranging from 59% to 71%. This alternative would produce approximately 2.1 mmbf.

167 acres would be treated with ground-based logging systems, and 69 acres would be ground-based harvested. Approximately 3.3 acres of temporary road would be constructed, in many cases utilizing existing skid trail features that were created and are still evident from the original entry in managed and natural stands. Ground-based systems would utilize existing skid trail remnants to the extent possible.

Slash would be left on skid trails and scattered throughout the unit. There would be no other fuels treatment except the hand piling and burning of incidental quantities of slash and debris at landings and along heavily used roads. In order to increase and promote species diversity, minor species such as western red cedar, red alder, black cottonwood, big leaf maple and other minor species would be retained.

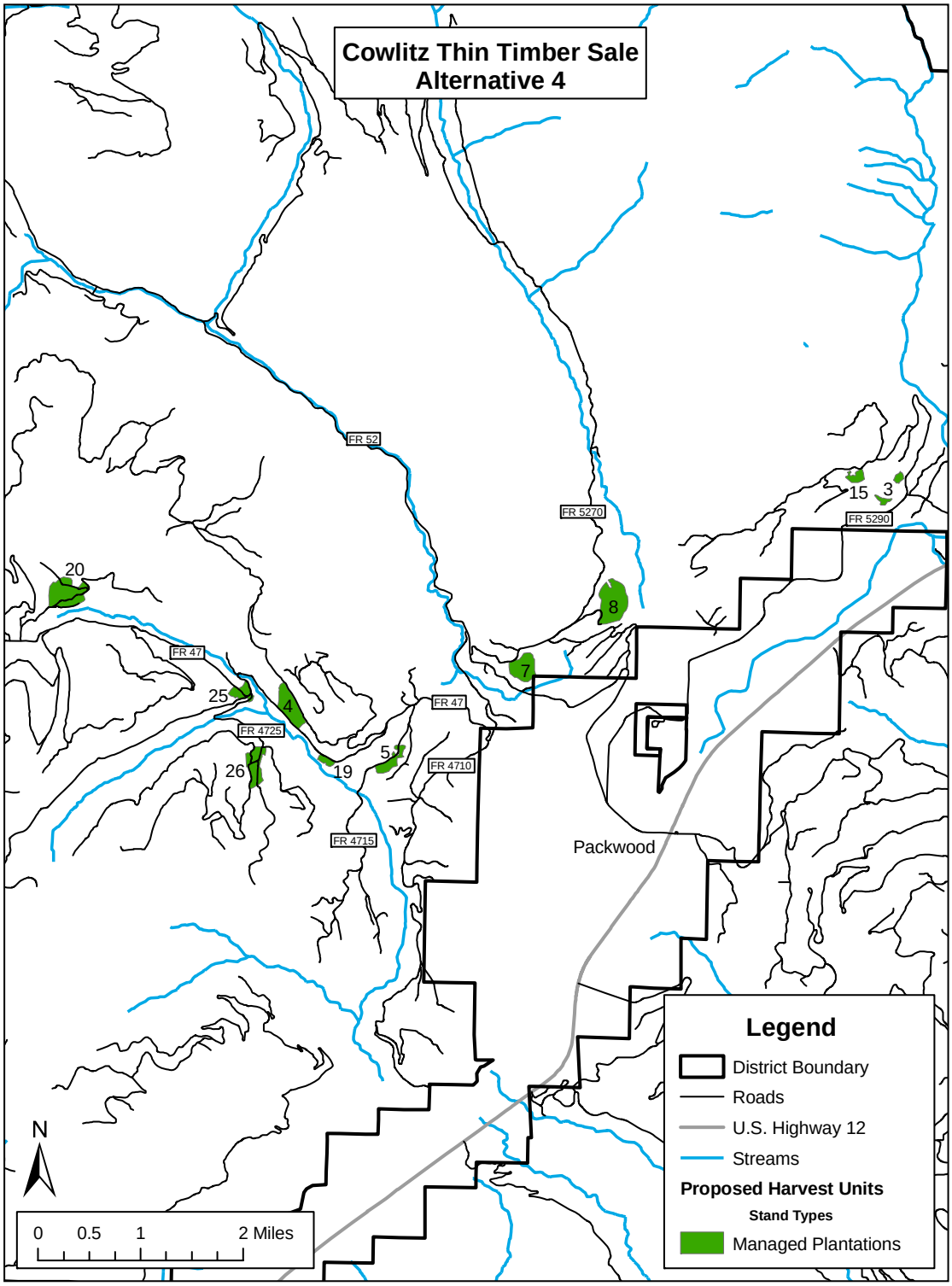

Figure 3.1.3. Cowlitz Thin Alternative 4, the "Managed Stand Alternative".

3.2 Mitigation Measures and Project Design Criteria

In response to public comments on the proposal, mitigation measures, project design criteria and best management practices were developed to ease some of the potential impacts the various alternatives may cause. The mitigation measures may be applied to any of the action alternatives.

Mitigation Measures, Project Design Criteria and Best Management Practices

1. Genetic resource select trees will be protected from damage during and after harvest. Select trees located within or near harvest unit boundaries will require protective measures consisting of the following: a) select trees located near or within a unit will be shown on the sale area map; b) select trees will not be used as guy trees, tailhold trees or be impacted by guy lines or skylines; c) directional felling will be employed in the vicinity of select trees; and d) provisions must be made to protect them during slash disposal activities.

   Alternatives 2 and 3: Units 6, 9, 14, 17.

2. Forest research plots will be protected from damage during and after harvest operations. Research plots located within or near harvest unit boundaries will require protective measures consisting of the following: a) research plots will receive a no-cut buffer of 100 feet to minimize the risk of windthrow and damage; b) research plots located near or within a unit will be shown on the sale area map; c) trees in research plots will not be used as guy trees, tailhold trees, or be impacted by guy lines or skylines; d) directional felling will be employed in the vicinity of research plots; e) skyline corridors and skid roads shall avoid the research plots and their protective buffer, and f) provisions must be made to protect research plots during slash disposal activities.

   Alternatives 2, 3, and 4: Unit 20

3. To protect retention/residual trees during high sap-flow periods, felling and yarding operations would have sap-flow timing restrictions. The objective is to reduce the amount of bole scarring and resultant impacts from the loss of tree growth, wood quality, and mortality. Increased or high sap-flow in the spring and early summer lasts from approximately bud break through shoot elongation. The timing varies by site and elevation. Restrictions will be included in the timber sale contract and may be waived if the operator can positively demonstrate an ability to fell and yard without unacceptable damage to leave trees.

   Restriction period March 1 through May 31:
   Alternative 4: Units 3, 4, 5, 7, 8, 15, 19.
   Alternatives 2 and 3: Units 3, 4, 5, 6, 7, 8, 9, 12, 14, 15, 16, 17, 19.

   Restriction period April 1 through June 30:

Alternatives 2, 3, and 4: Units 20, 25, 26

4. In all harvest units leaving retention/residual trees, the following actions should be considered to minimize damage and wounding of those trees (some of these can be included in the contract and some are only suggestions): a) pre-designate skid trails/skyline corridors and use existing skid trails whenever possible and practical; b) fell and yard skid trails/skyline corridors first; c) in the skid trails, cut stumps as low as possible so they will not shunt the skidding vehicle or logs sideways into residual trees; d) keep the skid trails/skyline corridors as narrow as possible; e) require felling to the lead with trees being felled 30-45 degrees toward or away from the skid trails/skyline corridors; f) do not allow whole-tree yarding (cut trees into logs, limbing and topping them prior to yarding; g) yarding equipment will be kept to designated skid trails; and h) consider requiring tree guards or designating rub trees, to be cut and yarded last, along the edges of skid trails/skyline corridors.

   Alternatives 2, 3, and 4: All units

5. No project activities that generate noise above ambient levels will occur in biological deer and elk winter range from December 1 to April 1. Due to the existing winter range road gates at FR 5290, no waivers or alterations of this restriction will be given due to low snow levels or other factors at units behind these gates (i.e. units 3, 14, and 15). At other units within winter range, waivers may be given to work <u>on one unit at a time</u> (i.e. complete work at one unit or site before starting at another), based on winter weather conditions, as determined by the District wildlife biologist. Written concurrence from the District wildlife biologist will occur before this restriction is lifted based on weather conditions. Applies as follows:

   Alternatives 2 and 3: Units 3-9, 14-17, 19
   Alternative 4: Units 3, 4, 5, 7, 8, 15, 19

6. No project activities will occur from **March 1 to August 31** within suitable spotted owl habitat units, to limit disturbance and provide post-fledging foraging habitat for the northern spotted owl. Also, no project activities will occur between March 1 to June 30 in units <u>adjacent</u> to suitable spotted owl nesting habitat, to limit disturbance to owls that may be nesting nearby. These restrictions assume that no blasting will occur in connection with this project; if blasting is proposed, the list of units below may change based on consultation with the District wildlife biologist. The above restrictions may only be waived if surveys to protocol standards are conducted, and it is determined that no nesting spotted owls are present. Any waivers will be documented in writing by the District wildlife biologist prior to the commencement of harvest activities. Applies as follows:

   Restriction period March 1 to August 31:
   Alternatives 2 and 3: Units 6, 14, 16, 17

   Restriction period March 1 to June 30:
   Alternatives 2 and 3: units 4, 19, 20, 25, 26
   Alternative 4: Units 4, 19, 20, 25, 26

7. No project activities that produce noise above ambient levels will occur from **April 1 to August 5** in or adjacent to units 4, 8, 9, 19 and 20, to limit disturbance to possible nesting marbled murrelets. Also, activities that produce noise above ambient levels will only occur between the hours beginning two hours after sunrise to two hours before sunset from **August 6 to September 15**. Applies to all action alternatives.

   Alternatives 2, 3 and 4: Units 4, 8, 9, 19, 20

8. No project activities that produce noise above ambient levels will occur from **January 1 to August 1** within 0.25 miles of suitable peregrine falcon nesting habitat. This restriction may be waived by the District wildlife biologist if surveys confirm that the falcons are not nesting that year. Any waivers will be documented in writing by the District wildlife biologist prior to the commencement of harvest activities. Applies to Alternatives 2 and 3.

   Alternatives 2, 3: All units that apply

9. Establish a one site-potential tree buffer near cliffs that provide potential nesting habitat for peregrine falcons.

   Alternatives 2, 3: All units that apply

10. No project activities will occur between **May 15 to July 1** in units 5 and 26, to limit disturbance to elk calving area habitat located adjacent to these units. This restriction may be lifted if field surveys indicate that elk are not using these areas that year, with any waivers documented in writing by the District wildlife biologist prior to the commencement of harvest activities.

    Alternatives 2, 3 and 4: Units 5 and 26

11. Minimize disturbance to standing snags and existing coarse woody debris (particularly large diameter, decayed, legacy trees/logs) to the extent practical by yarding away from these features, including them in no-thin "skips", or protecting them with a clump of adjacent leave trees. Existing, merchantable down trees or logs (or merchantable snags felled for logging safety reasons) will not be removed during the sale**.** Applies to all action alternatives.

    Alternatives 2, 3 and 4: All units

12. Protect Sensitive/Survey and Manage terrestrial mollusk sites by restricting thinning and ground disturbance within 15 meters (50 feet) of known sites at bigleaf maple trees. Following the sale create conifer snags, or fall trees for down wood, that are competing with bigleaf maples within this 15 meter zone to release and retain bigleaf maple tree habitat.

    Alternatives 2 and 3: Units 3, 6, 7
    Alternative 4: Units 3 and 7

13. Retain all mature bigleaf maple, red alder, cottonwood and western red cedar trees within harvest units.

    Alternatives 2, 3 and 4: All units

14. Create snags following the completion of harvest activities by topping or girdling live trees at the crown level. Trees chosen for snag creation should be a minimum of 17 inches in diameter in natural stands, or 15 inches in diameter in managed stands, unless this results in "high grading" the largest trees in a particular stand for snag creation. In no case should created snags be less than 12 inches in diameter. No snag creation will occur in units 7 and 8, as it is anticipated that many future snags will be created in patches of root rot. Where applicable, "release" bigleaf maple trees via snag creation to ensure the long-term persistence of maple habitat. Snag creation will only occur in the treated (thinned) acres within natural stand units, not in no-thin skips, which will supply snags over the long-term through competition-related mortality. Snags should be created as follows:

    Alternative 2: *One snag per acre in managed and natural stands, outside of riparian reserves. In riparian reserves, create two snags per acre. In units 3, 4, 15 and 20 create two snags per acre throughout.*
    Alternative 3: *In natural stands, create 2.6 snags throughout. In managed stands, create two snags per acre throughout.*
    Alternative 4: *Create one snag per acre outside of riparian reserves. In riparian reserves, create two snags per acre. In units 3, 4, 15, and 20 create two snags per acre throughout.*

15. Create down wood by falling live, green trees following the completion of harvest activities. A post-sale down wood survey will be conducted not sooner than 2 years following harvest to evaluate the actual number of trees to be felled to meet the alternative-specific guidelines below, which refer to percentages of sound (Class 1 or 2) material to be achieved within five years of the closure of the timber sale. This will allow some time to evaluate and include trees that have fallen due to windthrow and other factors since the completion of sale activities. Trees to be fallen for down wood should represent the average-sized trees in a particular stand, and the largest diameter trees should not be preferentially selected ("high graded") for down wood. Trees fallen for down wood should not be less than 12 inches in diameter, however. Down wood creation will only occur in the treated (thinned) acres within natural stand units, not in no-thin skips, which will supply down wood over the long-term through competition-related mortality. Also, Down wood will not be created in units 7 and 8, which are heavily infected with laminated root rot, and will be supplying ample quantities of down wood over time. Down wood should be created post-sale as follows:

    Alternative 2: *Achieve 240 linear feet (i.e. 2-3 trees/acre) in managed and natural stands outside of riparian reserves. In riparian reserves, achieve 3% ground cover in the managed part of the reserve, and 5% ground cover in the unmanaged part of the riparian reserve of sound material. In units 3, 4, 15 and*

20, achieve 3% ground cover throughout, and 5% in the unmanaged part of riparian reserves.
Alternative 3: *In natural stands, achieve 5% ground cover. In managed stands, achieve 3% ground cover throughout, with 5% cover in the unmanaged part of riparian reserves.*
Alternative 4: *240 linear feet (i.e. 2-3 trees/acre) outside of riparian reserves. In riparian reserves, achieve 3% ground cover in the managed part of the reserve, and 5% ground cover in the unmanaged part of the riparian reserve. In units 3, 4, 15 and 20, achieve 3% ground cover throughout, and 5% in the unmanaged part of riparian reserves.*

16. Ground-based machinery will not operate where soil water content is high enough to cause rutting that exceeds 6 inches in depth for a length of ten feet or more in accordance with Region 6 Standards and Guidelines (Forest Service 1998). Deviation from this measure should involve consultation with the appropriate resource specialist. This measure will limit the degree of soil compaction, rutting, and puddling as well as reduce the potential for offsite stream sedimentation. Applicable BMP: T-13. Erosion Prevention and Control Measures During Timber Sale Operations.

    Alternatives 2 and 3: Units 3, 5, 6, 8, 14, 15, 16, 20, 25, 26
    Alternative 4: Units 3, 5, 8, 15, 16, 20, 25, 26

17. Harvested trees will be felled away from streams, wetlands or other riparian reserve features. Exceptions would be trees which are leaning towards the creek, 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 measure is to prevent damage to riparian vegetation and soils within Riparian Reserves. Applicable BMPs: T-6 - Protection of unstable lands; T-13 - Erosion prevention and control measures during timber sale operations T-17 - Meadow protection during timber harvesting.

    Alternatives 2 and 3: 3, 4, 5, 6, 8, 9, 14, 15, 16, 19, 20, 25, 26
    Alternative 4: 3, 4, 5, 8, 15, 19, 20, 25, 26

18. One end log suspension will be required for ground-based and cable yarding systems (except during winching or lateral yarding). Full suspension will be required where possible over class IV streams. No yarding is permitted over class I, II, III streams. This will reduce the risk of soil compaction and displacement from dragging entire logs along the ground. The objective of this measure is to minimize erosion and potential sedimentation. Applicable BMP: T-13 - Erosion prevention and control measures during timber sale operations.

    Alternatives 2, 3 and 4: All units

19. The southwest portion of Unit 7, where slopes are greater than 20 percent, will not be regeneration harvested (HLR) to protect potentially unstable soils (SMU 19).

    Alternatives 2 and 4: Unit 7

20. All ground based equipment will be confined to approved temporary roads, skid trails and landings during yarding and brush disposal operations. Loaders or feller-bunchers may operate off designated skid trails, but must operate over slash beds that are as thick and continuous as practicable. Landings, temporary roads, skid trails and skyline corridors will be approved by the sale administrator prior to timber felling. Skid trails must be located at least 100 feet from any stream channel. Skid trails will be spaced a minimum of 150 feet apart for tractors and 400 feet apart for loaders. When possible, temporary roads and skid trails will be reestablished at previous skid trail locations rather than constructing new ones. These trails and roads will be treated to restore hydrologic function as needed. Temporary roads will not be constructed within Riparian Reserves, unless pre-approved. The objective of this measure is to minimize the extent and the degree of soil damage, displacement, and disturbance, and to allow sediment filtration. Applicable BMP: T-11. Tractor Skid Trail Location and Design

    Alternatives 2 and 3: Units 3, 5, 6, 8, 14, 15, 16, 20, 25, 26
    Alternative 4: Units 3, 5, 8, 15, 16, 20, 25, 26

21. Designated temporary roads and skid trails will not be permitted on slopes greater than 30 percent. Proposed exceptions to this restriction must be approved by the sale administrator in consultation with the Zone soil scientist or aquatic specialist, and must be documented in project file. This measure will limit the amount of erosion, soil compaction and displacement associated with use of equipment on steep slopes.

    Alternatives 2, 3 and 4: All units

22. Temporary roads and landings will be subsoiled to a depth of 18 inches (minimum). Subsoiling must be done immediately following logging activities. Any proposed alternative methods to subsoiling must be approved by the sale administrator in consultation with the Zone aquatic specialist or soil scientist. To prevent re-compacting of the treated roadways and landings, no ground-based equipment will be operated on subsoiled portions of roads and landings after subsoiling is completed. Cross-drains or water bars will be installed every 150 feet or more frequently where slopes exceed 5%. Available logging slash will be placed across the subsoiled road landing surface. (Acceptable grass seed mix; type of weed free mulch; and application rates will be specified by a qualified specialist). 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 at the entrance to the road or landing). Closure to vehicles is required to prevent these areas from being re-compacted 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. Applicable BMP: T-13. Erosion Prevention and control measures during timber sale operations; T-14 - Revegetation of area disturbed by harvesting activities; T-16. Erosion control on skid trails

    Alternatives 2, 3 and 4: All units

23. Rock will be used only when necessary to reduce erosion, puddling and compaction on landings and temporary roads, and applied only where needed ("spot rocking"). Rock will be incorporated into the roadbed by ripping or scarification following harvest activities (see mitigation measure which requires subsoiling). The objective is to allow better substrate for vegetative growth and water infiltration following logging and harvest activities.

    Alternatives 2, 3 and 4: All units

24. All drainage structures will be designed to accommodate peak-flow flood events, consistent with Northwest Forest Plan Standards and Guidelines (ROD, USDA 1994). Temporary drainage structures would be utilized one season and removed prior to the fall rainy season. If new structures are to weather through fall and winter, they must comply with standards and guidelines as if a permanent structure. Applicable BMP: T-13. Erosion prevention and control measures during timber sale operations

    Alternatives 2 and 3: Units 3, 14, 16
    Alternative 4: Unit 3

25. All currently closed system roads used by the sale will be reclosed after sale activities have been completed. The roads will be left in a self-maintaining condition by placing a barrier at the junction with the existing road system adequate to prevent off road vehicle use, constructing cross-ditching on steep-gradient sections and at culverts or other drainage locations. Applicable forest road systems include: Forest Roads 4710020, 47100015, 47100019, 4715405, 4715012, 4745410, 4715000, 5270023, and 5290000. This measure will prevent chronic ground disturbance, compaction and help promote hydrologic and biological process. Applicable BMPs: T-13 - Erosion prevention and control measures during timber sale operations; T-14 - Revegetation of area disturbed by harvesting activities

    Alternatives 2 and 3: Units 5, 6, 8, 14, 16, 20
    Alternative 4: Units 5, 8, 20

26. Prior to any expected seasonal period of precipitation and runoff cross drains and grade breaks would be installed in all temporary roads, skid trails, landings, and skyline corridors. Applicable BMP: T-13 - Erosion prevention and control measures during timber sale operations

    Alternatives 2, 3 and 4: All units

27. Subsequent to burning piled slash, burned areas greater than 100 square feet (not on permanent roads) will be seeded. This measure will mitigate the effects of severe burning on the soil.

    Alternatives 2, 3 and 4: All units

28. To reduce the potential for damage to the stream and flood plain as a result of a hazardous material spill, Spill-Booms will be placed downstream of the work site. Additionally, fueling equipment will be located outside of riparian reserves. A Hazardous Material kit will be on site, and would contain materials to control/contain a spill of fuel, oils, and/or hydraulic fluid. All service work on heavy machinery and refueling will be done on an established system road at a site approved by the Forest Service. Applicable BMPs: T-4 - Use of sale area maps for designating water quality protection needs; T-7 - Streamside management unit designation; T-17. Meadow protection during timber harvesting; T-22 - Modification of the TSC (Timber Sale Contract); R-12 - Control of construction in streamside management units

    Alternatives 2, 3 and 4: All units

29. The silvicultural treatment in the riparian reserve will follow a prescription to optimize structural development and plant species diversity to benefit water quality and old growth dependent fauna including native salmonids. The riparian treatment will prescribe down wood level and riparian reserve buffer widths based on topographic relief and other inherent channel stability indicators. For more information see Cowlitz Thin Riparian Reserve Silvilcultural Prescription (Appendix). Applicable BMPs: T-4 - Use of sale area maps for designating water quality protection needs; T-7. Streamside Management Unit Designation; T-17. Meadow Protection during Timber Harvesting; T-22. Modification of the TSC (Timber Sale Contract); R-12. Control of Construction in Streamside Management Units; W-3 - Protection of wetlands

    Alternatives 2, 3 and 4: All units except 7

30. 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 possible sediment delivery to stream courses. Erosion control treatment may include but not limited to repositioning displaced soil to recontour disturbed site, creating small ditches or diversions to redirect surface water movement, scattering slash material to create flow disruption and surface soil stability. Erosion control measures implemented by the purchaser will be complete prior to the onset of wet season (Oct 1) and approved by an aquatic resource specialist prior to the close of the timber sale. Applicable BMPs: T-6 - Protection of unstable lands; T-13. Erosion Prevention and Control Measures During Timber Sale Operations

    Alternatives 2, 3 and 4: All units

31. For instream projects: to minimize the amount of sediment entering the stream and possible damage to stream banks and channel bottoms, stream crossings and activities in the stream are prohibited except as prescribed for Forest Service instream projects.

32. All yarding and haul activities will be restricted to a Normal Operating Season (NOS), defined as June 15 to October 1. The objective of this measure is limit ground disturbing activities to the dry season thereby minimizing soil displacement, compaction, surface erosion and sediment delivery.

Exceptions to this timing restriction may be made during periods of anomalous weather conditions. Extraordinary wet weather during NOS may limit yarding and haul operations. During extended periods of dry weather outside the NOS, yarding and haul operations my proceed only with the written approval of an aquatic resource specialist and providing there is daily monitoring to evaluate if exceptional wet weather logging operations are meeting project design criteria. Applicable BMPs: T-4. Use of Sale Area Maps for Designating Water Quality Protection Needs; T-6. Protection of Unstable Lands; T-7. Streamside Management Unit Designation; T-13. Erosion Prevention and Control Measures During Timber Sale Operations; T-17. Meadow Protection during Timber Harvesting ; T-22. Modification of the TSC (Timber Sale Contract); R-12. Control of Construction in Streamside Management Units

Any pre-approved hauling activities occurring outside of the Normal Operating Season defined as June 15 to October 1, will monitor conditions daily as follows:

- Implementation and effectiveness monitoring of BMPs will be documented in daily diaries and made available to the aquatic resource specialist to assess conditions of haul routes, landings, and skid trails.

- Project activities will be curtailed and corrective action taken when ponding, rutting, rilling, culvert blockages, stream channel instability, and the occurrence of scour or sediment transport and deposition downstream of cross drains are encountered on adjacent system roads, temporary roads, skid trails, landings, stream crossings, riparian reserves or within harvest units where ground disturbance has occurred. See Fisheries Biological Evaluation for indicators of damage due to significant rainfall events.

  Alternatives 2, 3 and 4: All units

33. For instream work related to stream crossings: To minimize effects to fish and other aquatic organisms the project will comply with Washington State law (WAC 220-110-070) and provisions of the USDA Forest Service Memorandum of Understanding with the Washington State Department of Fish and Wildlife (2005).

    Alternatives 2, 3 and 4: Units 3,

34. For instream work related to stream crossings: to minimize the amount of sediment entering the stream channel, the operation period would be limited to low flow period. This measure will help minimize disturbance to aquatic organisms and their habitat.

    Alternatives 2, 3 and 4: Units 3,

35. For stream crossings and work adjacent to streams: to minimize the amount of sediment reaching the stream and to accelerate the re-vegetation process, rehabilitate areas compacted during management activities, and accelerate recovery of compacted

soils, subsoil the compacted areas and plant native vegetation to restore any areas used as access points by equipment. Alternatives to subsoiling should involve consultation with the appropriate resource specialist and documentation in project files to track for monitoring purposes. *See subsoiling and revegetation standards.*

Alternatives 2, 3 and 4: Units 3,

36. Protect Regional Forester's Sensitive botanical species as follows: Place fifty foot radius buffers centered on populations of **beard lichen *(Usnea longissima)***. During thinning operations, timber should be felled away from the reserve. The purpose of the buffer is to protect the host trees from impacts during harvest, to preserve nearby trees as possible future sites for lichen dispersal, and to avoid large changes in local microclimate. The sites in unit 17 are along the road, which is the boundary of the unit, so the buffers there will be a half-circle.

Alternatives 2 and 3: Unit 6 (one site), Unit 17 (three sites)

37. For actions conducted outside the road prism, all heavy equipment (bulldozers, skidders, graders, backhoes, dump trucks, etc.) will be cleaned prior to entering National Forest System lands to prevent the introduction of noxious weeds into the project area. An inspection will be required to ensure that equipment is clean before work can begin (Equipment cleaning clause Wo-C6.35) (**Standard 2**,).

Alternatives 2, 3 and 4: All units

38. 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. Mulch species shall preferably be from 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). (**Standard 3,** USDA 2005)

Alternatives 2, 3 and 4: All units

39. 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,** USDA 2005).

Alternatives 2, 3 and 4: All units

40. 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 prevent the establishment 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 altered plant communities. Under no circumstances will non-native invasive plant species be used for revegetation. (**Standard 13,** USDA 2005).

Alternatives 2, 3 and 4: All units

41. Temporary roads, landings and other areas of heavy disturbance would be revegetated with a native seed mix and application prescription developed by the Forest. Guidelines for site preparation would also be followed (see Gifford Pinchot Native Species Policy, 2000). The following prescription is recommended, or consult North Zone botanist: a locally native seed mix such as 65% *Elymus glaucus* with 35% *Deschampsia elongata* (by weght) applied at a rate of 100 lbs/acre, with fertilizer at 200 lbs/acre and enough weed-free mulch to cover the seed 2-3 inches. When seed is used it should be either certified noxious weed free or from Forest Service native seed supplies. Purpose of mitigation: to minimize soil erosion and weed establishment at disturbance sites.

Alternatives 2, 3 and 4: All units

42. Minimize road maintenance clearing zones, as much as safety regulations will allow. Purpose of mitigation: to maintain shady conditions that help minimize invasive plant population expansion.

Alternatives 2, 3 and 4: All units

43. During years of project implementation, conduct road brushing activities during spring-early summer, before seed heads mature. Purpose of mitigation: 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.

Alternatives 2, 3 and 4: All units

44. Clean heavy equipment used for project activities when equipment moves from or between project sites or areas known to be infested into other areas, infested or otherwise. If wash facilities are not readily available, all visible dirt and plant parts on equipment will be removed by brushing or scraping at the infested site before moving. Purpose of mitigation: to avoid spreading invasive weed populations.

Alternatives 2, 3 and 4: All units

45. Prevent encroachment on Wilderness Boundary. Any time a project is proposed that abuts or is within a half mile of a Congressionally Designated Area, such as wilderness, the Line Officer is responsible for ensuring the location of the boundary is

identified and located through proper surveying procedures (Regional Direction, 1994). Unit 14 is located approximately 260 feet from the wilderness boundary. This portion of the wilderness boundary was surveyed and posted in 1990. Boundary markers must be physically located prior to any harvest activity.

Alternatives 2 and 3: Unit 14

46. Ensure harvest activities do not impact Trail no. 161. This trail is located approximately 80 feet from the northwestern boundary of Unit 14. Directional felling away from trail. Do not allow motorized access on trail.

    Alternatives 2 and 3: Unit 14

47. Ensure opportunities for winter recreation. Units are located on or adjacent to a groomed winter recreation route for snowmobiles. Prohibit project activities (snowplowing, timber haul) along Forest Road 47 and 84 from December 1 through April 1. Waivers may be given based on winter recreation conditions (low snow levels), as determined by the District Recreation Planner. Any waivers will be documented by the District Recreation Planner or Public Service Assistant prior to the commencement of harvest activities.

    Alternative 2 and 3: Units 4, 5, 6, 16, 17, 19, 20, 25, 26
    Alternative 4: Units 4, 5, 6, 19, 20, 25, 26

48. Ensure Wilderness trails access. Units 3, 14, and 15 are located adjacent to Forest Road 5290. Units 7-9 are located on Forest Road 5270, both of these roads provide access to Trail no. 161. Keep roads open and provide signing if there will be wait periods.

    Alternative 2 and 3: Units 3, 7, 8, 9, 14, 15
    Alternative 4: Units 3, 7, 8, 15

49. Ensure Visual Quality Standards are met. Unit 7 is within the Visual Emphasis management prescription (VL). The standard for VL is Retention. Ground disturbance by any activity should be rehabilitated within one year to natural appearance in Retention. Stumps resulting from any activity should, where they are visible (within 100' of the travelway), be flush-cut or otherwise concealed in the foreground of Retention. Retain diversity in undergrowth in Retention. Utilize existing landings and rehabilitate after use.

    Alternatives 2, 3 and 4: All units

50. Ensure opportunities for summer recreation. The haul route along Forest Roads 47, 84 and 52 is located in a popular summer dispersed recreation area. Driving for pleasure and gathering special forest products is a common activity in this location, particularly in the Silver Creek Pass area. Keep roads open and provide signing if there will be wait periods.

Alternative 2 and 3: Units 4, 5, 6, 16, 17, 19, 20, 25, 26
Alternative 4: Units 4, 5, 6, 19, 20, 25, 26

51. Reduce or eliminate illegal motorized recreation. User developed trails have been identified in and near Unit 14, and there is known illegal ATV use on FR 5290 and 5290082. The last 300 feet of 5290 will be reopened for access to the harvest unit. After harvest, obliterate and close the 300 feet of reopened road to reduce ATV access. Aquatic resources have identified a mitigation measure that will address the needs of eliminating unmanaged recreation in this area.

    Alternatives 2 and 3: Unit 14

3.3 Comparison of Alternatives

This section provides a summary of the effects of implementing each alternative. Information in Table x is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives. Tables 3.3.1 and 3.3.2 provide a comparison of the analysis indicators for the significant issues (Section 2.7).

Table 3.3.1. Comparison of alternatives including a quantitative summary of activities or project elements.

Activities	Alternative 1 (No Action)	Alternative 2 (Proposed)	Alternative 3 (Modified)	Alternative 4 (Managed)
Commercial thin – total	0	760	760	277
Commercial thin- riparian	0	92	92	53
Temporary roads	0	3.3	3.3	1.0
Skyline harvest	0	105	105	69
Ground-based harvest	0	435	167	167
Landing area	0	7.0	7.0	2.3
Volume harvested	0	6.8 mmbf	4.5 mmbf	2.1 mmbf
Net value	0	$2,790,400	$1,550,300	$768,600
Cost:Benefit Ratio	0	1.6	1.9	1.8

Table 3.2.2. Comparison of analysis indicators for significant issues by alternative.

Issue	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (Modified Proposed Action)	Alternative 4 (Managed Stands)
Laminated root rot estimated volume lost over 25 years	488 mbf	0	393	0
Acres of mature forest treated (with skips represented)	0	483 (379)	483 (311)	0
Acres of suitable owl habitat temporarily degraded	0	364	298	0
Northern spotted owl effects determination	No effect	Likely to Adversely affect	Not Likely to Adversely affect	Not Likely to Adversely affect

4.0 ENVIRONMENTAL CONSEQUENCES

This section summarizes the physical, biological, social and economic environments of the affected project area and the potential changes to those environments due to implementation of the alternatives. It also presents the scientific and analytical basis for comparison of alternatives presented in the chart above. This analysis is organized by resource area.

4.1 Disturbance History

The Cowlitz Thin Planning Area is located in the Upper Cowlitz River Watershed and the Middle Cowlitz River Watershed. The upper watershed has a history of wildfire, and was in a contiguous forest of grass/pole and small trees prior to the 1880's. Fire suppression began to shape the watershed during the 1930's and 1940's, and regeneration harvest during the 1950's resulting in the loss of structural elements, including snags, large down coarse wood, and reduced duff layers.

Approximately 24,324 acres of the Upper Cowlitz Watershed has been harvested during the last 50 years. At least 52% of the watershed was in the grass-pole development stage as of 1997 (Upper Cowlitz Watershed Analysis, USFS 1997). Stands in this category originated from regeneration or clearcut harvest methods, which began in the 1950's and continued through the 1960's and 1970's. Most of the private lands within the watershed were harvested during the 1970's, and some stands have been entered and harvested a second time during the past decade. Additional biological and physical information regarding the planning area can be found in the *Upper Cowlitz Watershed Analysis* (USFS 1997a) and the *Middle Cowlitz Watershed Analysis* (USFS 1997b).

Floods are natural disturbances that produce high flows, scour events, and debris torrents. There have been approximately 15 ten-year or greater flood events since 1970 on the Cowlitz River, resulting in pronounced stream channel erosion, channel widening, increased channel instability, and the reduction of hydrologic complexity (USDA 2002).

Volcanic and seismic activities represent the dominant geological processes in the project area. Historic eruptions of Mount St. Helens deposited significant amounts of ash and tephra across the Upper and Middle Cowlitz watersheds. These deposits have contributed to increased fine sediment delivery to streams for periods lasting years to decades following each event. Mount Rainier eruptions have inundated the floodplain of the Cowlitz River with mudflows. Earthquakes cause landslide hazards that block drainages, forming dams and potentially causing break floods along stream channels (USDA 1997a, UDDA 1997b). Management related disturbances may trigger mass wasting in the form of large landslides (Butter/Skate Creek drainages), hillslope erosion, simplification of stream channels (Butter/Skate Creek drainages), and road conditions (Willame/Skate Creek drainages) (USDA 1997a).

4.2 Stand Growth and Productivity

The proposed Cowlitz Thin Timber Sale consists of 15 units planned to be sold during fiscal year 2007. Proposed treatments emphasize the sustainability of ecosystems and foster characteristics such as long-term site productivity, horizontal diversity in stand structure, species diversity, course woody debris (snags and down wood), and riparian protection and enhancement. Based on field reviews, stand inventories, and analysis of vegetation, the areas proposed for harvest are suitable for silvicultural treatments that remove timber volume while providing benefits to selected stands that are consistent with the purpose and need described in Chapter 1. Detailed silvicultural prescriptions are provide in the Appendix.

Tables 4.2.1 and 4.2.2 provide details of the current condition of each stand. There are two broad categories of stand types that are being considered for thinning under the proposed action: immature or "managed" stands of clearcut origin that are dominated by Douglas-fir. Typical plant associations include *Tsuga heterophylla*/*Berberis nervosa*/*Polystichum munitum* and *Tsuga heterophylla*/*Berberis nervosa-Gaultheria shallon*, with mesic environments, and a few more moist environments represented by *Tsuga heterophylla*/ *Tiarella trifoliata* excellent opportunities for intensive management. Some units lie within the drier, *Tsuga heterophylla*/*Gaultheria shallon* plant association. Unit 20, the only stand located in an LSR, is unique in that the dominant plant association is *Abies amabilis*/*Tiarella unifoliata*, a moist environment that also provides excellent opportunities for management.

Young, Managed Stands

Units 3, 4, 5, 7, 8, 15, 19, 20, 25 and 26 are young, managed stands that range in age from 42 to 56. These plantations were clearcut during the 1950's and the early 1960's. Nearly all were broadcast burned and planted with Douglas-fir. Most stands have some hardwood components including red alder and bigleaf maple, with very little conifer development in the understory. Most of the stands have laminated root rot infections, but in general not significant quantities. Units 7 and 8 have significant infections, and are discussed in detail in the following section.

Large, decaying down logs are the most abundant legacy feature that may be found throughout most stands; most snags observed during field visits to young stands were caused by laminated root rot induced mortality.

Summary of Stand Diagnosis and Treatment Recommendations

Most of the young, managed stands are experiencing decline due to density. Most are heavily overstocked, and competition-related mortality is occurring. The age and condition of the younger, managed stands present an opportunity for a commercial thinning entry to improve stand vigor, optimize growth, and promote development of multi-layered canopies. Current relative densities range from 51 to 70; relative densities would be reduced to a range of 26 to 45 under the proposed action. Estimated canopy closures after thinning would range from 55 to 67% for most stands; Units 7 and 8 would be reduced to 42 and 43 percent respectively due to existing openings created by

laminated root rot infections. The timber volume would be removed via ground-based logging and skyline systems, volumes removed ranging from 4 to 12 mbf/acre.

Two alternative treatments are being considered in the analysis for Units 7 and 8. Alternatives 2 and 4 would regenerate the infected portions of each unit, resulting in the opening of areas as large as 8 acres, and to thin through the remainder of each stand. Alternative 3 would thin through the units, with the expectation that the units would be entered to treat the laminated root rot infection in the future. Section 4.3 analyzes these alternatives in detail.

Riparian Reserves would be treated under all alternatives, and would include a variable width no-harvest buffer that would be designed to protect the inner riparian reserve along all streams. No-cut buffer widths were determined based on site conditions, including stream class, channel stability, inner channel gorge width, and site potential tree height. Riparian reserves with the lowest risk channel stability would receive at least a 30 foot-wide buffer away from non-fish-bearing streams (Class III, IV), and a minimum of 60 feet from fish-bearing streams (Class I and II).

The outer Riparian Reserves would be treated similarly to uplands, with ground-based equipment access restricted to the outer 1/3 or the Riparian Reserve. Relative densities would not fall below 35-40; if currently below this level, riparian reserve relative densities would remain at existing condition.

All or portions of stands would receive skips and gaps, and snags and down wood as described in Chapter 1, under the description of the alternatives, and in 4.4 under the Wildlife discussion.

Table 4.2.1. Cowlitz Thin stand data.

Unit	Acres	Age	Slope %	Aspect	Elevation	Site Index[1]	Site Class
3	9	42	0-55	SE	1200-1450	170 DF	2
4	38	48	30-65	SW	2400-3000	150 DF	3
5	19	56	5-35	S, W, NW	2000-2150	150 DF	3
6	177	125	5-45	NW,NE,SE,SW	1800-2400	130 DF	3
7	30	43	0-40	S, SE	1600-1800	150 DF	3
8	60	42	0-30	SE	1700-1900	150 DF	3
9	18	112	20-60	SE	1850-2100	100 DF	4
14	103	117	5-40	E, SE	1900-2350	100 DF	4
15	9	42	0-40	S, SE	1850-1950	150 DF	3
16	129	137	15-45	W,N,E,NE	1600-2200	110 DF	4
17	56	121	5-40	W,SW,S,SE	1900-2150	140 DF	3
19	7	48	10-30	S, SW	2300-2450	160 DF	2
20	54	53	25-45	SW, S, SE	3200-3800	130 DF	3
25	17	52	5-30	E, NE	2600-2900	130 DF	3
26	31	47	0-55	E, NE	2800-3150	130 DF	3

[1]McArdle 100-year base, equal to 109 DF for King 50-year base.

Mature, Naturally Regenerated Stands

Units 6, 9, 12, 14, 16 and 17 are mature stands ranging in age from 112 to 137, and dominated by Douglas-fir with western hemlock western red cedar and bigleaf maple. All but one mature stand (Unit 9) have been managed in the past, either commercially thinning or some type of selective harvest.

Most of the natural stands have 2-layered tree canopies and appear to be developing multi-story canopies. The most common plant association is *Tsuga heterophylla*/ *Berberis nervosa-Gaultheria shallon*, which indicates a mesic environment with good opportunities for intensive management. Relatively minor amounts of laminated root rot can be found in the mature stands, although there are a few pockets of severe infection.

Table 4.2.2. Cowlitz Thin existing stand conditions.

Unit	DBH	TPA	Basal Area/Ac.	Diameter Increment	Crown Ratio	Crown Width	Cubic ft/Ac.	Board feet/Ac.	Relative Density
3	14.5”	235	268 sq. ft.	2.1” last 10 years	35%	17 feet	10.5 M	47.5 M	70
4	13.9”	249	264 sq. ft.	2.2” last 10 years	40%	18 feet	9.5 M	41.4 M	71
5	13.5”	247	246 sq. ft.	2.0” last 10 years	30%	17 feet	9.9 M	45.3 M	67
6	15.2”	218	276 sq. ft.	1.1” last 10 years	25%	16 feet	11.8 M	57.5 M	71
7	12.7”	248	217 sq. ft.	2.8” last 10 years	40%	17 feet	7.3 M	30.4 M	61
8	12.8”	235	209 sq. ft.	2.2” last 10 years	30%	14 feet	6.9 M	28.2 M	58
9	12.4”	281	235 sq. ft.	1.1” last 10 years	25%	13 feet	7.8 M	33.2 M	67
14	13.1”	210	195 sq. ft.	1.1” last 10 years	30%	17 feet	6.1 M	24.8 M	54
15	13.2”	203	192 sq. ft.	3.0” last 10 years	45%	17 feet	6.3 M	25.6 M	53
16	13.4	231	227 sq. ft.	1.1” last 10 years	30%	18 feet	8.0 M	35.5 M	62
17	13.5”	254	252	1.5” last 10 years	35%	18 feet	11.5 M	57.5 M	69
19	13.7”	241	247 sq. ft.	1.9” last 10 years	35%	17 feet	9.5 M	42.2 M	67
20	13.9”	198	209 sq. ft.	2.3” last 10 years	45%	17 feet	6.8 M	27.8 M	56
25	11.7”	245	184 sq. ft.	2.4” last 10 years	45%	16 feet	5.7 M	22.6 M	54
26	11.9”	226	175 sq. ft.	2.8” last 10 years	45%	17 feet	4.8 M	18.4 M	51

Unit 9 is the only unmanaged stand in the Cowlitz Thin project. This is a mature 112-year-old stand of natural origin composed of Douglas-fir (100%). Unlike other units, this stand has a 1-layered tree canopy and is very homogeneous. It is an unusual stand in that the tree heights are very consistent across all the dbh classes in the stand, the boles are very tall, straight and clear, and the crowns are very small; undoubtedly a result of the stand's high stocking, it's relatively low site index, and no previous management. This stand has few late-successional characteristics. The dominant plant association is *Tsuga heterophylla*/ *Gaultheria shallon* which indicate a dry environment with a fair opportunity for intensive management. There are no obvious laminated root rot infection areas in this stand. The stand is largely devoid of large down wood and snags.

Summary of Stand Diagnoses and Treatment Recommendations

In general, all of the natural stands are experiencing decline in vigor due to age and density, as evidenced by crown ratios and reduced growth rates. Portions of most stands are overstocked and experiencing competition-related mortality. While most of the stands are not at an optimal age for thinning, they would benefit from an intermediate entry and stand treatment that would improve stand vigor and maintain or in some case improve small increments in growth. Portions of some stands are producing optimal cover and late-successional characteristics. In these cases, a light thinning is recommended to open the canopy enough to allow the continued production and development of the intermediate and understory canopies, while maintaining the current growth rate of the dominant and co-dominant trees. The range of relative densities would be reduced to 38 to 52, and estimated canopy closures after thinning would range from 59 to 71. The timber volume removed via ground-based and skyline harvest systems would remove approximately 13 mbf/acre.

Salal is a dominant shrub in the understory of several stands; opening the canopy can cause an increase in its amount and density. Western hemlock and western red cedar would also seed in and develop in the understory over time. There are fair amounts of large- and small-diameter down wood and some large snags in the older stands. These features would be preserved to the extent possible.

Unit 9 is also declining due to its age and density, as evidenced by its low crown ratios and low dbh growth increment. A relatively light, conservative thinning is recommended to open the canopy enough to help the production and development of intermediate and understory tree layers, while maintaining the current growth rate of the dominant and co-dominant trees. Because this stand has a southeast aspect on a relatively steep slope, and because its stems have grown in a densely stocked condition for so long, there is potential for windthrow following harvest.

All or portions of stands would receive skips and/or gaps, and snags and down wood as described in Chapter 1, under the description for each alternative. Section 4.4 also provides a detailed discussion of the skips and gaps prescribed under each alternative.

4.3 Stand Health, Productivity, and the Future Production of Late-Successional Forest

Laminated Root Rot

Laminated root rot (caused by the fungus *Phellinus weirii*) is a common disease in Pacific Northwest forest stands. In western Washington and Oregon it is the most damaging disease in Douglas-fir stands. It has been estimated that laminated root rot occurs in 8 percent of the commercial forest land in Washington and Oregon and causes a 40- to 70-percent reduction in wood volume on the areas affected (Thies and Sturrock 1995). Substantial reductions in tree growth, stand density, and timber volume have been demonstrated in second-growth, managed Douglas-fir stands. This native disease is one of the most damaging and difficult diseases to control in Pacific Northwest conifer forests (Hadfield 1985).

In the lower elevations of the upper Cowlitz River valley, laminated root rot is a very common disease in Douglas-fir stands (USDA 1997). Douglas-fir is highly susceptible to infection. It can be particularly problematic in young, managed Douglas-fir stands that were regeneration harvested in areas that were infected with the disease and then replanted with Douglas-fir (Hadfield 1985). It is in these stands where the potential for loss of future production of late-successional forest is high. The production of late-successional forest (70%+ conifer canopy closure, 21"+ avg. dbh, multi-storied canopy) is one of the management goals for attaining the desired future condition of the stands proposed for treatment (USDA 1995).

Laminated root rot infections are known to exist in 9 of the 15 stands being proposed for treatment in the Cowlitz Thin timber sale. And 5 of the 9 infected stands are located in young, managed Douglas-fir stands. With the exception of two, young managed stands (proposed Units 7 and 8), where formal root rot surveys have been performed, the amount and extent of the disease in the other seven stands is not well known because they have not had formal root rot surveys. But based on informal ground reconnaissance in May and June of 2006, the amount of laminated root rot in those other seven stands is believed to be generally low and not significant enough to warrant specific treatment for the root rot. The stands in proposed Unit 7 (located in the Visual Emphasis MAC) and proposed Unit 8 (located in the Deer and Elk Winter Range MAC) do not currently possess the attributes necessary to be late-successional forest.

Intensive, formal laminated root rot surveys were performed in proposed Units 7 and 8 in December 2006. The surveys revealed extensive laminated root rot disease in both stands.

Unit 7 (33 acres in size, 43 years of age, 96% Douglas-fir species composition) was found to have approximately 11.3 acres of root rot infection or 34% of the stand's acreage. It had a total of 20 infection centers, ranging in size from 0.1 acre to 3.0 acres, located throughout much of the stand, especially in its south and west portions, where the bulk of the infection centers are aggregated.

Unit 8 (60 acres in size, 42 years of age, 89% Douglas-fir species composition) was found to have approximately 14.4 acres of infection or 24% of the stand's acreage. It had a total of 35 infection centers, ranging in size from 0.05 acre to 5.0 acres, located throughout much of the stand, especially in its south and west portions, where the bulk of the infection centers are aggregated. Only the southeast edge and the northern end of the stand are relatively free of visible infection centers.

The damage caused by laminated root rot in proposed Units 7 and 8 consists of tree mortality (dead standing and windthrown) and understocking in disease infection centers, resulting in serious loss of conifer canopy cover, tree growth and wood production. Small infection centers consist of only a few dead or symptomatic trees (standing dead and/or fallen and/or live with thinning crowns of yellowish foliage) creating a very small canopy opening. The larger infection centers contain some standing dead or symptomatic live trees typically present around the edges of infection centers and scattered within them. Within 50 feet of an infection center there are live, green trees which are infected but, as yet, show no symptoms of infection. Douglas-fir trees that are within 15 feet of one killed by laminated root rot are usually infected. Crown symptoms may not be noticeable until 10 or more years after initial infection. Tree death will usually occur 5 to 10 years after symptoms develop (Hadfield 1985).

In the larger infection centers, seedlings of susceptible conifer species that become established often become infected and die at a young age, while disease tolerant or resistant conifers often continue to grow. Patches of bigleaf maple, red alder, vine maple and other hardwood tree and shrub species often develop in the larger disease centers because of the increased sunlight caused by the heavy loss of overstory conifer canopy cover.

The ability to produce late-successional forest on the acres currently infected with laminated root rot has been lost.

Environmental Consequences

Alternative 1 – No Action

Direct and Indirect Effects

This alternative proposes no forest management activities or other resource management projects.

Currently, the amount and distribution of laminated root rot in two young stands in the planning area is seriously affecting their health, productivity, and ability to produce future late-successional forest. Laminated root rot is a disease of the site that can persist on the site from one tree generation to another. This alternative will not treat any of the infected acres. No attempt will be made to reduce the spread and level of infection and the loss of tree growth due to tree death or poor tree vigor caused by the root rot disease. This alternative will do nothing to prevent the loss of productive acres that would produce future late-successional forest.

Cumulative Effects

The acres currently infected in the two young stands will continue to increase and over time continue to reduce site productivity on those acres (Hadfield 1985). Laminated root rot can significantly reduce long-term productivity of forests. Managing laminated root rot offers an opportunity to increase productivity on forest sites (Miller et al. 1989).

Laminated root rot disease centers are estimated to expand about one foot per year through root contact (Hadfield 1985). In the next 25 years the current level of infection will increase, as will the size of the infection centers (with infection centers that are currently near each other coalescing into larger infection centers).

The stand in which proposed Unit 7 is located would see its infection increase to approximately 17 acres or 51% of the stand's acreage. The stand's 20 infection centers will have coalesced into 7 infection centers ranging in size from approximately 0.4 acre to 7.8 acres. The 17 acres of infection represents acres that will not be capable of developing into late-successional forest.

The stand in which proposed Unit 8 is located would see its infection increase to approximately 22 acres or 37% of the stand's acreage. The stand's 35 infection centers will have coalesced into 16 infection centers ranging in size from approximately 0.2 acre to 7.5 acres. The 22 acres of infection represents acres that will not be capable of developing into late-successional forest.

The result of the continuing spread of the infection and expansion of the infection centers will be a serious decrease in conifer canopy closure and a loss of wood volume as overstory trees die. In 25 years it is estimated that approximately 11.3 acres (34 %) of the stand in Unit 7 will have a conifer canopy closure of less than 5% and a loss in wood volume of approximately 220,000 board feet. In Unit 8 it is estimated that approximately 14.4 acres (24%) will have a conifer canopy closure of less than 5% and a loss in wood volume of approximately 268,000 board feet. On a combined basis, there will be approximately 25.7 acres (or 28% of the total 93 acres in these two stands) with a conifer canopy closure of less than 5% and a loss in wood volume of approximately 488,000 board feet.

As laminated root rot continues to spread through these stands, live, infected trees will eventually succumb to windthrow. Because the canopy in the uninfected portions of these stands will not be opened up by thinning, the potential for a serious windthrow event is estimated to be low to moderate in the near future, but will likely increase over time as the infection centers expand and coalesce.

In the event of a serious windthrow event, the potential for an outbreak of Douglas-fir bark beetles increases. If significant windthrow should occur, a salvage harvest might be needed to prevent or lessen the severity of an outbreak in these stands. Laminated root rot is a particularly significant predisposing agent for Douglas-fir bark beetles. *Phellinus weirii*-infected Douglas-fir, 12 inches dbh or greater, are commonly infested by Douglas-fir bark beetles. *Phellinus weirii* provides a continuous source of favorable host material

for beetles between those times when conditions are favorable for epidemics (Thies and Sturrock 1995).

Windthrow of infected trees can be beneficial because the volume of laminated root rot inoculum in the soil will be reduced as roots are pulled out of the ground. *Phellinus weirii* will die in roots exposed to air (Hadfield 1985). The benefit from this would probably not be substantial and would be unlikely to make a significant positive impact on the spread of the fungus through these stands.

As infection centers continue to expand and trees die, the resulting canopy openings will continue to become occupied by some level of shrub and herb species, hardwood tree species and Douglas-fir seedlings (which will eventually become infected and die before getting very big). Over time (up to 40 or 50 years) the inoculum in the infection centers will decrease as the fungus devours available Douglas-fir roots and dies out due to lack of a food source. But as the disease continues to spread unchecked, it will continue to produce additional inoculum in these stands.

Alternative 2 – Proposed Action

Direct and Indirect Effects

Under this action alternative, the stands in proposed Units 7 and 8 would receive a combination of commercial thinning on the uninfected acres and light forest retention (HLR) regeneration harvest on the laminated root rot-infected acres.

In Unit 7, regeneration harvest will occur on 17 acres, with the remaining acres being thinned. In Unit 8, regeneration harvest will occur on 22 acres, with the remaining acres being thinned. The total 39 acres of regeneration harvest will remove all Douglas-fir trees in the infected areas of these stands, plus a 50-foot cut buffer beyond the edge of the visible infection to ensure against the future spread of the disease (the disease fungus does not spread on dead roots). While there is not an absolute guarantee that all infected areas will be captured in the regeneration treatment (it's very possible some small infection centers are not yet visible and thus might be missed), the treatment will cause a substantial and significant decrease in the root rot's spread through these stands (Thies and Sturrock 1995).

While this treatment strategy will effectively stop the spread of the disease into the uninfected portions of the stand, it will also create several large openings in the stand. Those openings will increase the amount of thinned stand edge exposed to the wind, which will increase the probability of windthrow in the adjacent thinned acres. The potential for a serious windthrow event under this alternative is estimated to be moderate to high. In the event of a serious windthrow event, the potential for an outbreak of Douglas-fir bark beetles increases. If significant windthrow should occur, a salvage harvest might be needed to prevent or lessen the severity of an outbreak in these stands.

The 39 acres that are regenerated will effectively have a conifer canopy closure of 0% after the treatment and much of the current, live wood volume on those acres will be captured and utilized by the wood products industry.

Cumulative Effects

By regenerating the infected portions of these stands and reforesting them with a tree species that is immune to the disease (e.g. red alder), the inoculum level will be greatly reduced over the next 40 to 50 years. It would take about that long for most of the *Phellinus weirii* to die out of most of the infected stumps and roots (Hadfield 1985). In 40 to 50 years the red alder could be removed and the 39 acres planted back to conifers to begin its development towards future late-successional forest.

The uninfected, thinned portions of these stands will continue to develop towards the goal of late-successional forest, assuming serious windthrow does not hamper that development.

The result of stopping the spread of the root rot infection will mean stopping the future loss of wood volume production from the disease on the currently uninfected ground.

Alternative 3 – Modified Proposed Action

Direct and Indirect Effects

Under this action alternative, the stands in proposed Units 7 and 8 would receive a commercial thinning without regard to the disease (thinning both the infected and uninfected acres in the stands).

This alternative will not treat any of the infected acres. No attempt will be made to reduce the spread and level of infection and the loss of tree growth due to tree death or poor tree vigor caused by the root rot disease. This alternative will do nothing to prevent the loss of productive acres that would produce future late-successional forest.

The thinning would capture an estimated 95,000 board feet of live wood volume in the currently infected areas of these stands that would die in the future.

This treatment will increase the potential for windthrow around the edges of the current openings created by the disease. Some of the live Douglas-fir trees that immediately surround the current disease openings are infected but show no visible signs of infection. Live, infected trees have a high probability of being windthrown if surrounding trees are cut, because their decayed roots will not support them. It should be assumed that most Douglas-fir within 20 feet of a visibly affected tree will have decayed roots and will be windthrown if the stand is thinned (Hadfield 1985).

Windthrow of any infected trees can be beneficial because the volume of laminated root rot inoculum in the soil will be reduced as roots are pulled out of the ground. The benefit from this would probably not be substantial and would be unlikely to make a significant positive impact on the spread of the fungus through these stands.

Cumulative Effects

The acres currently infected in the two young stands will continue to increase and over time continue to reduce site productivity on those acres.

In the next 25 years the current level of infection will increase, as will the size of the infection centers (with infection centers that are currently near each other coalescing into larger infection centers).

The stand in which proposed Unit 7 is located would see its infection increase to approximately 17 acres or 51% of the stand's acreage. The stand's 20 infection centers will have coalesced into 7 infection centers ranging in size from approximately 0.4 acre to 7.8 acres. The 17 acres of infection represents acres that will not be capable of developing into late-successional forest.

The stand in which proposed Unit 8 is located would see its infection increase to approximately 22 acres or 37% of the stand's acreage. The stand's 35 infection centers will have coalesced into 16 infection centers ranging in size from approximately 0.2 acre to 7.5 acres. The 22 acres of infection represents acres that will not be capable of developing into late-successional forest.

The result of the continuing spread of the infection and expansion of the infection centers will be a serious decrease in conifer canopy closure and a loss of wood volume as overstory trees die. In 25 years it is estimated that approximately 11.3 acres (34 %) of the stand in Unit 7 will have a conifer canopy closure of less than 5% and a loss in wood volume of approximately 176,000 board feet. In Unit 8 it is estimated that approximately 14.4 acres (24%) will have a conifer canopy closure of less than 5% and a loss in wood volume of approximately 217,000 board feet. On a combined basis, there will be approximately 25.7 acres (or 28% of the total 93 acres in these two stands) with a conifer canopy closure of less than 5% and a loss in wood volume of approximately 393,000 board feet.

As laminated root rot continues to spread through these stands, live, infected trees will eventually succumb to windthrow. Because the canopy in the uninfected portions of these stands will be opened up by thinning, but the current openings will not be expanded with a regeneration treatment, the potential for a serious windthrow event under this alternative is estimated to be moderate.

In the event of a serious windthrow event the potential for an outbreak of Douglas-fir bark beetles increases. If significant windthrow should occur, a salvage harvest might be needed to prevent or lessen the severity of an outbreak.

As infection centers continue to expand and trees die, the resulting canopy openings will continue to become occupied by some level of shrub and herb species, hardwood tree species and Douglas-fir seedlings (which will eventually become infected and die before getting very big). Over time (up to 40 or 50 years) the inoculum in the infection centers will decrease as the fungus devours available Douglas-fir roots and dies out due to lack of

a food source. But as the disease continues to spread unchecked, it will be continue to produce additional inoculum in these stands.

Alternative 4 – Managed Stands

Direct and Indirect Effects

The effects are the same as those discussed in Alternative 2.

Cumulative Effects

The effects are the same as those discussed in Alternative 2. Table 4.2.3 provides a summary of project effects in laminated root-rot infected stands, by alternative.

Table 4.2.3. Comparison of Cowlitz Thin project effects in laminated root rot-infected stands, by alternative.

Alternative No.	Acres of Root Rot Treated	Wood Volume Loss to Disease over the next 25 years	Total Acres of Infection in 25 more years	Risk of Significant Windthrow
1	0	488 MBF	39	Low-Moderate
2	25.7	0 MBF	25.7	Moderate-High
3	0	393 MBF	39	Moderate
4	25.7	0 MBF	25.7	Moderate-High

Harvest of Mature and Naturally Regenerated Stands

As discussed in Chapter 2, several units proposed for thinning under the proposed action are mature stands, regenerated following wildfires during the late 1880's. Several members of the public expressed concern regarding the harvest of mature stands, and are in general, opposed. Other members of the public are supportive. This issue is complicated in that it reflects a social issue that expresses personal beliefs and values related to the preservation of older, mature stands that appear to be developing late-successional or old growth characteristics. This issue also has a biological and ecological basis that is explored in depth in this chapter under the wildlife section, which includes discussion and analysis regarding potential effects to suitable owl habitat.

To address this issue, many stands and acres were dropped from consideration, including those with the highest quality late-successional habitat, and in particular, high quality spotted owl habitat. The original proposed action contained nearly 1680 acres, approximately 1190 acres of which were mature stands. Several units were dropped; the prevailing factor for the dropping of mature stands was the presence of high quality habitat. The resulting proposed action considered the thinning of a total nearing 1200 acres, approximately 770 acres of which were mature stands.

The final proposed action presented in this analysis was designed to further protect late-successional and old-growth legacy features and would treat 615 acres of 760 acres (untreated acres are in no-cut stream buffers), untreated acres representing no-cut

portions of riparian reserves. 379 of 483 acres of mature stands, and 236 of 280 acres of younger, managed stands would be treated under the proposed action. All but one (Unit 9) of the mature stands within the proposal have been managed in the past, but are often referred to within this document as "natural" stands because they were naturally regenerated. Table 4.2.4 displays original units and their sizes, and reasons for modifying or dropping them.

In addition to adjusting total acres treated throughout the analysis process, a separate alternative was considered and analyzed that only treats young, managed stands. Alternative 3 presents an alternative that maximizes the retention of late-successional features and high-quality, suitable spotted owl habitat by placing 30% of the stand in skips. See the description of alternatives in Chapter 2 and Section 4.4, Wildlife. In summary, natural and young, managed stands would receive skips; the percentage of area in skips varies depending on the alternative. Gaps and individual tree "culturing" would be implemented in young, managed stands.

Table 4.2.5 displays current acres and whether a stand is considered mature (natural) or managed (younger, plantation). Alternative 2 and 3 would manage a total of 760 acres, 483 of which are mature, naturally regenerated stands. 465 acres of the natural stands have been managed in the past. Table 4.2.5 provides a history of stand treatments. Unit 9 is a mature, naturally regenerated stand that has never been managed or has had an intermediate entry. Alternative 4 would harvest a total of 280 acres, none of which are mature stands.

Alternative 3 would retain more legacy features, late-successional and spotted owl habitat than Alternative 2 through the addition of skips that would selectively provide protection to these features on 30% of the area of each unit. Careful selection and placement of skips would maximize the protection of late-successional habitat. Alternative 2 would provide 15% skip coverage, which would also be placed to maximize protection of features, but would offer less protection than in Alternative 3. Alternative 4 would not manage any mature stands.

Table 4.2.4. Units and acres modified or dropped from consideration and primary reasons for change. Starting acres October, 2006; final acres considered in this EA.

Unit	Starting acres	Final Acres Alternatives 2 and 3	Final Acres Alternative 4	Reason for modification
1	29	0	0	Heritage, aquatic/floodplain
2	48	0	0	Aquatic/floodplain and flood damage
3	36	9	9	Aquatic/riparian
4	70	38	38	Aquatic, riparian and soils
5	47	19	19	Aquatic, riparian and soils
6	242	177	0	Spotted owl/critical habitat/legacy features
7	35	33	33	Mapping clarification
8	62	60	60	Mapping clarification
9	13	18	0	Mapping clarification
10	22	0	0	High quality owl habitat, LSR>120 years
11	15	0	0	High quality owl habitat, LSR>120 years
12	94	0	0	Logging systems/legacy features
13	38	0	0	High quality owl habitat, LSR>80 years
14	161	103	0	Spotted owl/critical habitat/legacy features
15	13	9	9	Riparian/aquatic
16	150	129	0	Spotted owl/critical habitat/legacy features
17	102	56	0	Spotted owl/critical habitat/legacy features
18	39	0	0	Spotted owl/critical habitat
19	12	7	7	Mapping clarification
20	54	54	54	
21	18	0	0	High quality owl habitat, LSR>80 years
22	74	0	0	High quality owl habitat, LSR>80 years
23	26	0	0	Aquatic/riparian
24	68	0	0	Spotted owl/critical habitat/legacy features
25	18	17	17	Mapping clarifications
26	39	31	31	Aquatic/riparian
30	15	0	0	Spotted owl/critical habitat/legacy features
31	71	0	0	High quality owl habitat
32	10	0	0	High quality owl habitat
33	18	0	0	High quality owl habitat
Total	**1674**	**760**	**277**	

Table 4.2.5. Summary of stand age and whether mature or young (natural vs. managed. Alternatives 2 and 3 include the sum of mature and managed, Alternative 4 includes the sum of managed (young plantations) only.

Unit	Age	Acres of mature/natural	Acres of young	Comments
3	42	0	9	Clearcut 1962, BB 1963, planted 1964, PCT 1977
4	48	0	38	Clearcut 1949, planted 1950, PCT 1977
5	56	0	19	Clearcut 1950, BB 1950, planted 1950/51, No PCT
6	125	177	0	North end: CT 1960, 53 acres CT 1968, 61 acres; south end: CT 1971, 82 acres, CT 1980, 84 acres
7	43	0	33	Clearcut 1962, planted 1963, PCT 1981
8	42	0	60	Clearcut 1963, BB 1963, Planted 1964, PCT 1980, Salvage 2004 (Smoke Salvage T.S.), 7 acres southwest corner
9	112	18	0	No past management activities
14	117	103	0	CT 1967, approx. 25 acres along south boundary of stand, CT 1978, approx. 200 acres that covered most of unit
15	42	0	9	Clearcut 1963, BB 1963, planted 1964, PCT 1987
16	137	129	0	CT 1980, 141 acres; Salvage, 35 acres in northeast corner
17	137	56	0	CT 1980, approx. 90 acres (including all of unit); Salvage 1985, approx. 10 acres on east tip of current unit
19	48	0	7	Clearcut 1956, BB 1957, naturally seeded documented 1958, PCT 1977
20	53	0	54	Clearcut 1950, BB 1951, Morris Fire Plots installed 1952, planted 1953, PCT 1978, bough ale 1984
25	54	0	17	Clearcut 1950, BB 1952, Planted 1954, PCT 1981.
26	47	0	31	Clearcut 1958, BB 1959, planted and natural seeding documented 1959, PCT 1981
Total		**483**	**277**	

4.4 Wildlife

The following section details the environmental effects of the proposed Cowlitz Thin project to the wildlife resource.

Northern spotted owl and Critical Habitat Unit WA-36

Four of the proposed Cowlitz Thin sale units (6, 14, 16 and 17) are classified as suitable spotted owl habitat, and three of these (6, 16, and 17) occur, entirely or partially, within the potential home ranges (i.e. 1.82 mile radius circle) of an historic spotted owl pair activity center. There are four other historic spotted owl pairs that contain proposed sale units- all classified as non-suitable, dispersal habitat - within their potential home ranges. Due to the lack of recent owl surveys to established protocol standards, other, presently unknown, pairs may exist as well. In addition, ten proposed sale units are entirely or partially within designated spotted owl Critical Habitat Unit WA-36, including three of the four units that are classified as suitable spotted owl habitat. Harvest of suitable spotted owl habitat units have the potential to degrade habitat conditions for individual owl pairs, and/or impact the quantity and quality of constituent habitat elements within CHU WA-36. This would occur through the destruction or breakage of habitat features such as snags, coarse woody debris (i.e. down trees), as well reducing canopy closure and altering forest understory species composition and abundance. Conversely, harvest of some managed stand units, and natural stand unit 9, which are presently classified as spotted owl dispersal habitat, may result in long-term improvement of habitat conditions for northern spotted owls, and increase the levels of constituent elements within forest stands in spotted owl Critical Habitat.

Barred owls, which compete with spotted owls for prey and territories, are also present in the sale area, and may be impacted- positively or negatively- from commercial thinning, which will ultimately affect northern spotted owls.

Environmental Consequences

Table 4.4.1 provides the total acres of suitable spotted owl habitat and designated northern spotted owl Critical Habitat treated (thinned) for the Cowlitz Thin timber sale alternatives for comparison.

Alternative 1 (No Action)

Under this alternative, no commercial thinning or other project activities will occur in the sale area. As mentioned above, five historic spotted owl pairs occur within or adjacent to the sale area, as well as an unknown number of barred owl pairs. In natural stands presently classified as suitable spotted owl “foraging” habitat, natural succession will proceed, and these sites will gradually develop into spotted owl “nesting and roosting” habitat over the next 100 years or so, as trees increase in size and snags and down trees become more numerous. Scattered canopy gaps will be present, the result of laminated root rot pockets, disease or other factors. Within these gaps, understory shrubs such as salal and Oregon-grape will predominate, although these will be absent, or reduced to scattered clumps, in denser, closed-canopied areas. Over time, it is anticipated that the total amount of salal and Oregon-grape will decrease in these stands as stand shade levels increase.

In managed stands originating from timber harvest, trees will gradually increase in size and levels of snags and down wood will slowly increase due to competitive mortality, as well as from scattered laminated root rot centers and other factors such as windthrow.

Table 4.4.1. Summary of acres of suitable spotted owl habitat and designated northern spotted owl Critical Habitat treated (thinned) for the Cowlitz Thin timber sale alternatives.

Alternative	Total acres of suitable spotted owl habitat temporarily degraded	Acres of suitable spotted owl habitat temporarily degraded within Critical Habitat Unit WA-36	Acres of spotted owl (non-suitable) dispersal habitat temporarily degraded within Critical Habitat Unit WA-36
1 (No Action)	0	0	0
2 (Proposed Action)	364	176	194*
3 (Modified Proposed Action)	298	146	194*
4 (Managed Stands Only)	0	0	179*

*Does not include 39 acres in laminated root rot patches in units 7 and 8 which are proposed for regeneration harvest in alternatives 2 and 4, and thinning in alternative 3. These acres are considered degraded in their present condition, and therefore are not included in the column figures above.

Eventually, these stands will succeed to suitable spotted owl "foraging" habitat in approximately 50-100 years. The proposed managed stand units, which are currently classified as (non-suitable) spotted owl dispersal habitat- which are used by dispersing, juvenile spotted owls following the nesting season- will continue to serve this function without interruption until they succeed to a suitable habitat condition.

No project-related disturbance to spotted owls will occur from this alternative. Ambient disturbance from motorized equipment and vehicles will continue in the sale area at low-to-moderate levels, with occasional concentrated disturbance at (legal and illegal) firewood cutting locations, off-road vehicle use areas, and other sites where motorized use occurs. Due to the lack of project activities and associated noise disturbance, Alternative 1 would result in a Biological Assessment determination of *"no effect"* to the northern spotted owl, and *"no effect"* to designated spotted owl Critical Habitat Unit WA-36.

Indirect and Cumulative effects

There are no known indirect or cumulative effects from the implementation of alternative 1 (No Action).

Alternative 2 (Proposed Action)

This alternative would result in 364 acres of presently suitable, spotted owl "foraging" habitat temporarily degraded, which is the most of the three action alternatives. A total of 176 of these acres occur within the boundary of designated spotted owl Critical Habitat Unit WA-36, within proposed natural stand units 6, 16, and 17. A total of 15% of the total unit acres within these stands would be placed in no-thin "skips", which would eliminate short-term degradation of some (but not all) patches of higher quality owl habitat. These "skips" would be placed at sites with concentrations of legacy features such as live, old-growth trees; old-growth snags; and/or patches of large, down trees (see Figure 4.4.1). The "skips" also occur at sites with a more closed canopy (i.e. approximately 80% or greater), with scattered understory shrubs and forbs, which are more likely more valuable to foraging spotted owls (Irwin and Rock 2000). Outside of the "skips", thinning would occur at a variable spacing, with post-sale snag and down wood created to mitigate logging-related losses or breakage of existing snags and down trees/logs (see Mitigation Measures). Thinning would result in short-term reductions of canopy closure, estimated at 14-47 years (average 30 years, based on DFSIM stand modeling projections), resulting in a post-thinning canopy closure range of approximately 60-75%, depending on the stand.

Figure 4.4.1. Closed forest canopy patch (potential "skip") within proposed natural stand unit 6, with legacy, old-growth snag.

Thinning would stimulate the existing forest understory vegetation, which in the case of the suitable habitat units 6, 16 and 17 is predominately salal and Oregon-grape (see Figure 4.4.2). This will result in a denser layer of these shrubs, or at least a longer period of their persistence within portions of the stand. This may make it more difficult for

spotted owls to procure small mammal prey items in these areas, at least until the forest canopy closes again and the shrubs are reduced in abundance from shading. Other negative, short-term effects from thinning include mechanical destruction of existing understory vegetation, as well as mechanical destruction, and loss of host trees, for below-ground fungi. There is also the potential for introduction of non-native plants, which may persist for many years following thinning (Chan et al. 2006), although this would be mitigated with post-sale weed reduction measures.

Included in alternative 2 are the construction of 3.3 miles of temporary road, scheduled to be closed following the project, and the construction of approximately seven acres of landings, five of which occur in the proposed natural stand units. Although these landings are scheduled for scarification and revegetation (see Mitigation Measures), they are considered to be a small, direct loss of suitable habitat compared to the degraded thinning acres, due to the much longer period of time it will take for them to return to a mature forest (i.e. suitable owl habitat) condition.

In managed stands, and natural stand unit 9, a total 194 acres of spotted owl dispersal (non-suitable) habitat will be temporarily degraded by decreasing canopy closure, as well as expected losses of some snags and pieces of down wood. In these stands, thinning is expected to increase tree growth, and accelerate their development towards suitable spotted owl habitat over the long-term. Understory vegetation, presently at low levels in most of these stands except for some stands such as units 9, 20, and 26, would be stimulated in thinned areas. This would benefit spotted owls over the long-term, except where salal and Oregon-grape are the predominant species. Canopy closure following thinning would be relatively rapid, estimated at 7-32 years (average 16 years, based on DFSIM stand modeling projections). The number of snags and pieces of down wood would be increased from the existing condition in these stands due to post-sale snag and down wood creation projects; all of these stands have presently low levels of these habitat features due to past management practices. The exceptions are units 7 and 8, which have higher snag and down wood levels due to patches of laminated root rot infection. Existing patches of down trees (often “cull logs” left from the logging that created these stands) would be protected with scattered leave trees and “skips” where feasible and wide-thin “gaps” would be included to enhance stand heterogeneity. Overall, the thinning of these managed, spotted owl dispersal habitat stands is expected to result in long-term improvement in stand habitat conditions, and acceleration of suitable spotted owl habitat development both inside and outside of CHU WA-36.

There would be the potential for increased disturbance to nesting spotted owls from this alternative, which will be partially mitigated through Limited Operating Period restrictions (see Mitigation Measures). Noise disturbance would occur from the thinning itself, as well as some post-sale project such as snag and down wood creation, and pre-commercial thinning.

As previously mentioned, barred owls occur in the sale planning area, and have increased in abundance on the Cowlitz Valley Ranger District (Pearson and Livezey, 2003). Barred owls favor the same mature forest habitats as spotted owls, and there is the potential that commercial thinning could enhance habitat conditions for barred owls over the long-term at the expense of northern spotted owls, particularly in the managed, dispersal habitat stands, and within the home ranges of existing barred owl pairs. Accurate predictions regarding the exact long-term effects of commercial thinning relating to barred owl/spotted owl competition are not possible, particularly with limited survey data for

barred owl (and spotted owl) pair centers and reproductive history. However, the assumption that effects from thinning would benefit only spotted owls may not be true considering barred owl competition. If barred owls are benefited from thinning, the result could be greater long-term competitive pressure on spotted owls in this area. This applies to alternative 2, as well as the other two action alternatives.

Although short-term degradation of suitable spotted owl habitat would occur within the potential home range of one historic spotted owl pair, this pair is not presently below established habitat threshold guidelines (i.e. 500 acres with 0.7 miles of the pair center, and 2663 within 1.82 miles), and therefore there would be a small, negative effect to the owl pair. There are no proposed, suitable habitat units within the 0.7 mile radius circle from pair center, where most foraging activity occurs. The remaining stands are not classified as suitable spotted owl habitat, and therefore thinning would not directly impact the additional four owl pairs in the planning area. There is the potential that unknown spotted owl pairs do exist in and adjacent to the timber sale area, however this area contains large patches of suitable owl (foraging) habitat and it is unlikely that an unknown pair would be reduced below the above threshold limits by this alternative. The determination in a Biological Assessment would be that alternative 2 *"may affect, but is not likely to adversely affect"* the northern spotted owl.

Due to the short-term degradation of at least some patches of high quality, suitable spotted owl habitat not included in the 15% "skips" in natural stands under this alternative, and the lower levels of snag and down wood creation following the sale compared to alternative 3, there would be an adverse impact to constituent habitat elements within Critical Habitat Unit WA-36 from alternative 2. In addition, the stimulation of the existing salal and Oregon-grape understory, particularly in the higher quality patches of suitable owl habitat not included in the above "skips", would likely make it more difficult for spotted owls to forage for prey for several decades until the pre-treatment canopy closure condition is restored. There would be a small, direct loss of habitat from the construction of five acres of landings in the natural stands, some of which are in designated Critical Habitat. There would be a positive net benefit to CHU WA-36 from thinning in the managed stands over the long-term, as described above. The determination is that alternative 2 "*may affect, and is likely to adversely affect"* northern spotted owl designated Critical Habitat Unit WA-36.

Alternative 3 (Modified Proposed Action)

A total of 298 acres of suitable spotted owl (foraging) habitat would be temporarily degraded under this alternative, or a reduction of 66 acres from alternative 2, due to an increase of no-thin "skips" to 30% of the natural stand unit acres. In addition, there would be increased levels of snag and down wood creation under alternative 3 following the sale compared to alternatives 2 and 3 (see Mitigation Measures). This would serve to protect all, or at least the majority, of the higher quality patches of suitable owl habitat, based on field evaluations by the District wildlife biologist. As per alternative 2, understory plants such as salal and Oregon-grape would be stimulated in thinned areas, resulting in a denser shrub layer that may make it more difficult for spotted owls to effectively forage for small mammal prey (North et al. 1999). The longevity of this denser shrub layer is unknown, but will likely last for several decades until stand canopy closure returns to pre-treatment levels. Shrubs will persist longer in scattered canopy gaps resulting from laminated root rot, windthrow or other natural factors. Other negative, short-term effects from thinning such as the potential for introduction of non-native vegetation and

mechanical destruction of below-ground fungi, would be reduced under alternative 3 compared to alternative 2, due to the retention of more acres of high quality habitat in the no-thin “skips”, and also the subsequent fewer total acres thinned in the suitable habitat units.

Effects from thinning the managed stands, and natural stand unit 9, are the same as under alterantive 2, except that post-sale down wood creation levels would be increased in units 5, 7, 8, 19, 25 and 25. This would provide increased benefits to spotted owl habitat over the short- and long-terms. In units 7 and 8, which contain scattered laminated root rot patches, which are presently degraded from an owl dispersal habitat standpoint, the root rot pockets would be thinned (instead of regeneration harvested under alternatives 2 and 4), which will retain more down wood and snags in these areas. However, thinning will not slow down or deter the spread of the root rot, which will continue to expand slowly into the surrounding, uninfected areas. The end result of this situation is unknown,

Figure 4.4.2. Canopy gap, proposed natural stand unit 6, with dense salal shrub layer.

although it is possible that the root rot will eventually spread throughout these two stands, and result in a degraded habitat situation that would persist for many decades. It is also possible that a stabilization point will be reached naturally that will deter or stop the spread of the root rot fungus.

Included in alternative 3 are the construction of 3.3 miles of temporary road, scheduled to be closed following the project, and the construction of approximately seven acres of landings, five of which occur in the natural stands. Although these landings are scheduled for scarification and revegetation (see Mitigation Measures), they are considered a small, direct loss of suitable habitat compared to the thinned acres, due to the much longer period of time it will take for them to return to a mature forest (i.e. suitable owl habitat) condition.

Similar to Alternative 2 above, there would be the potential for noise disturbance to nesting spotted owls during the nesting season from this alternative, which will be partially mitigated through Limited Operating Period restrictions (see Mitigation Measures). Noise disturbance would occur from the thinning itself, as well as some post-sale project such as snag and down wood creation, and pre-commercial thinning.

Per Alternative 2, the impacts to the historic spotted owl pair that contains natural stand, suitable habitat units within its potential home range would be relatively low, and the determination in a Biological Assessment would likewise be "may affect, but not likely to adversely affect" to the northern spotted owl. The 146 acres of natural stands temporarily degraded under alternative 3 would not contain the highest quality, suitable owl habitat patches as a result of increased no-thin "skip" levels to 30% The increased snag and down wood post-sale creation levels would provide additional mitigation of habitat impacts, and provide enhanced, long-term owl habitat. The small (less than five acres), direct loss of suitable habitat within the CHU from landing construction would be ameliorated by the above total increase of habitat capability, and retention of existing habitat features. The determination would be that alternative 3 "may affect, but is not likely to adversely affect" designated spotted owl Critical Habitat Unit WA-36, due to the small and discountable adverse effects to constituent habitat elements within the CHU.

Alternative 4 (Managed Stands Only)

Impacts from this alternative would be slightly less than displayed under the managed stand discussion in alternative 2. Due to the elimination of natural stand unit 9 under this alternative, there would be a 15 acre reduction in the amount of (non-suitable) spotted owl dispersal habitat temporarily degraded within CHU WA-36. Again, the effects of the reduction in stand canopy closure would be short-term in nature, with long-term benefits anticipated from increased tree growth, encouragement of variable spacing and heterogeneity due to the use of "skips" and "gaps" within the units, and the stimulation of forest understory layering.

With the elimination of the natural stands under this alternative, there would be no short-term degradation of suitable spotted owl habitat under this alternative in units 6, 14, 16 and 17. Long-term effects to these stands would be the same as displayed in the alternative 1 (No Action) discussion.

Also included in alternative 4 are the construction of one mile of temporary road, scheduled to be closed following the project, and the construction of approximately 2.4 acres of landings. Although these landings are scheduled for scarification and revegetation after the sale (see Mitigation Measures), they are considered to be a small, direct loss of owl dispersal habitat compared to the thinned acres, due to the much longer period of time it will take for them to return to a mature forest condition.

Similar to alternatives 2 and 3 above, there would be the potential for noise disturbance to nesting spotted owls during the nesting season from this alternative, which will be partially mitigated through Limited Operating Period restrictions (see Mitigation Measures). The LOP restrictions would apply to units adjacent to suitable spotted owl nesting habitat. Noise disturbance would occur from the thinning itself, as well as some post-sale project such as snag and down wood creation, and pre-commercial thinning. There would be reduced, total noise disturbance under this alternative due to the fewer project acres, as a result of the elimination of the natural stand units.

There would be no direct habitat effects to historic spotted owl pairs under this alternative, as no presently suitable spotted owl habitat would be impacted. Due to the potential for some limited noise disturbance during the late-nesting season (i.e. following June 30, the ending date for the spotted owl noise LOP), the determination in a Biological Assessment would be that this alternative ***"may affect, but is not likely to adversely affect"*** the northern spotted owl.

The 179 acres of spotted owl dispersal habitat temporarily degraded would have small and discountable effects within spotted owl Critical Habitat Unit WA-36. There would be some short-term reduction in dispersal habitat quality, although owl dispersal habitat is not limiting in this area. Long-term habitat benefits are anticipated, as displayed above, due to increased tree growth, stand layering, habitat feature creation (snags and down wood), and habitat heterogeneity. The determination is that alternative 4 "may affect, but is not likely to adversely affect" northern spotted owl CHU WA-36.

Indirect effects

There are no known indirect effects from the implementation of alternatives 2, 3 or 4.

Cumulative effects

Effects from the implementation of alternatives 2, 3, and 4 would be cumulative to those from the planned Pinchot Partners Restoration Thin (PPRT) project, located on the east side of the Cowlitz River in the Packwood Late-Successional Reserve (LSR). The goal of the PPRT project, estimated at 1600 acres in size, is long-term restoration of forest habitat from thinning in managed stands, similar to the managed (dispersal) stands proposed in the above Cowlitz Thin action alternatives. Long-term benefits from the PPRT are anticipated, with relatively small, short-term adverse effects resulting form a decrease in canopy closure, and loss/breakage of some existing snags and down trees and logs not protected in skips or by leave trees. There would be some additional, cumulative noise disturbance impacts within the watershed, although these would be mitigated with the Limited Operating Period spotted owl restrictions, and widely scattered on a spatial scale. The cumulative impact of the two commercial thinning sales would not substantially change the above determinations or effects, and overall, cumulative effects would be beneficial to spotted owl habitat due to the nature of the PPRT project, and projected long-term habitat benefits. Table 4.4.2 displays a synopsis of the Biological Assessment effects determinations by alternative for the northern spotted owl, and northern spotted owl Critical Habitat Unit WA-36, for the Cowlitz Thin timber sale alternatives.

Deer and elk winter range habitat

Affected Environment

A total of twelve proposed sale units (3, 4, 5, 6, 7, 8, 9, 14, 15, 16, 17, and 19) occur within biological deer and elk winter range, which extends to approximately 2400 feet in elevation. Similar to the northern spotted owl, thinning has the potential to adversely affect deer and elk habitat in some areas, and potentially benefit them in others. At present, there is an abundance of thermal cover for big game in the sale area and surrounding watershed, but a steadily decreasing amount of available forage on National Forest lands. Mature and late-successional stands at lower elevations typically contain a

dense understory of salal (*Gaultheria shallon*) and Oregon-grape (*Berberis aquafolium*), both of which are poor quality forage for the most of the year. Some palatable browse species also occur such as huckleberry (*Vaccinium* spp.), vine-maple (*Acer circinatum*), wild rose (*Rosa gymnocarpa*) and swordfern (*Polystichum munitum*), but these tend to be scattered except in higher-elevation stands such as unit 20. Effects from thinning include reduction in stand canopy closure, alteration of stand microclimate, accelerated tree growth, and stimulation of understory vegetation. In addition, there are potential short-term effects associated with disturbance and displacement of big game from the project area.

Environmental Consequences

Alternative 1 (No Action)

This alternative would perpetuate the existing condition for deer and elk in the sale area. In managed stands, which typically provide some thermal and escape cover for big game but very limited amounts of forage, the existing condition would continue until these stands gradually succeed towards a mature/late-successional condition over several decades. These stands would eventually supply some forage, the quality of which would depend on the particular site, as well as supply optimal cover, which is utilized by deer and elk during severe winter weather conditions. Natural stands, which presently provide higher quality thermal and optimal cover for deer and elk would slowly succeed towards a late-successional/old-growth condition. These stands have some dense patches of understory vegetation in scattered canopy gaps (see Figure 4.4.2) however most of this consists of salal and Oregon-grape, which are considered poor quality forage for big game.

Table 4.4.2. Synopsis of Biological Assessment effects determinations by alternative for the northern spotted owl, and northern spotted owl Critical Habitat Unit WA-36, for the Cowlitz Thin timber sale alternatives.

Alternative #	Northern spotted owl determination	Critical Habitat Unit WA-36 determination
1 (No Action)	**No effect**	**No effect**
2 (Proposed Action)	**NLLA**	**LAA**
3 (Modified Proposed Action)	**NLLA**	**NLLA**
4 (Managed Stands Only)	**NLLA**	**NLLA**

NLLA = “may affect, not likely to adversely affect”
LAA = “may affect, likely to adversely affect”

No project-related disturbance would occur to deer and elk under this alternative. Existing winter range gate closures would continue at Forest Road 5290, with other roads closed periodically during periods of deep snow or other weather events. There would be no increase to ambient noise generated by vehicles, chainsaws, or other motorized equipment from this alternative.

There are no indirect effects from alternative 1, nor would there be any cumulative effects.

Alternative 2 (Proposed Action)

Under alternative 2, both managed and natural stands would be thinned, with 15% of the unit acres placed in no-thin "skips" (see Table 4.4.3). As per all action alternatives, the 110 acres of thinning in the managed stands is expected to have a long-term benefit to deer and elk within winter range, with relatively small, short-term, adverse effects. Thinning will temporarily decrease tree canopy closure in these stands, making them less valuable as thermal cover in the short-term (i.e. approximately 16 years). However, the tree canopy will close in relatively quickly, and the stand's subsequent value as thermal cover would be restored and enhanced due to the development of trees with larger limbs and crowns that are capable of intercepting large quantities of snow.

These managed stands are all surrounded by large patches of thermal cover that can serve as "displacement habitat" for big game during periods of harsher winter weather, so short-term adverse effects from thinning would be small. The commercial thinning will also stimulate understory production in these stands, resulting in increased forage for big game, the value of which would depend on the particular site. Sites that produce an understory consisting of salal and Oregon-grape would provide limited forage benefits compared to sites with more palatable browse species such as huckleberry and vine-maple, such as unit 20. Although the benefits of thinning in the managed stands would vary by location, there would be a net, long-term benefit to deer and elk from commercial thinning in the managed stand units.

Table 4.4.3. Comparison of acres treated by alternative in biological deer and elk winter range (BWR).

Alternative #	Acres of managed stands treated (thinned) in BWR	Acres of natural stands treated (thinned) in BWR
1 (No Action)	0	0
2 (Proposed Action)	110	379
3 (Modified Proposed Action)	144*	271
4 (Managed Stands Only)	110	0

* includes thinning of laminated root rot patchess in units 7 and 8. These root rot patches would be regeneration harvested under alternatives 2 and 3.

In the natural stands within deer and elk winter range (units 6, 9, 14, 16, and 17), the benefits of thinning are less clear. In alternative 2, a total of 15% of these units would be placed in no-thin "skips", which would retain some patches of higher quality thermal cover for deer and elk (see Figure 4.4.1). In these "skips", tree canopy closure would remain high, reducing understory snow accumulations. Thinning would reduce canopy closure over the rest of these stands, decreasing their effectiveness as thermal cover in the short-term. The benefits of thinning in these natural stands are limited from a forage production standpoint, as the predominant understory species are salal and Oregon-grape, which are low quality forage species and unpalatable during most of the year. Therefore, the main benefits of these stands will continue to be as thermal cover, although scattered, palatable browse species such as wild rose, huckleberry and vine-maple are also present at low levels. Thinning is not expected to substantially increase the quality of thermal cover in these natural stands over the long-term. Again, large patches of "displacement habitat" occur near the proposed, natural stand units, which can serve as cover until canopy closure increases in approximately 30 years. The overall effects from thinning the 379 acres of natural stands under alternative 2 are considered to be neutral to winter range habitat over the long-term, with some short-term, negative effects anticipated.

Alternative 3 (Modified Proposed Action)

The effects of thinning managed stands in deer and elk winter range are very similar to alternative 2 above, with the exception that 34 acres infected with laminated root rot in units 7 and 8 would be thinned instead of regeneration harvested. Due to the presence of root fungus, it will be many decades before these root rot patches become thermal cover; in the meantime, they are providing some limited forage. Again, most of this forage is salal and Oregon-grape, so any actual benefits would be minimal. From a big game perspective, there would be fewer long-term benefits from thinning these patches than attempting to control the root rot through regeneration harvest, per alternatives 2 and 4. Under alternative 3, the root rot would likely continue to spread and degrade some or all of the adjacent forest stands, although the amount of this degradation over the long-term is not known, and it is possible that a natural stabilization point would be reached where spread stops or is greatly reduced. As per alternative 2, there would be an overall, long-term benefit to deer and elk from thinning the managed stand units.
Under this alternative, the total acres in no-thin "skips" increases to 30% in natural stands, so more and larger patches of quality thermal cover would remain untreated. This would reduce short-term, adverse affects from thinning such as decreased canopy closure and increased snow depths. Again, in the thinned areas, the salal and Oregon-grape understory would be stimulated, which would not provide any substantial benefits to deer and elk winter range habitat. In some cases, increased ambient light from commercial thinning could produce a very dense salal understory, which may occasionally present a movement barrier to big game. Alternative 3 would have fewer, short-term adverse effects than alternative 2, with the long-term effects still considered to be neutral overall, with some short-term, negative effects expected.

Alternative 4 (Managed stands only)

The effects of this alternative are the same as those displayed under alternative 2 for managed stands. Some short-term, adverse impacts are anticipated due to the increase in

canopy closure, with long-term, beneficial effects anticipated from the increase in tree crown and limb size, along with an increase in understory production. The forage benefits to big game would vary by site, depending on the forb and shrub species that appear.

Under all three action alternatives, potential disturbance to deer and elk winter range from harvest activities and post-sale projects such as snag and down wood creation would be mitigated with a Limited Operating Period restriction, which would eliminate disturbance during the December to April period (see Mitigation Measures). This restriction would only be lifted if mild winter weather conditions occur, and then only at one location at a time. Existing winter range gate closures on Forest Road 5290 would remain in place, with no waivers provided for units 3, 14, and 15.

Indirect effects from alternative 2, 3 and 4

There are no known indirect effects from the implementation of the three action alternatives 2, 3, and 4.

Cumulative effects from alternatives 2, 3 and 4

The implementation of alternatives 2, 3 and 4 would be cumulative to the Pinchot Partners Restoration Thin (PPRT) sale currently being planned on the east side of the Cowlitz River, in the Packwood Late-Successional Reserve (LSR). That project is confined to managed stands (former clearcuts), some of which are located in deer and elk winter range, and is designed to restore and enhance habitat in the LSR and adjacent areas. It is anticipated that any cumulative effects to those presented above for alternatives 2, 3 or 4 would be small and discountable, and that the PPRT would enhance habitat conditions in deer and elk winter range over the long-term. There would be some additional, cumulative noise disturbance impacts within the watershed, although these would be mitigated with the Limited Operating Period winter timing restriction (December 1 to April 1) and widely scattered on a spatial scale. Outside of the winter range LOP dates, cumulative disturbance would result in some temporary displacement of deer and elk from the immediate project sites (units), although animals would return soon after disturbance ends, and no long-term disturbance-related effects are anticipated.

Proposed, Endangered, and Threatened Wildlife Species

Affected Environment

Proposed, Endangered and Threatened (PET) species that occur, or potentially occur, in the project area include the northern spotted owl, northern bald eagle, marbled murrelet, and the gray wolf (Table 4.4.4) One or more proposed sale units also occur within designated northern spotted owl Critical Habitat and marbled murrelet Critical Habitat. The wide-ranging grizzly bear has not been documented on the Gifford Pinchot National Forest, and if present it would be expected in remote wilderness or roadless areas, and therefore is not suspected to occur in the Cowlitz Thin project area.

Table 4.4.4. Threatened and Endangered species and designated Critical Habitats known or suspected to occur within the Cowlitz Thin planning area.

Species/Critical Habitats	Status	Comments
Gray wolf (*Canis lupus*)	ENDANGERED; Suspected	May prey on deer and elk within sale area, especially in winter. Some unconfirmed, historic sighting reports of this species in and adjacent to the sale area.
Northern spotted owl (*Strix occidenatalis caurina*)	THREATENED; Documented	Five historic pairs within planning area.
Marbled murrelet (*Brachyramphus marmoratus*)	THREATENED; Suspected	Status uncertain due to paucity of survey data, although planning area is at edge of range (i.e. 55 miles from saltwater).
Northern bald eagle (*Halieetus leucocephalus leucocephalus*)	THREATENED: Documented	Nests and winters on Cowlitz River and appears occasionally at Skate Creek.
Northern spotted owl Critical Habitat Unit WA-36	DESIGNATED	
Marbled Murrelet Critical Habitat	DESIGNATED	One proposed unit (#20) occurs within murrelet CH.

Environmental Consequences

The northern spotted owl and spotted owl Critical Habitat Unit WA-36 were addressed under the key issue discussion above, therefore they will not be included in the following evaluation.

Alternative 1 (No action)

There would be no impacts to federally-listed species or designated Critical Habitats under this alternative. Over the long-term, forest stands in the planning area would succeed towards a late-successional or old-growth condition at various rates based on site conditions, stand age, and other factors. Existing noise disturbance would continue throughout the year, including motorized use such as ATV's, snowmobiles, chainsaws, and other sources. This noise disturbance is reduced at sites such a Forest Road 5290, due to the existing winter range gate closures.

Due to the absence of habitat or noise disturbance effects to the gray wolf, northern bald eagle, marbled murrelet, or designated marbled murrelet Critical Habitat Unit WA-11-d,

the determination is that alternative 1 would have "no effect" to the above species or Critical Habitats.

Alternative 2, 3 and 4

Gray wolf. Potential effects to the gray wolf's primary prey species, deer and elk, were evaluated under the winter range key issue discussion. Although there would be some variation in effects among the action alternatives related to deer and elk, no action alternative is expected to result in a measurable, adverse effect to deer and elk numbers.

Noise disturbance from project activities during the winter months-the period where wolf occurrence would be most likely- could adversely impact the gray wolf by causing avoidance of some areas where timber harvest is occurring. This potential for this disturbance is reduced by the deer and elk winter range Limited Operating Period restriction (December 1 to April 1), which could be waived during periods of mild weather conditions at some units. Disturbance outside this period could adversely impact gray wolves by causing temporary avoidance of project sites. The determination is that the three action alternatives 2, 3 and 4 ***"may affect, but are not likely to adversely affect"*** the gray wolf.

Northern bald eagle. The northern bald eagle is a relatively common winter resident, mainly along the forks and main stem of the Cowlitz River, and occasionally at larger streams such as Skate Creek. Only proposed unit 3, which occurs in each action alternative, is located within one-quarter mile of the Cowlitz River and may have the potential to adversely impact the northern bald eagle through noise disturbance. However, this unit has an existing big game winter range Limited Operating Period restriction with no potential waivers (see Mitigation Measures), which is the period when the majority of bald eagles occur in this area. Due to the small potential that noise disturbance outside this period may impact some individual bald eagles along the adjacent Muddy Fork of the Cowlitz River, the determination is that the three action alternatives ***"may affect, but are not likely to adversely affect"*** the northern bald eagle.

Marbled murrelet. Under the above action alternatives, a total of 10 sale units occur entirely or partially within the potential nesting range of the marbled murrelet, defined as 55 miles from the nearest saltwater (i.e. Puget Sound). Of these 10 units, nine are managed stands, and therefore not presently suitable for murrelet nesting due to their small tree sizes and absence of suitable nesting platforms. A small portion of the northern end of natural stand unit 6 (alternatives 2 and 3 only) also occurs within this murrelet nesting range, but no known suitable nesting trees occur at this site, based on field reconnaissance. Therefore, no direct habitat effects to the marbled murrelet are anticipated from any of the action alternatives. Potential noise disturbance during the nesting season is possible to adjacent, suitable nesting habitat at units 4, 8, 9, 19, and 20, and would be mitigated with a Limited Operating Period restriction (see Mitigation Measures). The determination is that all three action alternatives ***"may affect, but are not likely to adversely affect"*** the marbled murrelet.

Marbled murrelet Critical Habitat Unit WA-11-d. Proposed managed stand unit 20 is included in all action alternatives, and is the only unit that occurs within designated marbled murrelet Critical Habitat, which corresponds to the boundaries of the Nisqually Late-successional Reserve under the Northwest Forest Plan. Due to this designation, the thinning prescription for unit 20 was specifically designed to include wide-thin gaps

within the stand, in an effort to provide for maximum accelerated growth for future marbled murrelet nest trees, as well as "daylighting" of individual trees outside gaps. Based on this culturing of future murrelet nest tree, which is expected to produce better marbled murrelet nesting habitat over the long-term in unit 20, the determination is that alternatives 2, 3, and 4 would have a **"beneficial effect"** to designated marbled murrelet Critical Habitat Unit WA-11-d.

Indirect Effects

There are no known indirect effects to the above Federally-listed species from the Cowlitz Thin action alternatives 2, 3 and 4.

Cumulative effects

Effects from the implementation of alternatives 2, 3, and 4 would be cumulative to those from the Pinchot Partners Restoration Thin (PPRT) project, located on the east side of the Cowlitz River in the Packwood Late-Successional Reserve (LSR). The goal of the PPRT project, estimated at 1600 acres in size, is long-term restoration of late-successional forest habitat from thinning in managed stands, similar to the managed stands proposed in the above Cowlitz Thin action alternatives. Long-term benefits from the PPRT are anticipated, with relatively small, short-term adverse effects resulting form a decrease in canopy closure, and loss/breakage of some existing snags and down trees and logs not protected in skips or by leave trees. There would be some additional, cumulative noise disturbance impacts within the watershed, although these would be mitigated with several Limited Operating Period restrictions for winter range, northern spotted owl and marbled murrelet nesting, and would widely scattered on a spatial scale. The cumulative impact of the two commercial thinning sales would not substantially change the above determinations or effects, and overall, cumulative effects from the PPRT would be beneficial the above species due to the nature of the PPRT project, and projected long-term habitat benefits.

Sensitive and "Survey and Manage" Animal Species

Affected Environment

Sensitive animal species (from the April, 2004 update of the Region 6, Regional Forester's Sensitive Species List) that are known or suspected to occur in the Cowlitz Thin sale area and its vicinity, based on a pre-field review of available sighting/survey data and habitat inventories, are displayed in Table 4.4.5, along with overlapping, listed "Survey and Manage" species.

Environmental Consequences

Alternative 1 (No Action)

Due to the absence of ground disturbance or project noise, no sale-related impacts would occur to Sensitive or "Survey and Manage" species under this alternative. Over the long-term under this alternative, habitat for the Sensitive/"Survey and Manage" snail Cryptomastix devia would decline at some locations, as existing bigleaf maple trees- which are essential habitat for this species (Burke et al. 2005)- are over-topped and out-competed by Douglas-fir and western hemlocks in densely-stocked, managed stands. This

species will persist in the sale area within scattered canopy gaps within natural and managed stands that contain bigleaf maples. There will also likely be some future "release" of maple trees in canopy gaps caused by laminated root rot, in both managed and natural forest stands. Effects to other listed mollusks such as the Malone jumping-slug and blue-gray tail-dropper would be negligible, as these species are apparently quite rare in the upper Cowlitz River drainage, and were not detected on project surveys. Under alternative 1, these slugs, if present, would persist due to the lack of disturbance to existing down wood and forest understory vegetation. There would also be no habitat impacts or disturbance to the Larch Mountain salamander from this proposal, and over the long-term habitat for this species would be altered or impacted by fire, landslides, weather, or other natural events and disturbances.

There would be no project-related noise disturbance to the American peregrine falcon or the California wolverine from this alternative, in addition to that from existing sources such as firewood harvest and off-road vehicle use. Existing visual disturbance from special forest harvest harvesters and local recreationists would continue to occur occasionally at a potential peregrine falcon nest site in the sale area.

The Townsend's big-eared bat has been observed roosting under a concrete bridge outside the timber sale planning area, however its occurrence within or adjacent to proposed timber sale units is unknown due to the lack of project-specific bat surveys.

Table 4.4.5. Sensitive and "Survey and Manage" animals species documented (D) or suspected (S) to occur in the Cowlitz Thin planning area.

Species	Status and Occurrence	Comments
Puget Oregonian snail (*Cryptomastix devia*)	SENSITIVE; SURVEY AND MANAGE Present; documented during project surveys	**Bigleaf maples provide suitable habitat for this species, which is widespread on the Cowlitz Valley Ranger District (CVRD)**
Malone jumping-slug (*Hemphillia malonei*)	SENSITIVE; SURVEY AND MANAGE Unlikely to occur; not detected during project surveys	**Very rare species on CVRD (3 known locations), all north of Cowlitz River in the Davis Creek drainage and in the 'Mineral Block'. Coarse woody debris is an important habitat feature for this species.**
Blue-gray tail-dropper (slug) (*Prophysaon coeruleum*)	SENSITIVE; SURVEY AND MANAGE Unlikely to occur; not detected during project surveys	**Very rare species on CVRD (3 known sites), the closest is in the Iron Creek drainage, south of Randle and Highway 12. Habitat is coarse woody debris and deciduous leaf litter. All documented CVRD sites are in classic, old-growth stands with large deciduous trees.**
Larch Mountain salamander (*Plethodon larselli*)	SENSITIVE; SURVEY AND MANAGE Documented	**One site located during project surveys outside a unit boundary. Other known sites occur within or near the planning area.**
American peregrine falcon ***(Falco peregrinus anatum)***	SENSITIVE Documented	**Nesting suspected in project area.**
Townsend's big-eared bat (*Corynorhinus townsendii*)	SENSITIVE Documented within one mile of project area	**Rare on Cowlitz Valley District, has occasionally been documented roosting under concrete bridges**
California wolverine (*Gulo gulo*)	SENSITIVE Suspected	**Very few historic sighting records on the District. More likely to occur in higher-elevation, alpine habitats and wilderness, but possible during winter at lower-elevation sites, where it may feed on carrion or prey on weakened ungulates.**

There are no known mines, caves, abandoned bridges or buildings in the sale area that may provide breeding habitat or hibernacula for this species. There would be no

disturbance or effects to the Townsend's big-eared bat or bat habitat under this alternative due to the lack of habitat effects.

There would be no indirect effects from alternative 1 to any of the above species. As no action is being taken under this alternative, no cumulative effects would occur in conjunction with other nearby projects, such as the planned Pinchot Partners Restoration Thin, located on the east side of the Cowlitz River.

The determination is that alternative 1 would have "no impact" to any listed Sensitive animal species.

Alternatives 2 (Proposed Action) and 3 (Modified Proposed Action)

Proposed harvest units under these alternatives include nine Sensitive/"Survey and Manage" animal locations within or adjacent to proposed unit boundaries, all located during project surveys. These sites are all *Cryptomastix devia* terrestrial snail locations associated with bigleaf maple trees, with the exception of one Larch Mountain salamander site. A 15 meter (50 feet) buffer is prescribed around the *C. devia* sites to minimize habitat disturbance, based on empirical data that indicates that this is the distance where most *C. devia* occur (sighting records on file, Cowlitz Valley R.D.). Post-sale snag/down wood creation to "release" bigleaf maple trees in managed stands, where appropriate, is also prescribed to preserve long-term habitat capability. Short-term, microclimatic changes resulting from thinning outside the buffers are expected to be small and discountable, and over the long-term habitat conditions are predicted to improve at these sites. This is due to the additional sunlight provided to the maple trees, resulting in increased maple foliage production, and subsequently deeper leaf litters in the understory. The additional sunlight will also stimulate understory production, particulary swordfern (*Polystichum munitum*), which provides important escape and aestivation habitat for this species (Burke et al. 2005). The determination is that alternatives 2 and 3 "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" for the terrestrial snail *Cryptomastix devia*. There will be "no impact" to the Malone jumping-slug or the blue-gray tail-dropper from these two alternatives, as there are no known sites in the project area, based on field surveys and historic records. Although their absence cannot be presumed with certainty, mitigation measures to protect down wood will help to provide essential habitat for these terrestrial slugs, and the addition of additional down wood following the sale will augment the existing down trees and logs.

One Larch Mountain salamander location occurs outside the boundary of proposed unit 9 at an open, sparsely vegetated, rock outcrop area, and is likely part of a metapopulation of this species present on the steep slopes above Butter Creek. This species can be found associated with a variety of vegetation types in rocky substrates (Crisafulli 1999), including the above shrub/herb dominated site. The boundary of unit 9 avoids the salamander site and associated suitable habitat, and therefore no disturbance, or adverse microclimatic effects, to the salamander site are anticipated. Alternatives 2 and 3 will have "no impact" to the Larch Mountain salamander.

A pair of American peregrine falcons was observed at cliffs near a proposed sale unit in late-summer, 2006, following the falcon nesting season. It is possible that this pair nested on the cliffs during 2006. The unit boundary will be adjusted to provide a one site-potential tree buffer near the suitable nesting cliff, and a Limited Operating Period timing restriction will be employed to eliminate project-generated noise disturbance to the birds

during the nesting season (January 1 to August 1), unless field surveys confirm that the birds are not present and nesting that year. With the implementation of these mitigation measures, the determination is that alternatives 2 and 3 "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" to the American peregrine falcon.

The wide-ranging California wolverine may be a rare visitor or transient in the Cowlitz Thin sale vicinity. It would be most likely to occur during the winter, when carcasses of deer, elk, or other species would provide an available food source. However, the likelihood that wolverines actually occur in the sale area, and that they would be impacted by sale activities, is extremely low due to the presumed rarity, and wide-ranging habitats of this carnivore. The Limited Operating Period (LOP) restriction for deer and elk winter range (December 1 to April 1) would serve to reduce or eliminate potential disturbance to wolverines as well. No long-term reductions in big game or small mammal prey are anticipated from any action alternative. The determination is that alternatives 3 and 4 **"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"** to the California wolverine.

There is the small potential that the rare Townsend's big-eared bat occurs in the Cowlitz Thin sale units. No project surveys were conducted for this species. The only known occurrence of this species on the Cowlitz Valley District are individual big-eared bats roosting under concrete bridges, although there have been very few bat surveys conducted on the District, so they may be more common than indicated by these few incidental observations. This species (as well as other bats) would be far more likely to occur in late-successional and old-growth stands- such as those that occur adjacent to some of the Cowlitz Thin project units- where roosting sites would be more abundant, or at caves, mines, abandoned bridges, or other similar sites elsewhere. However, its occurrence within the Cowlitz Thin units cannot entirely be discounted. There are scattered old-growth, legacy trees and snags in unit 6, and these will be placed in no-thin "skips", thereby protecting potential roost sites for bats or other species. Due to the very low likelihood that individual Townsend's big-eared bats would be impacted from the loss of potential roost sites within the Cowlitz Thin sale units, the determination is that the action alternatives 2 and 3 **"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".**

Indirect effects

There are no known indirect effects to the above species from alternatives 2 and 3.

Cumulative effects

The implementation of alternatives 2 and 3 would be cumulative to the Pinchot Partners Restoration Thin (PPRT) sale currently being planned on the east side of the Cowlitz River, in the Packwood Late-Successional Reserve (LSR). As that project is confined to managed stands, and designed to restore and enhance habitat in the LSR, it is anticipated that any cumulative effects to those presented for alternatives 2 and 3 would be small, or that the PPRT would enhance habitat conditions for Sensitive and "Survey and Manage"

species over the long-term, with minimal short-term effects. This would be particularly true for a species like the terrestrial snail *Cryptomastix devia*, where critical bigleaf maple tree habitat and forest understory species like swordfern would be maintained and enhanced over hundreds of acres in the upper Cowlitz watershed.

Alternative 4 (Managed stands only)

Under this alternatives, six Sensitive/"Survey and Manage" sites occur within boundaries of proposed sale units, all of which are *Cryptomastix devia* terrestrial snail locations associated with bigleaf maple trees. A 15 meter (50 feet), no-harvest buffer is prescribed around each site, which will serve to minimize leaf litter and down wood disturbance at these locations. At some of these sites, the bigleaf maple tree habitat with which *C. devia* is associated is being over-topped and out-competed by conifers, mainly Douglas-firs. This will reduce or eliminate habitat capability for *C. devia* over the long-term, so post-sale snag and down wood creation will occur at these sites to "release" the maple trees and ensure their long-term persistence. There will be some short-term microclimatic changes due to thinning near the site buffers, however this will be relatively short-lived and is expected to have minimal adverse impacts this species, based on the species occurrence and persistence at other relatively open sites bordering roads, openings and forest edges. The determination is that 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" for the terrestrial snail *Cryptomastix devia*. Over the long-term, habitat capability for this species would be enhanced due to the creation of small canopy gaps around maple trees, and the stimulation of forest understory vegetation, particularly swordfern.

There are no other mollusk or amphibian sites associated with this alternative, based on survey results and habitat evaluations. As with the previous alternatives, there is the very small potential for a small population of Malone's jumping-slug, or blue-gray tail-droppers to occur within sale units, both of which were undetected during survey efforts. Again, the protection of many existing down trees and logs, combined with the augmentation of existing down wood, and the fact that these two species are likely absent from sale units, results in a determination of "no impact" to these species from alternative 4.

There are also no potential nest sites for the peregrine falcon adjacent to proposed units in this alternative, so there will also be "no impact" to the American peregrine falcon from alternative 4.

There is a very small chance that the California wolverine could occur during winter near proposed units 3, 5, 7, 8 and 15 in deer and elk winter range, although the winter range timing restriction would reduce or eliminate most potential noise disturbance to this species. Over the long-term, this alternative would enhance habitat conditions for big game and small mammals (i.e. wolverine prey) in the managed stands, which currently provide relatively poor habitat for these species. The determination is that alternative 4 ***"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"***.

Habitat for the Townsend's big-eared bat is essentially absent within the units in alternative 4, due to the lack of large trees and snags that might provide roost sites.

Also, no mines, caves, or abandoned bridges or buildings are located near the units either. Alternative 4 would therefore have *"**no impact**"* to Townsend's big-eared bat.

Indirect effects

There are no known indirect effects to the above species from alternatives 2, 3 and 4.

Cumulative effects

The implementation of alternatives 2, 3 and 4 would be cumulative to the Pinchot Partners Restoration Thin (PPRT) sale currently being planned on the east side of the Cowlitz River, in the Packwood Late-Successional Reserve (LSR). As that project is confined to managed stands, and designed to restore and enhance habitat in the LSR and adjacent areas, it is anticipated that any cumulative effects to those presented for alternatives 2, 3 and 4 would be small, or that the PPRT would enhance habitat conditions for Sensitive/"Survey and Manage" species over the long-term, with minimal short-term effects. This would be particularly true for a species like the terrestrial snail *Cryptomastix devia*, where critical bigleaf maple tree habitat and forest understory species like swordfern would be maintained and restored over hundreds of acres of managed stands originating from timber harvest in the upper Cowlitz watershed.

Management Indicator Species

Affected Environment

Management Indicator Species (MIS), as designated in the Gifford Pinchot National Forest Plan, as amended, are those that are in high demand for consumptive or non-consumptive use, or represent other species with similar habitat requirements. Within the project area, the species that are known to occur, or likely occur, are displayed in Table 4.4.6.

Environmental Consequences

Alternative 1 (No Action)

No MIS will be adversely impacted from this alternative due to the lack of habitat disturbance, as well as the lack of project-related noise disturbance. In the short-term, snag levels in the proposed sale units, particularly the managed stands resulting from timber harvest, will remain at low-to-moderate levels, depending on the stand, but will slowly increase over time due to competition-related mortality, as well as mortality from laminated root rot or other natural sources.

Habitat conditions will also steadily improve for the pine marten, due to the increase of down wood resting and denning habitat, and small mammal prey habitat. Managed stands will continue to supply relatively poor habitat for both cavity excavators and the pine marten for several decades, however, as they slow succeed towards a late-successional condition that would provide increased habitat capability for these species. See previous

sections for effects to the northern spotted owl, deer and elk, northern bald eagle, and peregrine falcon.

Table 4.4.6. Management Indicator Species (MIS) that are known or suspected to occur in the Cowlitz Thin planning area.

Species	Status	Comments
Northern spotted owl (*Strix occidentalis caurina*)	Documented	Represents species requiring lare areas (2200 acres) of mature and old-growth forests. See spotted owl key issue analysis
American (pine) marten (*Martes americana*)	Suspected	Represents species requiring smaller areas (160 acres) of mature and old-growth forests.
Pileated woodpecker (*Dryocopus pileatus*)	Documented	Represents species requiring moderate-sized areas (300 acres) of mature and old-growth forest. Distinctive foraging sign is common within and adjacent to sale units.
Roosevelt elk and black-tailed deer	Documented	MIS based on high level of demand for hunting and viewing. See big game key issue analysis.
"Cavity excavators"	Documented	Represents species which use or require dead tree (snag) or down log habitat.
Peregrine falcon (*Falco peregrinus anatum*)	Documented	MIS based on (former) federal "threatened" status and demand for viewing. Very rare nesting species on Cowlitz Valley District. See Sensitive/Survey and Manage section analysis
Northern bald eagle (*Halieetus leucocephalus leucocephalus*)	Documented	MIS based on "Threatened" status and demand for viewing.

Alternative 2 (Proposed Action)

Under this alternative, habitat for "cavity excavators" and the pileated woodpecker would be improved over the short-term and long-terms in managed stands through the creation of snags and the augmentation of down wood. In natural stands, some existing snags would likely be felled for logging safety reasons, and down wood broken or damaged by yarding of logs, but this loss would be partially mitigated by the creation of snags and down wood after harvest. A total of 15% of the natural and managed stands would be placed in no-thin "skips" which would protect some existing snags and patches of down wood. Habitat for the pine marten would likewise be enhanced in the managed stands due to the stimulation of understory vegetation and the augmentation of existing down wood

(Wilson and Carey 2000). In natural stands, the 15% no-thin "skips" would protect some, but not all, patches of higher quality habitat that contain legacy features such as large down trees, large snags, and live, old-growth trees.

Alternative 2, as well as the other action alternatives 3 and 4, will result in short-term disturbance to MIS during logging operations and post-sale projects such as snag and down wood creation, which may include disruption of nesting or breeding activity. This would occur in units such as 3, 7, and 15 that are not subject to spotted owl or marbled murrelet Limited Operating Period restrictions during the breeding/nesting season. However, as most of the sale units are covered by one or more LOP restrictions, the number of acres subject to disturbance would be very limited, and there are large amounts of suitable breeding/nesting habitat surrounding these stands that would not be impacted.

Alternative 3 (Modified Proposed Action)

This implementation of this alternative would provide the greater benefits to MIS compared to alternative 2, with the fewer adverse impacts, due to the increased levels of post-sale snag and down wood creation, and the retention of more patches of higher quality habitat in the natural stands because of the increase of no-thin "skips" to 30%. This will protect most of the patches within natural stands that contain legacy habitat features such as snags, down wood and live, old-growth trees. Again, managed stand habitat capability will be increased over the short- and long-terms due to thinning and post-sale snag and down wood creation. Habitat capability for the pine marten would be increased under this alternative due to the stimulation of forest understory vegetation in the managed stands.

Alternative 4 (Managed stands only)

Only managed stands, which typically contain relatively poor quality habitat for most MIS, will be thinned under this alternative. In these stands, existing snag and down wood levels are low, except where patches of Class 3-4 decayed down logs occur; these are usually large "cull logs" from the parent stand, left in place during previous logging. The treatment of these stands will improve habitat conditions for "cavity excavators", pileated woodpecker, and pine marten, particularly in conjunction with post-sale snag and down wood creation projects. Some losses of existing snags and breakage or loss of existing down wood will inevitably occur during thinning operations, although these losses will be mitigated by protecting these features with "skips" and individual trees where possible. Understory vegetation will be enhanced in these stands, which would benefit the pine marten as the stands succeed towards a late-successional condition. Overall, the effects of alternative 4 are judged to be beneficial to Management Indicator Species over the short- and long-terms.

Indirect effects

There are no known indirect effects to the above species from alternatives 2, 3 and 4.

Cumulative effects

The implementation of the action alternatives 2, 3 and 4 would be cumulative to the Pinchot Partners Restoration Thin (PPRT) sale currently being planned on the east side of the Cowlitz River, in the Packwood Late-Successional Reserve (LSR). As that project is confined to managed stands, and designed to restore and enhance habitat in the LSR and adjacent areas, it is anticipated that any cumulative effects to those presented for alternatives 2, 3 and 4 would be small and temporary, and that the PPRT would enhance habitat conditions for Management Indicator Species over the long-term through the acceleration of late-successional habitat, and increases in habitat features such as snags and down wood through post-sale projects.

Migratory Birds

Alternative 1 (No Action)

This alternative would have no direct habitat impacts to migratory birds, nor would there be any additional disturbance to these species. Over the long-term, the managed stands would slowly improve as migratory bird habitat, as stand complexity increases, including tree layering and understory shrub and forb development. There would be some mortality of bigleaf maple trees, particularly in the managed stands, as maples are lost to competitive exclusion by Douglas-firs and western hemlocks. This reduction in deciduous trees would negatively impact some migratory bird species, such as the Pacific-slope flycatcher (Altman 1999). Some maples or cottonwoods would survive in scattered root rot patches and riparian areas within stands such as units 7 and 8, and in most of the natural stand units (6, 9, 14, 16, and 17).

There would be no indirect or cumulative effects to migratory birds from Alternative 1.

Alternatives 2, 3 and 4

Under all action alternatives, commercial thinning is expected to improve habitat conditions for migratory birds by stimulating understory production and stand layering, particularly in the closed-canopied managed stands. The “release” of bigleaf maple trees, in particular, as a result of thinning would provide direct short- and long-term benefits to some migratory birds that tend to favor coniferous stands containing deciduous trees such as maples and cottonwoods. In the natural stands under alternatives 2 and 3, this would also occur to a lesser degree, although there would also be some losses of existing legacy snags, which may adversely impact some (mostly resident) bird species. Under alternative 3, these snag losses would be reduced due to the larger number of acres in no-thin “skips”. The retention of no-thin “skips” would provide habitat for species requiring a high degree of canopy closure, such as the hermit warbler (Altman 1999).

There would be some disturbance/disruption or actual nest losses to migratory birds during the breeding season in stands that are not included in a spotted owl or marbled murrelet Limited Operating Period restriction, such as units 3, 7, and 15.
However, as most of the sale units are covered by one or more LOP restrictions, the number of acres subject to disturbance or nesting disruption would be small, and there are

large amounts of suitable breeding habitat surrounding these stands that would not be impacted.

Indirect effect

There are no known indirect effects to migratory birds from the three sale action alternatives.

Cumulative effects

The implementation of the action alternatives 2, 3 and 4 would be cumulative to the Pinchot Partners Restoration Thin (PPRT) sale currently being planned on the east side of the Cowlitz River, in the Packwood Late-Successional Reserve (LSR). As that project is confined to managed stands, and designed to restore and enhance habitat in the LSR, it is anticipated that any cumulative effects to those presented for alternatives 2, 3 and 4 would be small, or that the PPRT would enhance habitat conditions for migratory birds over the long-term through the acceleration of late-successional habitat (including stand layering and understory development), and increases in habitat features such as snags and down wood through post-sale projects.

There would be cumulative disturbance to migratory birds in PPRT units that do not have an LOP for spotted owl nesting, which could result in disruption of nesting or direct loss of bird nests. The overall effects of this cumulative disturbance are expected to be relatively small, as there is a large amount of surrounding habitat in the watershed of higher present suitability for migratory birds that will not be impacted, either in the short-term or long-term.

4.5 Botanical Resources

Botanical surveys were conducted in Cowlitz Thin Timber Sale July 21st –August 4th, 2006. Due to the seasonal nature of plant identification it is not always possible to completely survey a given area with a one time survey, however, the knowledge of plant-habitat relationships, growth habit, and flowering dates helps the investigator in this regard (refer to Appendix B). The phenology of Sensitive lichens, bryophytes and the fungus *Bridgeoporus nobillisimus*, is such that they can be identified throughout most of the year. Based upon this, surveys for these species are generally conducted at the same time as surveys for TEPS species.

In the 2004 Survey and Manage Record of Decision (USDA & USDI 2004, pg. 6), the assumption was made that species being transferred from the Survey and Manage Program to the Sensitive Species Program that were not considered "survey practical" under the Survey and Manage Standards and Guidelines (most category B & D species, including most fungi), would not require survey under the Sensitive Species Program. Rather, other components of pre-project clearances (habitat evaluations etc.) will be utilized to evaluate potential risks to the species resulting from project activities. This evaluation is then used to prescribe project design features and/or mitigations to address these risks. Species that fall into this category are indicated in Appendix A. Of the Sensitive species not specifically targeted during surveys, the project area may provide habitat for 13 fungi and one lichen species. These species are addressed within the Determination of Effects section of this report.

Complete survey documentation is on file at the Cowlitz Valley Ranger District in the Botany Project files.

Current Condition

Threatened, Endangered & Proposed Plant Species. None were located within the project area.

Sensitive Plant Species. Multiple sites for one Sensitive Species, *Usnea longissima*, were found within planned units for the Cowlitz Thin planning area. Sites and locations are listed in Table 4.5.1.

Table 4.5.1. Regional Forester's Sensitive Species found within units of the Cowlitz Thin timber sale

Location (Unit)	Species
6	*Usnea longissima*
17	*Usnea longissima* (3 sites)

Survey and Manage Plant Species

In addition to being a Sensitive Species, *Usnea longissima* is a Category F Survey and Manage Species. Sites within the units would be protected with a 50 ft. radius buffer centered on the population. During thinning operations, timber would be felled dirctionally away from known sites.

Threatened, Endangered & Proposed Plant Species

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 palustrine emergent wetlands with seasonal drawdown. No such wetland habitats will be impacted by the implementation of this project. In addition, wetlands to be impacted by this project were surveyed and no TEP species were located. Thus, project action alternatives will have **NO EFFECT** on federally listed species.

Sensitive Species

Surveys performed within project units located one Sensitive species: *Usnea longissima.* A determination of impact for this species is documented below.

Usnea logissima. Four new sites for this species were located in Cowlitz Thin units during surveys in 2006. Since this species can grow high in the canopy, there may be other individuals in the area that were not detected. This lichen is yellow green, fruticose, and can be up to 3 m long, garlanding trees like Christmas tinsel. The main branches are very long and seldom divide, with short perpendicular side branches. The cortex soon disintegrates leaving a rough surface over the brownish central cord. This species primarily reproduces asexually by fragmentation of the thallus, with the majority of vegetative propagules dispersing only short distances (i.e. typically less than 5 meters) from their source locations, and thus the species is considered to be dispersal limited. Experiments have shown that *Usnea longissima* can thrive in young stands if transplanted. Retention of colonized green trees is therefore considered to be the most important design feature to preserve this species in harvest areas (Survey Protocols for Survey and Manage Category A lichens in the Northwest Plan area, Derr et al. 2003). Under alternative 2 and 3, fifty-foot radius buffer areas would be created around the known populations as a project design feature, and trees outside the buffers would be felled directionally away from the buffers. Stands 6 and 17 are not proposed for harvest in alternative 4, which thins only managed stands. For these reasons, alternatives 2 and 3 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. Alternative 1 and 4 for this project would have NO IMPACT upon this species.

Non-surveyable Sensitive Species

Direct effects

Within all Units of Cowlitz Thin Timber Sale there is potential habitat for a number of Sensitive species, including 13 fungi species and 1 lichen species, that were not specifically targeted during surveys. 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 <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 'non-surveyable' 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, using guidelines set by Region 6 of the Forest Service (Likelihood of Occurrence Key 2004); the impact analyses (see below) reflect this assumption.

Lichen: *Chaenotheca subroscida*

Direct Effects

On the Gifford Pinchot National Forest, there is one known site for this species on the Cowlitz Valley Ranger District. Cowlitz Thin Timber Sale is located from ~1200 to 3800 ft. elevation, and the plant community type is quite different from the known site which hosts this species, i.e. dominated by fairly homogeneous conifer stands dominated by Douglas-fir (*Pseudotsuga menziesii*). All Cowlitz Thin Timber Sale units have the potential to host this species, but because the habitat within Cowlitz Thin is quite dissimilar to the site from which the species is known on the Gifford Pinchot National Forest, the potential for occurrence within the project area is estimated to be low.

Since *Chaenotheca subroscida* is a small, cryptic species that takes specialized knowledge to identify accurately (for these reasons this species is considered non-surveyable), it is likely under-reported and under-collected. If this species is found within the Cowlitz Thin project area, it would most likely be associated with the largest, oldest conifers, which the thinning prescriptions for the project will maintain. In addition, 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.Rainier) will continue to provide undisturbed habitat for this species outside of the Cowlitz Thin Timber Sale. For these reasons, this project ***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. The no action alternative will result in NO IMPACT to this species.

Fungi: Albatrellus ellisii, Cordyceps capitata, Gomphus kauffmanii, Gyromitra californica, Leucogaster citrinus, Mycena monticola, Otidea smithii, Ramaria cyaneigranosa, Ramaria gelatiniaurantia, Ramaria rubrievanescens, Sarcodon fuscoindicus, Sowerbyella rhenana, Spathularia flavida

Direct 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 saprobic species of fungi.

Because land based harvest techniques result in soil distubance and compaction, alternatives incorporating these techniques impact fungal diversity, and preservation of rare fungal species. Skyline logging techniques may have less impact than ground based techniques, particularly for compaction.

See the Botanical Report/Biological Evaluation in the project file for details regarding each species. In summary, for all 13 Sensitive fungi, any harvest impacts to habitat, such as soil compaction, would be less under alternative 4 than for alternatives 2 and 3 because fewer units are harvested (Table 4.5.2). Considering these factors, the action alternatives MAY IMPACT individuals or habitat, but will not likely lead to a trend towards federal listing or a loss of viability to the species. The no action alternative will result in NO IMPACT to any species.

Cumulative Effects

The cumulative effects area chosen for this analysis is the eastern area of the Cowlitz Valley Ranger District (not including the Rockies). This area was chosen because it is large enough to contribute to or receive the lightest propagules, such as fungal spores, of local populations of Sensitive or S&M plant species that may exist or have habitat in the project area. Some species with very light propagules may achieve distribution greater than this, but establishment is most likely near the source. The choice of the district boundary was determined because the size was suitable, and information about habitat

Table 4.5.2. Summary of determinations of effects for Sensitive plant species.

Species	Alt 1: (No Action)	Alternatives 2 & 3 (Proposed action, modified proposed action)	Alternative 4 (managed stands only)
Usnea longissima	No impact (NI)	May impact individuals or habitat, but will not likely lead to a trend towards federal listing (MIIH)	No impact (NI)
Non-surveyable 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)	May impact individuals or habitat, but will not likely lead to a trend towards federal listing (MIIH)

conditions is usually available in terms of mapped political units, although the boundary is not biologically meaningful. The past time horizon for comparison of cumulative effects to rare species is approximately 1900, when large scale European settlement with land clearing began to alter presettlement forest disturbance patterns and habitat availability for rare species. The future time horizon is 2022, when all activities associated with the sale will probably be complete. Effects will not end at this horizon, but become increasingly speculative in longer time frames.

An approximately 1500 acre commercial thinning sale is currently being planned by Pinchot Partners in stands on the south side of the Cowlitz River on the Cowlitz Valley RD in the Packwood area. Projects that have been approved or are being carried out in the last five years on the district are listed in Table 4.5.3.

There has also been an unknown quantity of timber harvest on private lands within the Cowlitz Valley Ranger District administrative boundary. These projects may have had effects similar to the possible effects of the Cowlitz Thin project, such as impacts to undetected individuals of TES or S&M species, or effects to habitat suitability such as soil compaction. These effects may overlap in time with the effects of the Cowlitz Thin project, as soil recovers from past compaction in completed timber sales, and thus accumulate in the cumulative effects area. No measurement is available for impacts to undetected individuals, but pre-project surveys on Forest Service harvest areas are believed to lower the probability of such impacts in recent actions.

Cumulative effects of timber harvest upon “non-surveyable” species sites and habitat quality are largely unknown. Project design attempts to minimize impacts upon these species. We assume that, by practicing thinning, retaining a high degree of species diversity within stands, maintaining woody debris substrate (for saprobes), and live trees (for mycorrhizal species), that this project, while impacting species, will not devastate entire mycelial networks and colonies, and thus will reduce the contribution to cumulative effects.

Table 4.5.3. Approximate acres of Timber harvest planned and sold on the Cowlitz Valley Ranger District 2002-2007		
Project name	Approximate Acres	date
Dry Burton thin	161	May be sold 07
Iron Horse Thin	507	2006
Tower Rock Thin	54	2006
Silver Watch Thin	92	2005
Smooth Juniper	289	2005
Smoke Salvage	60	2004
Galena Thin	52	2004
Lower Iron Thin RR	165	2004
Iron Summit Thin	141	2004
Upper Iron Thin	266	2003
Upper Greenhorn Thin	376	2003
Johnson Thin RR	132	2003
Cispus Flats Thin	196	2003
Dry Jackpot Thin	128	2003
Dark Canyon Thin	139	2003
Helitower Thin	277	2002
Upper Iron Thin	199	2002
Total	**3,234**	

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 (non-surveyable species) are either 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.

Noxious Weeds/Invasive Plants

Direct and Indirect Effects

Under all Cowlitz Thin Timber Sale action alternatives, there would be ground disturbance and opening of the canopy during the course of timber harvest activities. Ground-based harvest systems, temporary road construction and landings may constitute as much as 20% of the area disturbed within ground-based units; however much less typical (see soils report). Not all ground disturbance results in soil displacement or compaction. 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 would, 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. Alternatives 2 and 3 incorporate the greatest distance (3.3 mi) of temporary road construction, so they provide more suitable habitat for weed establishment than alternative 4 (1 mi) or 1(no miles). In summary of the action alternatives, Alternative 4 will have lower potential to cause establishment and spread of noxious weeds and invasive plants than either Alternatives 2 or 3.

In order to control noxious weed colonization and spread under the action alternatives, weed-spread prevention and weed eradication activities should be implemented before, during and after project activities.

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

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

Class A Weeds

None

Class B Weeds

Cytisus scoparius (scotch broom) – low

Leucanthemum vulgare (oxeye daisy) – low

Class C Weeds

Hypericum perforatum (St. John's wort) – moderate
St. John's wort grows scattered throughout Watershed.

Circium arvense (Canada thistle) – high
Seven large populations reported by surveyors.

Circium vulgare (bull thistle) – moderate
Bull thistle grows scattered throughout the Watershed.

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

Digitalis purpurea (foxglove) - low

Noxious Weed and Invasive Non-Native Species Risk Assessment with Project Design Criteria and Mitigations

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, diseases, and competitors that controlled these species in their native habitats are not present in the habitat where they are introduced. If a species is unchecked by competition or predation, 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.

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). To be in compliance with the EIS for Managing Competing and Unwanted Vegetation, it is also recommended the applicable *Standard Procedures to Reduce the Risk of Spreading Weeds* be implemented in all projects, regardless of weed risk ranking. 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.

Risk Ranking

Factors (factors that contribute the spread of weeds) and Vectors (“vehicles” or modes of transportation or spread, sources) considered in determining the risk level for the introduction or spread of noxious weeds are:

Factors

A. Known noxious weeds in close proximity to project area that may foreseeably invade project.
B. Project operation within noxious weed population.
C. Any of vectors 1-8 in project area.

Vectors

1. Heavy equipment (implied ground disturbance including compaction or loss of soil "A" horizon.)
2. Importing soil/cinders/gravel/straw or hay mulch.
3. ORVs or ATVs.
4. Grazing.
5. Pack animals (short term disturbance).
6. Plant restoration.
7. Recreationists (hikers, mountain bikers, etc…).
8. Forest Service or other project vehicles.

High, moderate, or low risk rankings are possible. For a high ranking the project must contain either a combination of factors A+C or B+C above. A moderate ranking contains any of vectors #1-5 in the project area. A low ranking contains any of vectors #6-8 in the project area or known weeds within or adjacent to the project area, without vector presence (Table 4.5.4).

Table 4.5.4. Weed risk ranking results.

Project	Factors	Vectors	Risk
Cowlitz Thin Timber Sale	A, B, C	1, 2, 8	High

Cumulative effects

Past land clearing and trade have introduced invasive plant species to the Cowlitz Valley Ranger District. Invasive plant have established on most roadsides and in many riparian areas. A draft environmental impact statement for the site-specific invasive plant treatment project detailing known sites is available at http://www.fs.fed.us/r6/invasiveplant-eis/site-specific/gip/. The cowlitz thin project is expected to contribute to the further spread of invasive plants. This incremental increase in invasive plant populations, added to the effects of past sales and activities on private land, may reduce the capacity of the district to provide habitat for native species and produce timber products (pacific northwest region invasive plant program: preventing and managing invasive plants, section 1.1. avaialble at http://www.fs.fed.us/r6/invasiveplant-eis/). The proposed mitigations, if adopted, would reduce this cumulative effect.

4.6 Soils

The effects of the Proposed Action and Alternatives on the soil resource and the extent of detrimental soil conditions within units of the action alternatives were analyzed for the Cowlitz Thin Timber Sale. Quantitative analysis and professional judgment were used to evaluate soil quality in terms of the percent area in a detrimental condition. The term "project area" refers to the larger scale boundary surrounding all the units in the proposed action, also referred to as the "planning area."

The Gifford Pinchot National Forest Land and Resource Management Plan, Amendment 11 (p. 2-58 to 2-62) requires losses in soil productivity be limited to 20 percent or less of the activity area. Site treatment practices and harvest methods, particularly the use of fire and pesticides, are to be modified to minimize soil and litter disturbance.

Regional direction and clarification of terms is given in the Forest Service Manual, Chapter 2520, R-6 Supplement No. 2500.98-1. In the standard, "activity area" is the total area in which ground-disturbing activity is planned and includes the transportation system, in and directly adjacent to, the activity area. The Northwest Forest Plan requires designating unstable and potentially unstable lands as riparian reserves.

Soil quality is maintained when soil compaction, displacement, puddling, burning, erosion, loss of organic matter and altered soil moisture regimes are maintained within defined standards and guidelines. Under the action alternatives, these standards and guidelines would be achieved in all activity areas.

Background Information

Existing soils information for this project area was collected on a site-specific basis through field surveys conducted October 11 and December 5-7, 2006. Soils of the project area were mapped as part of the Gifford Pinchot National Forest Soil Resource Inventory (Wade, et. al., 1992). This information is available at the Gifford Pinchot National Forest Headquarters.

Table 4.6.1 lists the Soil Mapping Units and Figures 4.6.1-5 show the extent and distribution found within the activity areas that would be affected by the proposed timber harvest and related activities. Some field surveys changed delineation of current SRI mapping to closer match on-the-ground conditions, notably in Cowlitz Units 5, 6 and 17 (Figure 4.6.3), and Cowlitz Unit 4 (Figure 4.6.2).

Table 4.6.1. Selected Soil Mapping Interpretations, from (Wade, et. al., 1992)

Soil Mapping Unit	Soil Stability		Slope Productivity			
	Inherent stability	**Sensitive to management actions[1]**	**Displacement Potential**	**Compaction Potential**	**Erosion Potential**	**Potential for Regeneration**
14	Very Stable	No	Moderate	Moderate	Slight	High
15	Very Stable to Stable	No	Moderate	Moderate	Slight	Moderate
16	Stable	No	N/A	N/A	Moderate	Moderate
19	Moderately Stable to Unstable	Very	N/A	N/A	Moderate	Moderate
40	Stable	No	N/A	N/A	N/A	N/C
41	Stable	No	N/A	N/A	Moderate	Low to Moderate
4116	Stable	No	N/A	N/A	Moderate	Low to Moderate
4140	Stable	No	N/A	N/A	Moderate	Low to Moderate
51	Stable	No	N/A	N/A	Moderate	Moderate
5116	Stable	No	N/A	N/A	Moderate	Moderate
53	Moderately Stable to Unstable	Yes	Moderate to High	Moderate to High	Moderate	Moderate
5351	Moderately Stable to Unstable	Yes	Moderate to High	Moderate	Moderate	Low to Moderate
5357	Moderately Stable to Unstable	Yes	N/A	Moderate	Moderate	Moderate to High
57	Moderately Stable to Unstable	Yes	High	High	Moderate	Moderate to High
58	Very Stable	No	Moderate	Moderate	Moderate	Moderate

[1] Expected mass movement as a result of management activities

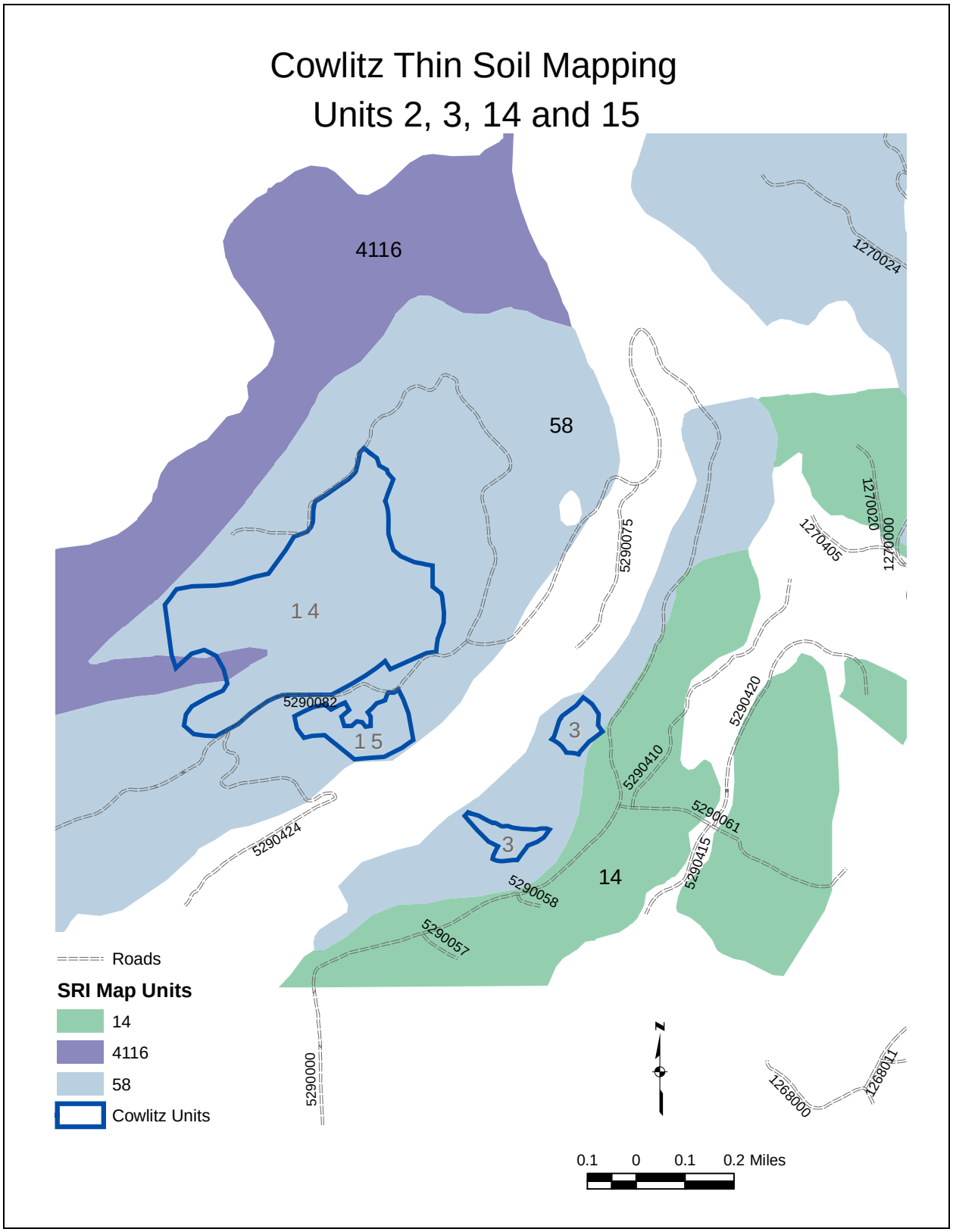

Figure 4.6.1. Modified soil mapping for Cowlitz Units 3, 14 and 15

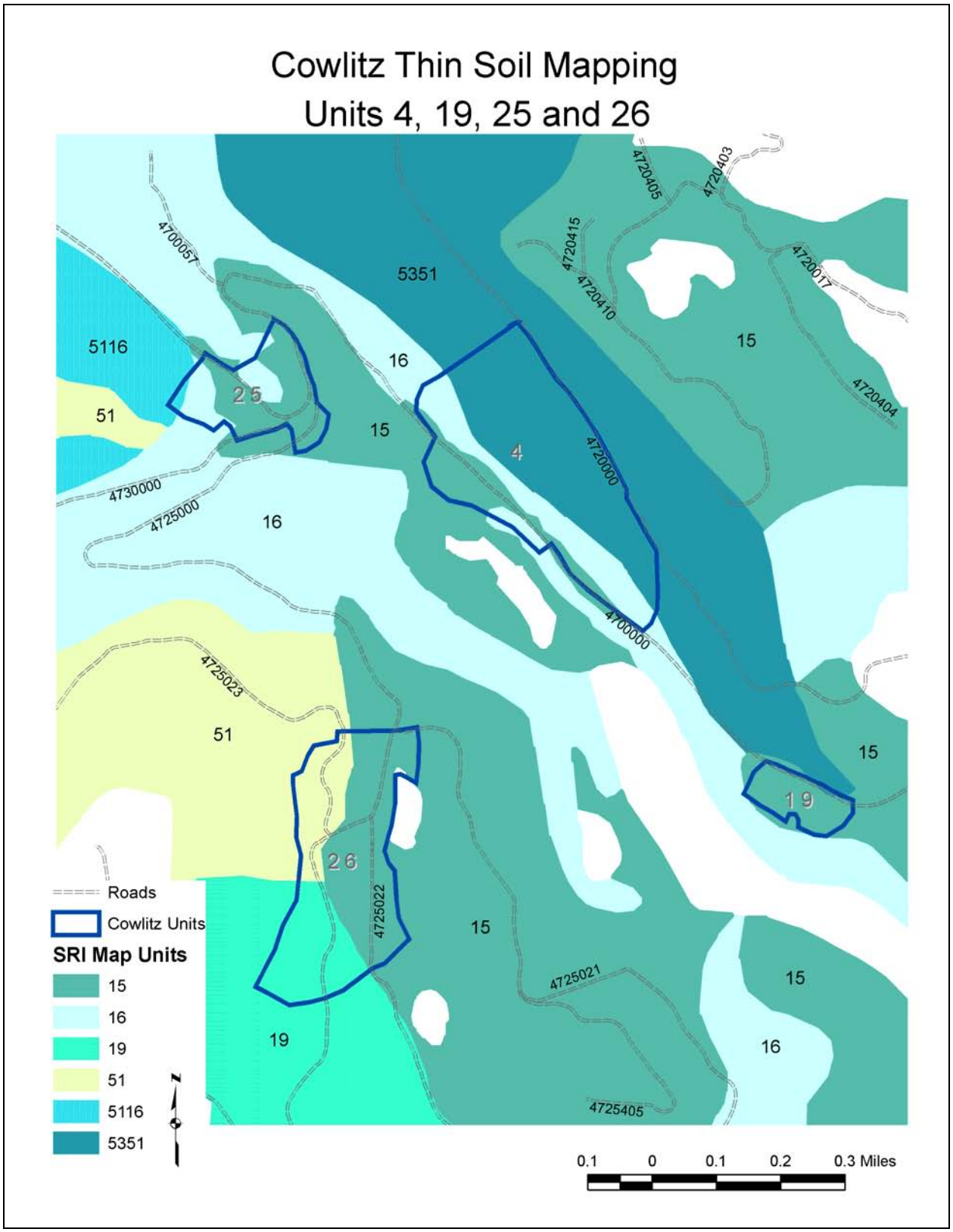

Figure 4.6.2. Modified soil mapping for Cowlitz Units 4, 19, 25 and 26

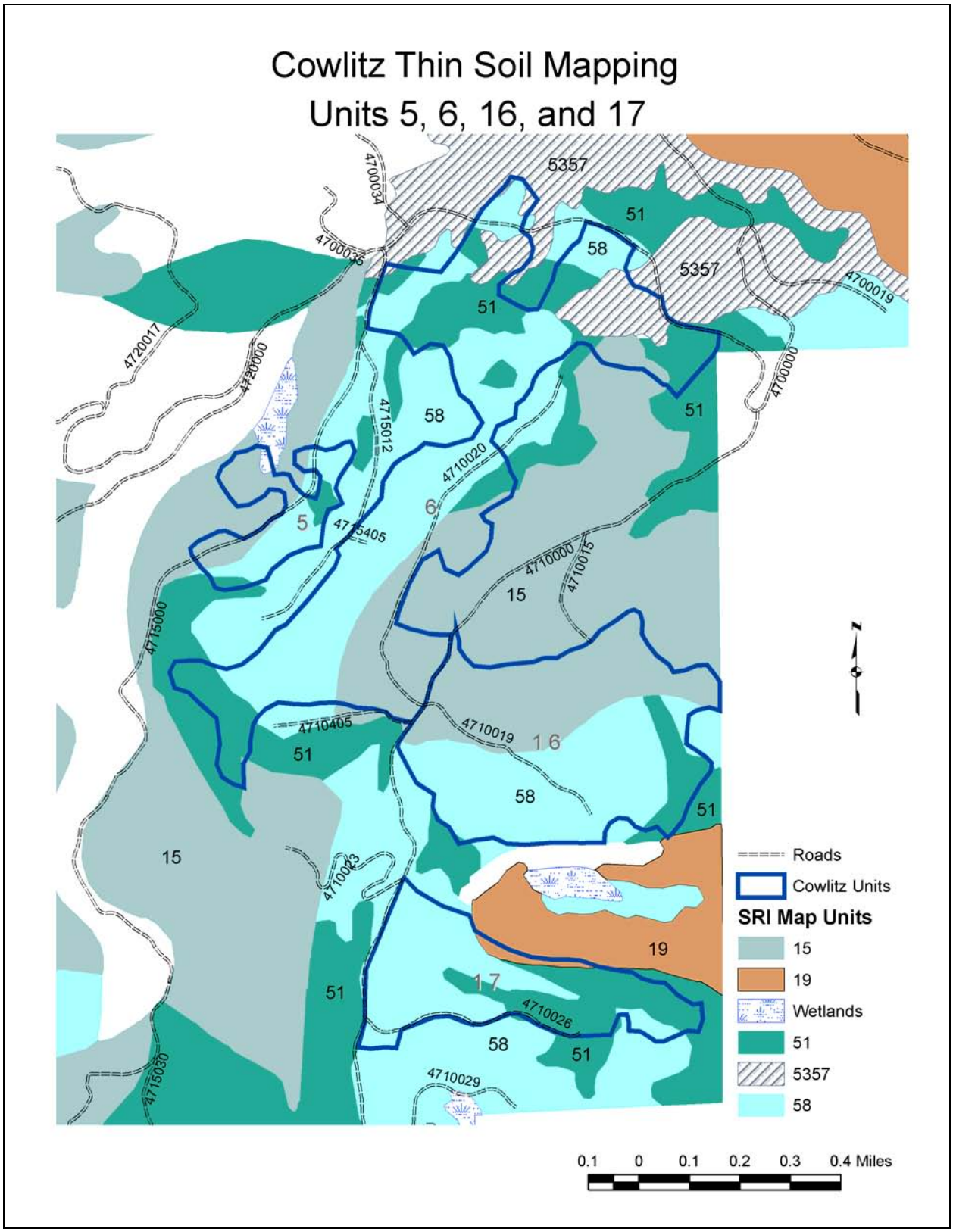

Figure 4.6.3. Modified soil mapping for Cowlitz Units 5, 6, 16 and 17

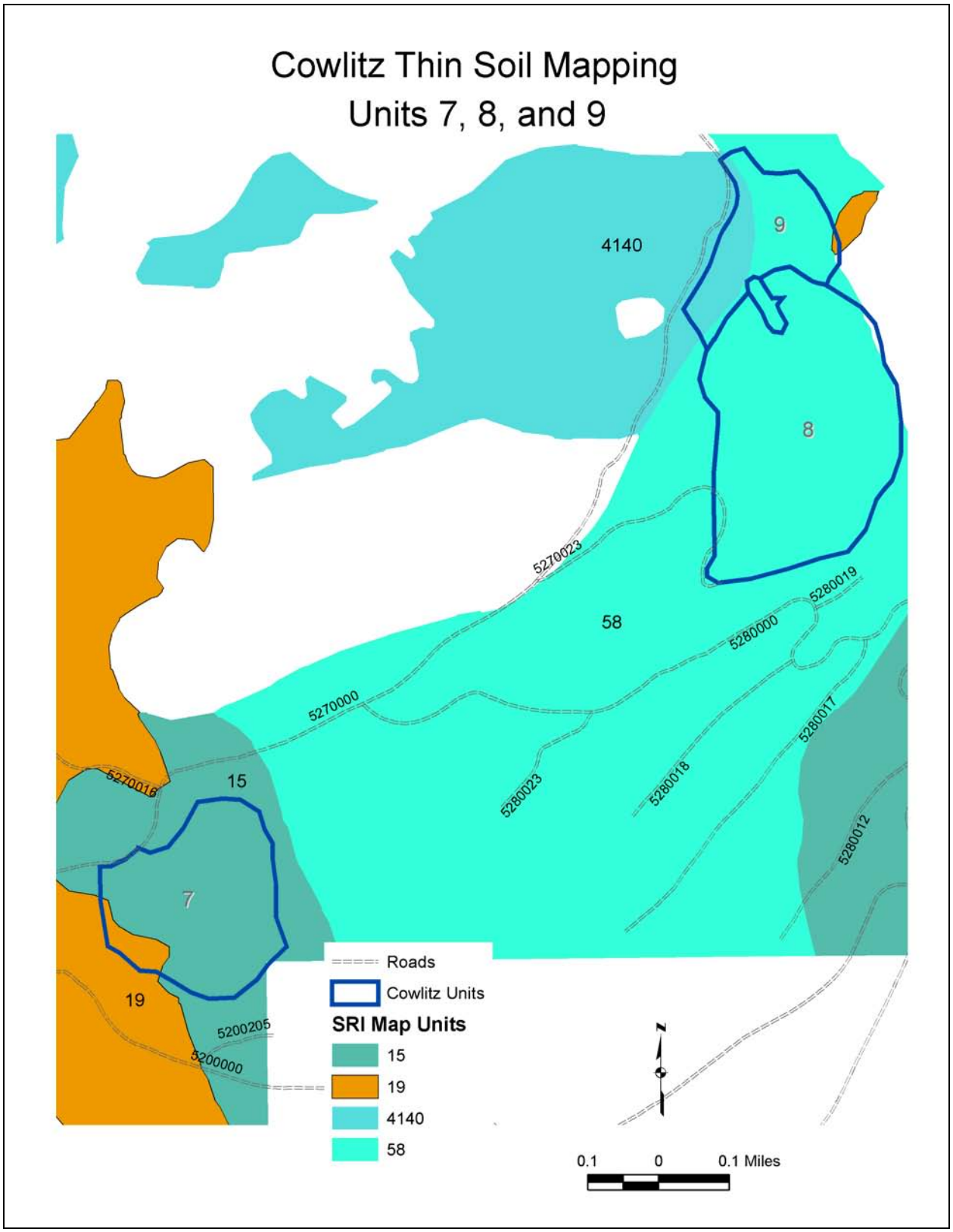

Figure 4.6.4. Modified soil mapping for Cowlitz Units 7, 8, and 9

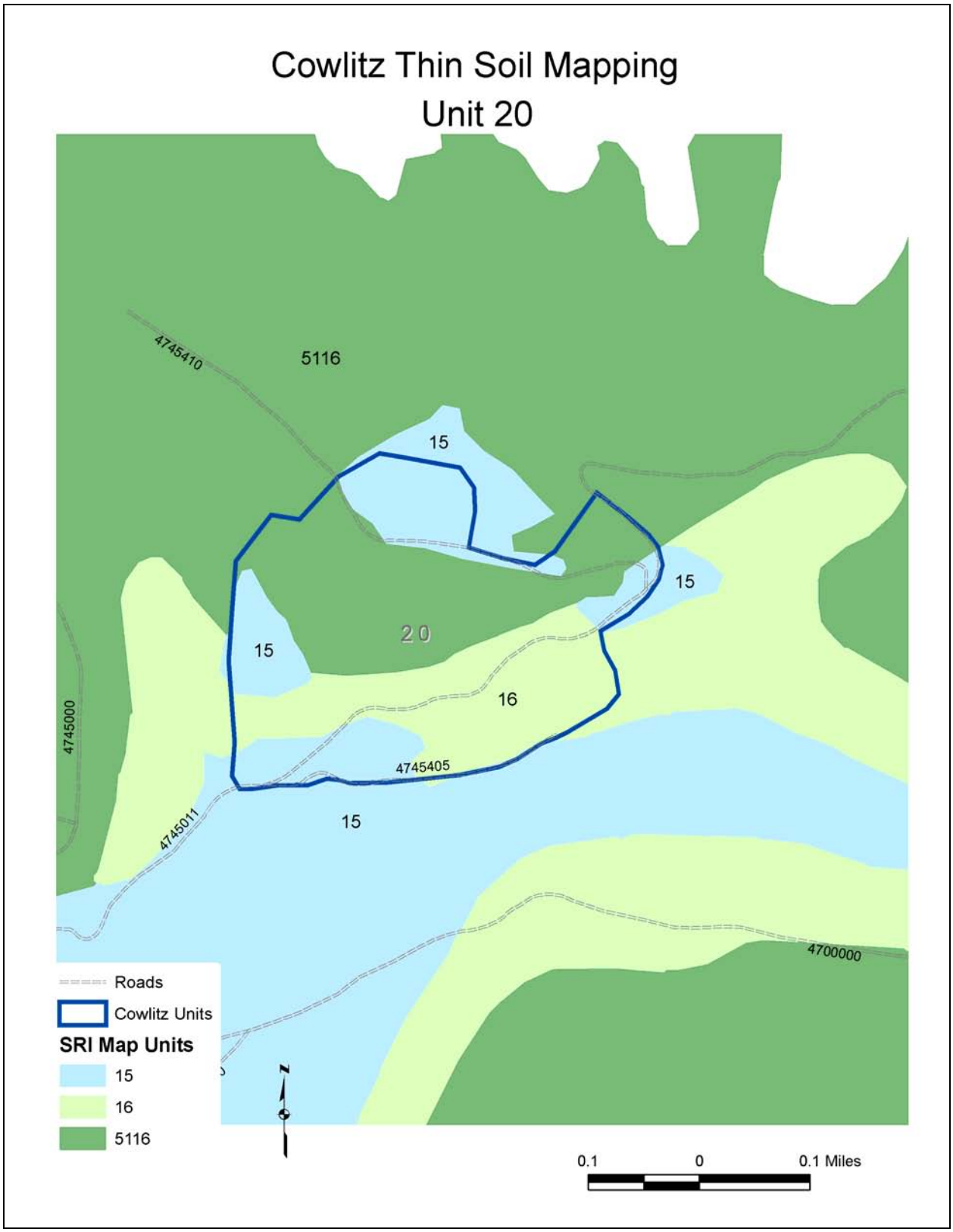

Figure 4.6.5. Modified soil mapping for Cowlitz Unit 20

Slope Stability

Road construction and timber harvest can increase the rate of mass failures, and the size and number of these events. Changes in hydrologic processes and root deterioration can contribute to these effects (Sidle, R. C. 1985). Soil compaction, soil displacement, and vegetation removal can cause changes in hydrologic process. There is a potential for increased frequency of landslides if groundwater conditions change and root strength is diminished. Factors in soil stability not related to management activities include soil type, geology (rock composition and slope shape), and earthquakes.

Existing Condition

Field surveys conducted October 11 and December 5-7, 2006 identified unstable and potentially unstable slopes in Units 7, 8, 9, 12, 25, and 26. Revisions to the proposal were recommended so that timber harvest activities avoided impacts to those portions of the unit.

Unit 4 has a soil mapping "complex" (SMU 5351, Figure 4.6.2) that includes soils which are in transition from "moderately stable to unstable," having a potential for increased mass wasting when construction or timber harvest occurs. Although parts of the unit near the 4720 Road have shallower soils that are not unstable and not prone to increased mass wasting, the increased weathering and moisture of the soils in these dissected slopes indicate that the soils with more unstable properties are the dominant feature of this unit. The north lobes of Unit 6 contain a riparian reserve soil mapped as potentially unstable (Figure 4.6.3). As originally mapped, soils in Unit 7 include about half of the unit in riparian reserves for potentially unstable slopes. Field verification and mapping using GIS technology changed the boundaries of the mapped soil type to that shown in Figure 4.6.4.

The southwest portion of Unit 26 contains unstable slopes. Downhill logging on the steeper slopes west of Road 4725 in Unit 26 is not recommended on slopes less than 40 percent, due to the potential for gouging and damage to the soils on steep slopes.

Alternatives 2, 3 and 4

Direct and Indirect Effects

The rate, size, or number of mass failure events would not change due to the proposed action alternatives or the no-action alternative. Because all the units listed below are treated similarly in Alternatives 2, 3 and 4, there is no difference between the alternatives with respect to effects on slope stability. The distribution of thinning – harvesting away from the wetter riparian soils via a no-cut buffer – also reduces the risk of affecting slope stability.

The risk of increasing the number and frequency of landslides in Unit 4 is mitigated with the buffers created by the riparian reserve standards and the proposed thinning prescription. Thinning to a higher resulting canopy cover, such as those proposed for riparian buffers, would reduce the potential for an increase in mass wasting events in these soils, compared to the heavier upland thinning.

Alternatives 2 and 4 prescribe less trees to be harvested, and would then be less likely

than Alternative 3 to increase the risk of mass wasting. Alternative 3 is also a thin that does not create a significant risk (Relative Density of 41) to potentially unstable slopes in Unit 4. A no-cut buffer of the slopes mapped as Soil Mapping Unit (SMU) 19 in Cowlitz Unit 7 (Figure 4.6.4) would mitigate the risk of landslides.

The buffer around scarp areas in units 8 (north slopes) and 9 (southeast slopes) as proposed would decrease the risk of re-activating an existing landslide. The buffers created by the riparian reserve standards would decrease the risk of affecting potentially unstable slopes near the streams in Unit 25. The buffer around the steep area in the southwest portion of Unit 26 as proposed would decrease the risk of damaging sensitive soils there.

Long-term effects

Long-term effects on soil stability are not expected, as short-term direct effects are expected to be minimal. Because areas of instability would be avoided by excluding them from within units, long-term effects are not anticipated.

Cumulative effects

Because areas of instability will be excluded from units, there would be no expected additive or cumulative effects on soil stability. The project is not expected to increase the number or frequency of soil movement or landslides.

Soil Productivity – Locally Concentrated Losses

The potential effects of the proposed activities on soil productivity are compaction, puddling, displacement, and erosion. Timber harvest, fuels treatment and site preparation can result in soil damage and loss of site productivity.

Soil compaction inhibits root elongation, reduces the infiltration and storage of water and decreases the gaseous exchange between roots and the atmosphere. This can inhibit seedling establishment and can reduce the growth of trees. Reductions in future timber volume are proportional to the degree and extent of compacted soil.

Puddling affects soil productivity in much the same way as compaction. Displacement of topsoil can remove soil nutrients from the root zone of desired vegetation and expose the soil to the forces of erosion. Soil erosion can result in nutrient-rich topsoil moving down slope, away from the root zone of desired vegetation. If eroded soil reaches a stream, it can impair water quality. Exposed mineral soil may promote the invasion of a site by undesirable vegetation.

Based on the best information available, the Standards and Guidelines are believed to be adequate to protect the soil resource. 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 extent and distribution of detrimental soil impacts such as compaction, displacement, and severe burning, measured in percent of each activity area, are used to describe the effects of management activities on long-term soil productivity. A detrimental soil condition occurs when site productivity and hydrologic function are adversely affected by

soil displacement, compaction, soil puddling, severe burning or accelerated erosion. Soil displacement is the lateral movement of topsoil by mechanical forces such as equipment blades, vehicle traffic, or logs being yarded. Mixing of surface soil layers by disking, chopping, or subsoiling, are not considered displacement.

Logging and site preparation can affect the numbers of species and abundance of soil organisms. 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 affect soil organisms.
Efforts to minimize soil disturbance, maintain organic matter, and encourage rapid growth of native vegetation would help to conserve soil organisms, facilitate re-colonization, and maintain forest productivity.

Existing Condition

System roads currently occupy between 0 and 10.6 percent of the activity areas (Table 4.6.2). Landings and skid trails occupy a range of between 0 and approximately 2.2 percent of the activity areas (Table 4.6.2). In addition to system roads, remnants of non-system access roads or skid trails, which were not routinely obliterated or scarified during previous entries, are present throughout most stands. Representative areas of the listed units were traversed on the ground to evaluate soil compaction and displacement.

Evidence of past ground-based timber harvest activities exists within the Cowlitz Thin Timber Sale Unit boundaries that has affected soil productivity in the managed stands (Units 3, 4, 5, 7, 8, 15, 19, 20, 25, and 26). Soils in the project area have been converted to an essentially non-productive condition in the long term (greater than fifty years) due to road construction. Most of the precipitation that falls on the compacted surfaces becomes surface runoff.

Alternatives 2, 3 and 4

Direct and Indirect Effects

Soil productivity would be lost where temporary road and landing areas are built because the surface organic layer which provided nutrients for vegetative growth generally is displaced and not available. Under the action alternatives, the standards and guidelines for soil productivity would be achieved in all activity areas. Full recovery of productivity on temporary roads and landing areas would not be anticipated despite efforts to reclaim these areas because of the nutrient loss.

Table 4.6.2. Approximate extent of detrimental soil conditions currently in Cowlitz Thin units - Existing Condition

Unit	Acres	Acres of System Roads[2]	System Roads (% of unit)	Acres of non-system roads and landings[3]	Existing detrimental soil conditions (% of unit)
3	9	0	0.0%	0	0
4	38	2.4	6.3%	1.2	9.4%
5	19	1.0	5.3%	0.1	5.8%
6	177	5.2	2.9%	2	4.0%
7	33	0.3	0.9%	0.6	2.7%
8	60	0.6	1.0%	0.6	2.0%
9	18	0.8	4.5%	0	4.5%
14	103	2.0	1.9%	2.2	4.1%
15	12	0.1	0.8%	0.1	1.7%
16	129	2.4	1.8%	1.3	2.8%
17	64	3.6	5.6%	0.6	6.5%
19	7	0.5	7.3%	0	7.3%
20	54	3.8	7.1%	0.2	7.4%
25	17	1.8	10.6%	0	10.6%
26	31	3.2	10.2%	0	10.2%

The losses in productivity from these areas would occur on a small part of the planning area, and the analysis between alternatives is mostly the comparison of the extent of this impact. Alternative 1 is the No Action alternative.

Alternative 2 is the Proposed Action of commercial thinning of up to 610 (of 760) acres in the Middle Cowlitz Watershed. A combination of skyline and ground-based logging systems are proposed. Alternative 3 is a modified version of the Alternative 2. Alternative 4 is similar to Alternative 2 except for excluding treatments to the unmanaged stands, Cowlitz Units 6, 9, 14, 16 and 17 (shaded rows in Table 4.6.3).

Ground-Based logging. All the action alternatives would involve ground-based logging of Units 3, 5, 7, 8, 15, 20, 25 and 26. The effects to soil productivity due to the proposed actions would be the same in the action alternatives. Ground-based logging methods would be employed to yard logs on ground of less than 30 percent side slope.

[2] Assuming an 8m road width
[3] Assuming landings are a quarter acre and temp road are 5m wide

Table 4.6.3. Prediction of cumulative remaining detrimental conditions in the Cowlitz Timber Sale Units due to proposed temporary road and landing construction (based on Appendix A: Disturbance Calculations and Assumptions)

Unit No.	Project Specific Soil Disturbance[4]	**Remaining Topsoil Displacement (without mitigation measures)[5]**	Remaining Compacted Soils (with mitigation measures)[6]
3	9.4%	**9.4%**	0.0%
4	0.0%	**9.4%**	9.4%
5	8.1%	**13.4%**	5.3%
6	4.5%	**7.4%**	2.9%
7	2.5%	**3.4%**	0.9%
8	4.3%	**5.3%**	1.0%
9	0.0%	**4.5%**	4.5%
14	2.5%	**4.4%**	1.9%
15	16.8%	**17.6%**	0.8%
16	2.7%	**4.5%**	1.8%
17	0.0%	**5.6%**	5.6%
19	0.0%	**7.3%**	7.3%
20	1.2%	**8.3%**	7.1%
25	0.0%	**10.6%**	10.6%
26	4.3%	**14.5%**	10.2%

Changes in soil productivity are a function of the type, timing, and location of disturbances, and of soil properties in the disturbed areas. Direct effects due to soil disturbing activity occur on site and affect only the area where they occur. Off-site effects, such as sedimentation to streams, occur some time after or some distance away from the disturbance.

Potential effects of the proposed activities on soil productivity are due to compaction, puddling, displacement, erosion, 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.

[4] Temporary roads and landings
[5] Using cumulative displacement of roads (**Error! Reference source not found.**) and skid trails that disturb the topsoil
[6] Using system roads and remaining skid roads & landings as permanent compaction features

Soil impacts would remain less than 20 percent of the project, including existing skid trails. Locally concentrated losses in soil productivity would occur due to additional compaction and displacement. Additional soil damage is expected to be minor with the prescribed logging system design. The percent area to be affected was calculated based on the proposed action. No net loss in soil productivity is predicted in any of the units. The detrimental conditions listed include both the new and existing roads and landings. Between about 3.2 (Alternative 4) and 10.3 (Alternatives 2 and 3) acres of new road and landing construction would occur within the harvest unit boundaries. Once areas have been cleared for roads and landings, the topsoil would not be completely restored. Decaying slash and other organic matter, seeding, and natural processes would help, but displacement of remaining topsoil has a slow recovery time in the short term. The third column labeled "Topsoil Displacement Remaining" in the table below assumes a slow recovery in the short term.

Skyline Logging. Monitoring of skyline logging has shown relatively little damage to soils when done correctly. Because full end suspension would be required on slopes greater than 70% in Cowlitz Unit 4, displacement and erosion would be kept to an insignificant amount of detrimental soil conditions.

Slash Treatment. The effects of slash burning on soils would be insignificant in all the action alternatives. Slash burning is generally not a concern because the extent of burning is relatively small and a fraction of a percent of the unit's area. Slash piles are planned only on landings, which does not add any negative impacts to soil productivity.

Limitations to tractor logging equipment are listed in Table 4.6.4. The assumption is that tractor logging equipment is restricted from slopes greater than 30 percent, and where stated in the table. A "no" under the Tractor Logging heading means tractor logging is NOT permitted for that soil type (Wade, et. al., 1992). A "yes" means it is permitted for the soil types in that unit. Generally restrictions are on slopes greater than 30 percent.

Long Term Effects - more than 50 years

Conditions in disturbed areas would have improved where restored by subsoiling, fertilization and revegetation. Logging slash is an important source of organic matter that supplies sites with nutrients and reduces the potential for surface erosion. Harvesting only

the bole of trees does not greatly deplete nutrients, and losses tend to be associated with whole tree harvest and short rotations. Neither whole tree harvest nor short rotations would be conducted or employed in this sale.

Table 4.6.4. Tractor logging restrictions by Soil Mapping Unit

Cowlitz Thin Harvest Unit	Soil Mapping Unit	Tractor Logging Permitted
Unit 3	58	Yes
Unit 4	5351, 16	No
Unit 4	15	Yes
Unit 5	51	No
Unit 5	15	Yes
Unit 6	51, 5357	No[7]
Unit 6	58, 15	Yes
Unit 7	19	No
Unit 7	15	Yes
Unit 8, 9	19[8]	No
Unit 8, 9	58	Yes
Unit 9	4140	No
Unit 14	4116	No
Unit 14	58	Yes
Unit 15	51[9]	No
Unit 15	58	Yes
Unit 15	51	No
Unit 16	15, 58	Yes
Unit 17	51	No
Unit 17	58	Yes
Unit 19	15	Yes
Unit 20	5116, 16	No
Unit 20	15	Yes
Unit 25	16	No
Unit 25	15	Yes
Unit 26	19, 51	No
Unit 26	15	Yes

[7] For SMU 57, it is permitted on slopes less than 30 percent.
[8] Unit boundary appears to be delineated to avoid this soil type in Units 8 and 9.
[9] Unit boundary appears to be delineated to avoid this soil type in Unit 15.

Cumulative Effects

Temporary road and landings can be restored to accelerate their recovery and reduce long term losses in soil productivity. That recovery is accounted for in the right column of Table 4x labeled "Compacted Soils Remaining." Between about 9.8 (Alternative 4) and 23.8 (Alternatives 2 and 3) acres of temporary roads and landings would be used within the harvest unit boundaries. The majority of the remaining compaction is from National Forest System Roads. Although Cowlitz Unit 4 would not have any temporary road or landings constructed, a skid road system from previous harvest activity exists within the unit that would not be used or restored (subsoiled).

In general, the losses predicted are relatively minor in intensity, and vary with time (Table 5). Short-term losses would be low to moderately damaging to soil quality. This should translate to similar effects on soil productivity.

Some of the units, shaded as rows in Table 4.6.3**Table** , are not included in Alternative 4, but are in Alternatives 2 and 3. Those are units 6, 9, 14, 16 and 17. For those units, the existing condition (Table 3) would be the extent of detrimental conditions remaining.

4.7 Hydrology

Background

This analysis is based on an action area expected to be affected directly or indirectly by the proposed action and alternatives, and not merely the immediate area involved in the proposed action. The Cowlitz Thin aquatic analysis area, or as designated as per this section and the Fisheries section: "analysis area" is located within two 5th field watersheds (Upper and Middle Cowlitz and includes all or portions of five 6th field Hydrologic Unit Codes (HUCs) (Table 4.7.1).

The Cowlitz Thin planning area is located in the Upper Cowlitz River Watershed (HUC 1708000402) and the Middle Cowlitz River Watershed (HUC 1708000403). These watersheds include anadromous fish-bearing portion of the Butter, Skate and Willame sub-watersheds, and small tributaries to the Cowlitz River located in Hall and Coal subwatersheds (Appendix A Map 1).

Physical Conditions. Annual precipitation in the analysis area ranges between 60-100 inches with the greater amounts of precipitation falling at the higher elevations between the months of October and May. Watershed elevations range from a low at the Cowlitz River of about 1,000 feet and about 4,500 feet at the headwaters of Skate and Butter Creeks. The analysis area is predominately within the rain-on-snow zone (1500-3000 ft) leaving it susceptible rapid increase in surface water during warm winter storms. Bedrock made up of alternating layers of volcanic ash (tuffs and tuff breccia) is located within Willame, Butter, and Skate Creek Subwatersheds, accounting for a relatively high number of landslides. Pumice deposits in the analysis area are highly erosive when the vegetative cover is removed.

Table 4.7.1. Location of harvest unit acres and their respective Hydrological Unit Codes (HUC) for the Cowlitz Thin. Lewis County WA.

5th Field Watershed	6th Field Subwatershed			Analysis Area(Ac)	Unit Area[1] (Ac)
HUC Name	Name	HUC	Acres		
Upper Cowlitz	Butter Creek	170800040203	12,244	12,244	60
Upper Cowlitz	Coal Creek	170800040201	12,128	3,524	105
Upper Cowlitz	Hall Creek	170800040204	12,670	2,656	28
Upper Cowlitz	Skate Creek	170800040205	22,409	22,409	312
Middle Cowlitz	Willame Creek	170800040302	13,463	13,463	255
		Total	72,915	54,298	760

[1] unit acres accounts for all area within unit boundary including inner riparian areas and skips

Water Quantity - Change in Peak/Base Flows

Background Information

Vegetation manipulation can affect hydrologic processes at the stand scale (locally), including changes in the interception of precipitation, changes in evapotranspiration, changes in snow accumulation, and changes in rates and timing of snowmelt. These hydrologic changes brought about by vegetation modification can affect the amount and timing of water that is available for runoff from a site, and thus can cumulatively affect streamflows. The degree to which these stand scale changes are manifested at the subwatershed scale in terms of changes in streamflow is dependent upon a number of factors related to both the extent and intensity of the forest manipulation, and characteristics of the site and subwatershed.

Two methods used to predict the sensitivity of subwatershed changes peak-flow magnitude and timing are based on the hydrologic maturity of stands. The Aggregate Recovery Percentage (ARP) is an index of the proportion of a watershed in a "hydrologically mature" condition. As timber harvest occurs, the ARP for that drainage is reduced from 100%, reflecting the loss in hydrologically mature forest cover. Hydrologic maturity is defined for this purpose in terms of the ability of a forest stand to intercept snow and reduce winds across a snowpack. 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 the 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 in the forest generate more water during rain-on-snow events, which can contribute to increased peak stream flows. As an increasing portion of a watershed is put into an open or hydrologically immature condition, the potential for peak flows to be increased becomes greater. The GPNF considers ARP values below 70% to be "a high predicted adverse potential for stream reaches to experience degradation."

The second prediction factor for predicting peakflow sensitivity is by calculating Water Available for Runoff (WAR) percentages. WAR is an estimate of the predicted increase in streamflow due to changes in vegetative cover based on rainfall, tree size, temperature, antecedence snow accumulation and elevation. The GPNF considers WAR percentages above 10% are considered to have the potential to result in contributing to instability of streams.

Additionally, streamflow conditions are readily impacted by precipitation patterns across the contributing area. Four precipitation zones occur throughout the analysis area. The Rain-on-snow zone has the greatest potential to affect peakflows, thus the percentage of a subwatershed within this elevation band is used as an indicator of potential peakflow sensitivity concern. This zone is located between 1,500 and 3,500 feet where shallow snowpacks are common in winter with greater snow accumulation in clearings than in forested acres (USDA 1997).

The values of ARP, WAR, and percent of watershed in the Rain-on-snow zone within the Cowlitz Thin Sale area are summarized in Table 4.7.2. ARP values have increased in the last 10 years with stand growth and limited stand management, which would decrease hydrologic maturity. In the Wind River Watershed, for example, ARPs were found to increase 1-4% in 17 of 24 similar sized drainage areas during a 5 year growth period with limited stand management (USDA 2001). Assuming similar response to a 10 year growth period, ARP for most of these drainage areas could be greater than 85 and considered functioning appropriately. The former Hall Creek subwatershed was predicted to have an ARP value below 70 percent, which would not improve enough in 10 years to exceed 85 percent. For this reason rating for this element on a subwatershed scale remains "Functioning at Risk" while the project area scale rating for this element is "properly functioning".

Direct and Indirect Effects

In the absence of research findings quantifying levels of change in snow accumulation, snowmelt, or evapotranspiration in thinned stands as compared to untreated stands, hydrologists on the Gifford Pinchot National Forest have determined 40 percent canopy closure as a breakpoint between stand conditions that are more reflective of a mature forest, and stand conditions that are more representative of open conditions. It is recognized that the actual change in snow accumulation and in snowmelt doesn't occur at a point, but occurs as a continuum of incremental changes in a number of parameters, but for purposes of evaluating proposed projects, the collective professional judgment of the hydrologists was used to establish a common reference point.

The alternatives being considered would treat between 277 and 760 acres, and thinning would occur in about 83 percent of that area due to skips and riparian and wildlife management buffers. The area being treated ranges between 0.2 and 1.9 percent of the each contributing subwatershed area, as shown in Table 4.7.4.

Table 4.7.2. Peak flow risk ratings for subwatersheds in the Cowlitz Thin Sale area (adapted from USDA 1997).

Old 6th Field Watershed Name	% Watershed in Transient Rain on Snow Zone	% ARP	WAR - % Increase in Peak flow During a 2 Yr. Unusual Event	Peak flow Rating - Reason Rating Received[10]
Coal Creek	11	90	4.3	Low
Butter Creek	11	86	7.9	Moderate – ROS
Hall Creek	22	68	17.6	High – ROS, ARP, WAR
Skate Creek	14	84	6.1	Moderate – ROS
Willame Creek	28	80	7.7	High – ROS, WAR

[10] Peakflow rating reasons: ROS = Watershed exhibits a Transient Rain-on-snow zone greater than 10 percent; ARP = Watershed was found to have ARP less than 70 percent; WAR = Watershed was found to have WAR greater than 10 percent.

Table 4.7.3. Acres and percent of each subwatershed treated within the Cowlitz Timber Sale.

Subwatershed	Total Subwatershed Area (acres)	Cowlitz Thin Units within each subwatershed	Alt 2	Alt 3	Alt 4
Coal Creek 170800040201	12,129	Total Unit Area (acres)	122	122	19
		Percent of Subwatershed	1.0%	1.0%	0.2%
Butter Creek 170800040203	12,244	Total Unit Area (acres)	60	60	42
		Percent of Subwatershed	0.5%	0.5%	0.3%
Hall Creek 170800040204	12,670	Total Unit Area (acres)	29	29	18
		Percent of Subwatershed	0.2%	0.2%	0.1%
Skate Creek 170800040205	22,409	Total Unit Area (acres)	307	307	33
		Percent of Subwatershed	1.4%	1.4%	0.1%
Willame Creek 170800040302	13,463	Total Unit Area (acres)	252	252	166
		Percent of Subwatershed	1.9%	1.9%	1.2%

The post-treatment canopy closure will range between 51 and 71 percent in all areas except 39 acres involved in alternative 2. Since stand closures exceed the 40 percent threshold presented earlier, we assume that thinning the forest to this canopy closure may have some effects on the amount of water available for runoff, but changes at the site scale would be moderated by the remaining forest cover, and not likely to get translated into measurable changes in stream discharge because of the complexities of water routing from hillslopes into nearby streams. Consequently, changes in peak flows or WAR are not modeled or measureable at the stand or site scale.

Several areas within units 7 and 8 have been identified to be infested with “root-rot.” Alternative 2 and 4 includes specific prescriptions to control the spread of “root-rot” by removing the infected trees. The resultant canopy cover of these areas would fall below 40 percent and therefore have some potential to increase snow accumulation through less interception and longer fetch lengths. Table 4.7.3 shows percent of project area within each watershed, and Table 4.7.4 summarizes the areas within each subwatershed that would be have a post-treatment canopy closure of less than 40 percent. These areas represent the only portions of the Cowlitz timber sale that could provide measurable changes in stream discharge.

The combined area of post-treatment canopy closure below 40 percent measures only 39 acres and represents only 0.08% of the combined subwatershed drainage areas. These areas are expected to have increases in snow accumulation and associated increases in runoff, but due to the small size of these areas, and the fact that vegetative buffers exist between these units and the stream network, the probability of the increased runoff affecting subwatershed peak flows is considered low and not measurable.

Table 4.7.4. Areas within Cowlitz Timber Sale alternatives where post-treatment canopy closure would fall below 40 percent.

Subwatershed	Total Subwatershed Area (acres)	Areas that proposed treatment would create canopy closure < 40%	Alt 2 & 4	Alt 3
Butter Creek 170800040203	12,244	Area of treatment (acres)	15	0
		Percent of Subwatershed	0.12%	0%
Hall Creek 170800040204	12,670	Area of treatment (acres)	7	0
		Percent of Subwatershed	0.06%	0%
Skate Creek 170800040205	22,409	Area of treatment (acres)	17	0
		Percent of Subwatershed	0.08%	0%

As such, the magnitude of any changes in peak flows resulting from thinning activity in the Cowlitz Thin planning area is estimated to be low and probably undetectable in the normal variation of streamflow levels found in these streams based on the intensity of the proposed thinning treatments and proportion of the subwatersheds treated in all alternatives.

Cumulative Effects of All Action Alternatives

These alternatives would cumulatively affect forest canopy conditions in the analysis area due to the proposed modifications in canopy cover. For the period of approximately 1939 to the year 1996, approximately 19 percent of the National Forest lands within the watershed were clearcut harvested, six percent were commercially thinned (USDA 1997). Most non-National Forest ownership has also been harvested.

The Upper Cowlitz River Watershed Analysis identified potential peak flow increases of less than 10 percent in all but one subwatershed draining the analysis area. Those estimates were based on current conditions at the time of the analysis (USDA 1997). The increases predicted in that modeling effort were presumably driven by stand conditions resulting from the past harvest that had been done in the watershed by that time. Areas that undergo regeneration harvest exhibit canopy closures of less than 40 percent and can affect peak flows. Regeneration harvest has historically occurred in this area.

Table 4.7.5 summarizes past regeneration harvesting activity on National Forest land by subwatershed. This table also summarizes the distribution of regeneration harvest proposed under Alternative 2.

The total combined regeneration harvest in the analysis area, including all past and proposed regeneration activities, represents between 7 and 37 percent of the contributing area. Based on the proportion of these subwatersheds in which canopies have been or would be reduced below 40 percent closure, and the degree of modification of the treated stands, the cumulative effect of this project is not likely to have measurably changed peak or base flows in the Cowlitz River or its tributaries.

Table 4.7.5. Past and proposed regeneration harvest areas on National Forest System lands within the Cowlitz Thin analysis area. (Past harvest was between1940 and 1996, adapted from USDA 1997).

Subwatershed	Total Area (acres)	Past Regeneration Harvest (acres)	Proposed Regeneration Harvest in Alt 2 & 4 (acres)	Total area Regenerated (acres)	% of subwatershed
Coal Creek 170800040201*	6,613	738	0	738	11.2%
Butter Creek 170800040203	12,244	895	15	910	7.4%
Hall Creek 170800040204*	18,407	3,938	7	3,945	21.4%
Skate Creek 170800040205	22,409	3,417	17	3,434	15.3%
Willame Creek 170800040302	13,463	4,997	0	4,997	37.1%
Total	73,137	13,985	39	14,024	19.2%

Water Quantity: Increase in Drainage Network

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 indicate increased peak flows (Wemple et al., 1996; WFPB 1997).

Stream channel network extension estimates were 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). Table 9 summarizes road and stream density, as well as estimated increases in the stream channel network, that have occurred as a result of existing road construction within subwatersheds in the Cowlitz Timber Sale area.

Wemple et al. proposed that roads modify drainage density by extending the total length of effective surface flow; in other words, extending the 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. Unfortunately gully information was not available for this analysis, so a modified formula was used to represent the stream channel network extension in each subwatershed, where $\mathbf{L}_{RC}$ represents the length of road segments discharging runoff directly to stream channels.

The resulting "post-road" drainage density is a direct reflection of relationships among stream channel length, number of stream crossings, average distance between culverts and drainage area. Drainage network increase based on culvert spacing, number of

crossings and stream channel lengths. Numbers reflect National Forest System Lands only. The estimated distance between ditch relief culverts of 500 feet was used as a conservative value (Table 4.7.6).

The drainage network extension is rated as "Functioning at risk" at the subwatershed scale and project scale. Stream channel network extensions were estimated to be highest in the Willame Creek subwatershed with a 57 percent increase over the pre-management (and pre-road) drainage density condition.

No new permanent road would be constructed under any of the alternatives. All proposed alternatives would construct temporary roads to access landings and thinning units.

Direct and Indirect Effects of all Alternatives

Drainage networks would not be negatively affected by this project because no permanent roads would be constructed or decommissioned. All proposed alternatives would construct temporary roads to access landings and thinning units, but drainage densities will not change since these roads will be removed after use.

Pre-harvest repair will be completed on 0.8 miles of closed roads that may remain seasonally open after harvest to meet long-term Forest objectives. These 0.8 miles of road are located on FR 4710.020 and FR 5270.023, which are overgrown and closing naturally at this time. Since these roads are currently considered "closing naturally" and have not been decommissioned, they are included in existing road calculations. Leaving them in a "seasonally open" status would not affect subwatershed road length or density levels, as they would still be included in these future road calculations until they have been officially decommissioned.

Table 4.7.6. Estimated drainage network increases within the Cowlitz Timber Sale.

Drainage	Area (mi^2)	Drainage network length, miles		Drainage density, mi/mi^2		Percent change
		Streams (L_S)	Road-related extension (L_{RC})[1]	Streams (D_d)	[1]Total (D'_d)	
Butter Creek	19.2	92.0	14.21	4.8	7.2	41
Skate Creek	35.0	199.0	71.9	5.6	6.6	16
Willame Creek	21.0	96.0	63.3	4.6	7.3	57

[1] Assumes distances between stream crossings and relief culverts is 500 feet. Drainage network increase is considered high "risk" >20% and moderate 5% to 20%.

Between 1 and 3.3 miles of temporary road would be constructed under these alternatives. All but 0.1 mile of these roads would be located outside of Riparian Reserves. Most of the temporary roads are on ridges or convex slopes, and as such would have very little accumulation of upslope drainage. Several temporary stream crossings will be constructed, but they are not likely to contribute to extension of the drainage network because stream network increase is affected by new roads, not stream crossings.

All stream crossings will be removed and temporary roads will be obliterated as soon as all harvest activities are complete. No new permanent road would be constructed under any of the alternatives.

The probability of any portion of this project increasing the drainage network density in the watershed is low. There would be no construction or decommissioning of any permanent roads. Any temporary roads constructed for logging this sale and that are not decommissioned prior to the wet season would be weatherproofed by construction of waterbars, crossdrains and grade breaks. This will ensure that surface waters do not concentrate on the road surface and contribute directly to increases in drainage network density.

Cumulative Effects of All Action Alternatives

These alternatives would not cumulatively affect drainage network density within the watershed since no new roads would be constructed. Additionally, no new roads are being proposed on Forest Service lands within these watersheds through any other projects, including the Pinchot Partners Restoration Thin.

Water Quality: Stream Temperature

Water temperature in the Cowlitz Thin analysis area is classified as "Functioning at risk". Skate Creek temperatures are cool within the analysis area, with maximum 7-day averages less than 15^{o}C. Stream temperature increases down stream with the greatest heating occurring off Forest Service lands at the intersection of State and Private lands. Detailed water temperature date is available in the analysis file.

Willame Creek temperatures are warm, with maximum 7-day averages above 15^{o}C and maximum 1-day temperatures exceeding state water quality standards of 16^{o}C. The greatest heating occurs at the confluence of the Cowlitz River. The increase in temperature in the lower reaches of Skate Creek is attributed to channelization. Increase in temperature is also attributed to stream widening resulting from past removal of large instream wood and excessive sediment from roads and landslides in Willame Creek and Skate Creek (USDA 1997, 2006). Water temperatures in Coal Creek and Butter Creek are cool, with maximum 7-day averages less than 15^{o}C. (USDA 2007). Coal Creek and Butter Creek are “Functioning Properly”.

Direct, Indirect, and Cumulative Effects of All Alternatives

Water temperatures will not be affected by this project because no shade producing vegetation will be cut and sediment delivery from the project will not increase stream width, which has the potential to increase stream temperatures by decreasing water column depth.

No thinning would occur in close proximity to streams. No-cut buffers have been prescribed on all streams in part to protect existing shade-producing trees from being cut. The USDA Forest Service and BLM (2004) demonstrated that retaining shade in the primary shade zone while thinning in the secondary shade zone results in no measurable stream temperature increase assuming a perennial stream 20 feet wide or less. Primary shade distances of stands with 100 foot trees were estimated to be 50-60 feet varying by

slope. Based on this analysis, the minimum no cut buffers (60 foot on fish bearing streams when site potential tree height is 220 feet and 60 foot on non fish bearing perennial streams where the site potential tree height is 170 feet) in the Cowlitz Timber Sale are wider than the necessary primary shade zone for adequate shade to prevent increases in stream temperatures.

The probability of increased temperatures as a result of this project is very low due to the project design features that would not permit removal of any shade-producing trees.

Water Quality: Suspended Sediment/Turbidity

Of the various surface erosion processes at work in the watershed, sediment delivery via roads is the most prevalent (USDA 2002). Principal mechanisms for sediment delivery to streams from roads in the Cowlitz timber sale area were identified as: surface ravel from exposed cut-and fill-slopes, side-cast and fill-slope failures, and undermining of roadbeds due to gully erosion associated with insufficient drainage. Additionally, a lack of road maintenance has increased the risk of culvert failure, which could provide additional sediment delivery to streams. Unlike the composition of landslide sediments, 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. Sediment production and transport during periods of runoff is positively correlated with traffic levels, so increased road traffic—particularly heavy truck traffic—has a significant influence on levels of sediment in road drainage during wet conditions. Road drainage is typically delivered to streams through roadside ditches and culvert outlets.

Existing sediment distributions have been identified through Wolman pebble counts during field surveys. The distribution of fine materials at different locations on the stream can be compared. Fish spawning habitat can be negatively affected by excessive amounts of fine materials. Based on data analysis of Wolman pebble counts, the distribution of fine materials termed “sand” remains below 10 percent in all surveyed reach locations. Based on this result, fine sediment delivery from roads and the potential effects to aquatic resources in the Upper and Middle Cowlitz Watersheds are considered to be minimal.

Direct and Indirect Effects

Thinning activities. Thinning outside of Riparian Reserves occurs in all 13 units of the sale under alternatives 2 and 3 and within 8 units under Alternative 4. Minimum no cut/equipment buffer widths were determined based on site specific information, including stream class, channel stability, and site potential tree height. Thinning in Riparian Reserves with the highest channel stability would occur at least 30 feet away from non-fishbearing streams, and a minimum of 60 feet from fishbearing streams. When channel stability was found to be less than optimal, larger untreated buffer widths were assigned. The stream class, minimum untreated buffer width, and proposed logging system for each unit in the Cowlitz Timber Sale can be found in Table 4.7.7.

Table 4.7.7. Logging systems, minimum untreated buffer widths, and stream class for proposed thinning units under Alternatives 2 and 3 in the Cowlitz Thin Sale. Alternative 4 includes the same units except for the highlighted units which would not be treated.

Unit #	Stream Class*	Minimum Untreated Buffer Width (ft)	Logging System in Riparian Reserves
3	I/II/III/IV	120/87/87/30	Ground
4	III/IV	89/33	Skyline
5	II/III/IV	85/89/60	Ground
6	III/IV	60/60	Ground
8	II/IV	60/60	Ground
9	II	60	Skyline
14	III/IV	62/30	Ground
15	III/IV	62/35	Ground
16	III/IV	84/39	Ground
20	III/IV	90/60	Skyline
26	IV	60	Ground

* Definitions of Stream Class:

- Class I streams support anadromous fish
- Class II streams support resident fish
- Class III streams have perennial flow and are not known to support fish
- Class IV streams have intermittent flow and are not known to support fish

Because the felling of trees is not expected to cause appreciable ground disturbance, 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. Trees cut in the units identified for skyline logging would be yarded upslope by cable, with the leading edge of the tree suspended above the ground and the trailing end of the tree dragging along the ground surface. Soil disturbance is expected to occur along skyline paths in these units, making soil available for transport to the stream. However, the probability of this material entering the stream is low because of the distance of the disturbance to the stream and because the untreated forest between the thinning area and the stream would provide significant opportunities for any sediment-laden surface runoff to infiltrate the ground or be detained and filtered as it flows across the undisturbed forest floor.

Due to the distance of thinning from the stream and the intervening untreated riparian forest between thinned areas and the stream, the magnitude of any sediment reaching the stream from thinning and yarding activities would be very low and probably not detectable. The distance of the activities from streams and the presence of intervening riparian areas provides filtering of any sediment laden surface discharges from thinning and yarding outside of Riparian Reserves.

Hauling and Road Activities. 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). Sediment from the road system can be delivered to streams by direct erosion of cut and fillslopes associated with stream

crossings, or by surface runoff from roads and ditches that carries sediment-laden water directly or indirectly to streams. 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 debris before entering streams.

Two of the greatest 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. Traffic levels in the National Forest lands of the Upper Cowlitz River watersheds are very low, thus traffic activities were not considered to be an affecting factor in the analysis of alternatives.

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. Because many of the roads in the vicinity of the Cowlitz Timber Sale are poorly surfaced, and are in many cases directly linked to the stream network through roadside ditch drainage, timing of haul for this project has been limited to the summer months and to dry periods of the early fall to reduce rates of sediment introduction to the Cowlitz River and tributaries (see Mitigation section of this report).

Approximately 48 miles of FS road would be used for this project under Alternatives 2 and 3. Some segments of the road network parallel or are in proximity to streams and there are 79 perennial and intermittent stream crossings on these segments of road to be used for haul in this project. In addition to the stream crossings, there are an unknown number of ditch relief culverts, some of which would have surface channel connectivity with nearby streams during periods of runoff.

Primary haul routes for this project would be Forest Roads 47, 52, and 84, and some combination of arterial systems (Table 4.7.9). A majority of the haul routes on the national forest are unpaved, gravel or native surface roads.

Prior to hauling, portions of the haul route will be treated to repair and improve drainage structures, improve the running surface of the road, and to clear vegetation along roadsides. Following haul, portions of the haul route will again be treated to repair damage done during logging and to restore the roads to a condition that supports normal forest uses and to ensure proper drainage and stability of the roads. Portions of the haul route that are in particularly poor condition will be reconstructed prior to haul activities. Road reconstruction includes application of surface rock, replacing damaged or poorly functioning culverts, adding ditch relief culverts where necessary and replacing or stabilizing fill and subgrade materials. No new permanent road construction would occur with this sale.

Table 4.7.9. Summary of roads used in haul routes for the Cowlitz Timber Sale.

Arterial Road	Collector Road	Local Road	Project Miles
4700			6.31
	4710		1.55
		4710015	0.45
		4710019	0.41
		4710020	0.82
		4710026	0.47
		4710405	0.28
	4715		0.77
		4715012	0.41
		4715405	0.04
	4720		1.78
	4725		1.60
		4725022	0.22
		4725023	0.10
	4730		0.09
	4745		0.13
		4745011	0.91
		4745405	0.28
		4745410	0.34
5200			5.35
	5270		1.92
		5270023	0.47
	5290		8.68
		5290082	0.56
8400			14.20
Total	**Miles**		**48.2**

Planned action for all open permanent roads includes construction of typical drainage control device (e.g. installing waterbar, cross ditch, and sloping road grades), but several miles of road will need definite reconstruction. The project will treat 5.5 miles of existing roads (Table 4.7.10 and 4.7.11). To improve access to units, pre-harvest road repair or reconstruction will occur on approximately 4.7 miles of currently un-drivable roads, and an additional 0.8 miles of road will be only receiving brushing.

Pre-harvest repair will be completed on 2.0 miles of road that are currently closed. All but 0.8 miles of those closed roads will be returned to a closed and stable condition after harvest. The 0.8 miles of closed, but repaired road that may remain open is located on FR 4710.020 and FR 5270.023, which are overgrown and closing naturally at this time. These roads may be kept open seasonally to meet long-term Forest objectives.

Table 4.7.10. Road reconstruction associated with Alternatives 2 and 3 of the Cowlitz Timber Sale. Alternative 4 includes the same roads and treatments except for the highlighted roads which would be not be reconstructed or where reconstruction would be significantly reduced under that alternative.

Road Number	Access to unit(s)	Reconstruc-tion of closed road (miles)	Repair of Open Road (miles)	Road Brushing only (miles)	Install Temp Culverts (# sites)	Length of road within 100 ft of streams (miles)	Aquatic Risk Rating
4710015	16	0.4			2	0.08	M
4710019	16	0.4			1	0.04	L
4710020	6			0.8	0	0	L
4710405	6	0.3			0	0	L
4715000	5,6		0.8		1	0.05	M
4715012	6		0.4		0	0	M
4715405	6	0.04			0	0	L
4725000	26		0.3		0	0.06	H
4725022	26		0.2		0	0	M
4725023	26		0.1		0	0	M
4745410	20	0.3			0	0	M
5270023	8	0.5			0	0.04	L
5290000	14		0.2		1	0.02	M
5290082	14,15		0.6		0	0.17	M
Total Lengths		**2.0**	**2.7**	**0.8**	**5**	**0.45**	**-**

Table 4.7.11. Road treatment projects for Alternatives 2 and 3 of the Cowlitz Timber Sale. Alternative 4 includes the same roads and treatments except for the highlighted roads which would be not be reconstructed or where reconstruction would be significantly reduced under that alternative.

Road Number	Unit Access	Treated Miles	Pre-harvest improvements	Post-harvest treatment
4710.015	16	0.4	Improve surface and drainage for haul, perform roadside brushing, install one temporary culverts and one temporary culvert or drainage dip.	Remove culverts and restore surface road drainages in a self-maintaining condition
4710.019	16	0.4	Improve surface and drainage for haul, perform roadside brushing, install one temporary culvert.	Remove culvert and restore surface road drainages in a self-maintaining condition
4710.020	6	0.8	Reopen by cutting overgrown vegetation	Restore surface road drainages in a self-maintaining condition
4710.405	6	0.3	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
4715	5,6	0.8	Improve surface and drainage for haul, perform roadside brushing, install one temporary culvert. (T. 13N, R 9, Sec. 18)	Remove culvert and restore surface road drainages in a self-maintaining condition
4715.012	6	0.4	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
4715.405	6	0.04	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
4725	26	0.3	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
4725.022	26	0.2	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
4725.023	26	0.1	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
4745.410	20	0.3	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
5270.023	8	0.5	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition
5290	14	0.2	Improve surface and drainage for haul, perform roadside brushing, install one temporary culvert or drainage dip	Remove culvert and restore surface road drainages in a self-maintaining condition
5290.082	14,15	0.6	Improve surface and drainage for haul and perform roadside brushing.	Restore surface road drainages in a self-maintaining condition

Otherwise, post-harvest treatments include road closures and stabilization. Pre-harvest repairs of existing roads will also include installation of temporary stream crossings that will be removed post-harvest to restore natural hydrologic function. Alternatives 2 and 3 include the construction of five temporary stream crossings over existing closed roads, whereas Alternative 4 would necessitate construction of two temporary stream crossings.

Temporary roads will be necessary to access portions of some units. These roads will be managed throughout the life of the project and then obliterated. If in use more than one season, roads will be weatherized prior to the onset of wet weather in the fall. Following completion of harvest, all temporary roads and skid trails will be treated including out-sloping, sub-soiling to a depth of approximately 18 inches to reduce ground compaction (in areas where greater than 60 feet of continuous soil compaction or displacement as identified by 6-inch deep ruts has occurred), and seeding and mulching. Native seed will be applied as described in the mitigation measures. Prior to any expected seasonal period of precipitation and runoff, and after sale activities are complete, cross drains and grade breaks will be installed on all temporary roads and skid trails. In addition, the temporary spur road would be sub-soiled post-sale. In special cases (i.e. stream crossings, contributing areas near streams, or other sensitive areas along existing roads), mulch, erosion matting or re-contouring may be used as needed to prevent or reduce sedimentation. The expectation of this treatment includes the maintenance of soil permeability and soil productivity, and the near-elimination of increased channelization of surface flows in harvest units near streams originating from temporary roads and harvest related activities. Following harvest, all Forest roads used as haul routes will be restored to pre-harvest conditions.

Construction of approximately 3.3 miles of temporary roads will occur to access various units under Alternatives 2 and 3, and 1.0 miles of temp road would be constructed under Alternative 4. Approximately 0.1 mile of temp road would be located within the outer Riparian Reserves (Units 3 and 15). One temporary stream crossing would also be created on the temp road accessing the southwestern section of unit 3, which is included in all action alternatives. This crossing is located over an intermittent channel, which has been interrupted by FR 5290 and has lost connectivity with its historic stream course. Table 4.7.12 summarizes the lengths of temporary road to be constructed under each alternative, as well as the number and acreage of landings.

Table 4.7.12. Approximate length (feet) of temporary road and landing construction by alternative for the Cowlitz Timber Sale.

Activity	Alt 2 & 3	Alt 4
Total Length of Temp Roads (mi)	3.3	1.0
Length of Temp Roads in RR (mi)	0.1	0.1
Total Number of Landings (#)	116	58
Area of New Landings (acres)	7.0	2.3

Approximately 116 landings have been identified for the sale under Alternatives 2 and 3, while Alternative 4 would include 58 landings. Most of these landings are on existing road systems and will require minor brushing around the edges to make them functional. However, some earthwork would be required to clear and establish a site that is suitable to landing logs and to provide access for log trucks.
Newly constructed landings are estimated to total 7.0 acres under Alternatives 2 and 3, which reduces to 2.3 acres under Alternative 4. Landings that lie outside normally traveled road surfaces would be rehabilitated by scarification, waterbarring where necessary, and application of seed and/or mulch as described in mitigation measures.

Comparison of Alternatives

The proposed alternatives can be compared using standard, measurable evaluation criteria. The water quality criteria related to increased sediment production and their quantifiable indicators used in the Cowlitz timber sale are summarized in.

Indirect and Direct Effects

Although Table 4.7.13 combines the evaluation criteria results for alternatives 2 and 3 into the same areas, the amount of sediment to be introduced to the stream network differs between these two alternatives. The unit treatment prescriptions differ between alternatives in that Alternative 3 calls for higher amounts of downed wood to be left on the ground than the levels prescribed in Alternative 2. Vegetation cover, including downed wood, provides a capture mechanism for sediment before it can be transported into streams, thus a higher level of downed wood would provide improved upland sediment capture. Additionally, areas within units 7 and 8 have been identified to be infected with "root-rot," and the treatment prescriptions for these small areas vary between Alternatives 2 and 3.

Table 4.7.13. Comparison of proposed alternatives from the Cowlitz Timber sale on risks to increased stream sediment production.

Description	Indicator	Alt 2 & 3	Alt 4
Risk to stream sediment from logging systems	Area of Skyline Corridor disturbance (acres)	1.0	0.5
	Area of Ground-based logging disturbance (acres)	66.6	20.5
	Total Area of Ground Disturbance (acres)	**67.6**	**21.0**
Risk to stream sediment from ground disturbance associated with log transportation	New Road construction (acres)	0.0	0.0
	Temp Roads construction outside RR (acres)	4.6	1.3
	Temp Roads construction within RR (acres)	0.1	0.1
	Area of New Landing construction (acres)	7.0	2.3
	Total Area of Ground Disturbance (acres)	**11.8**	**3.7**
Risk to stream sediment from crossing aquatic features	Stream Crossings within Haul Route	79	73
	Temporary Stream Crossings on existing roads	5	2
	Temporary Stream Crossings on temp roads	1	1
	Total Stream Crossings	**85**	**76**

Alternative 2 includes a prescription that would eradicate and control the spread of "root-rot" by removing a higher density of the infected trees than Alternative 3. As such, more ground-disturbance and vegetation removal would occur in these areas through Alternative 2.

With this project, there is a high likelihood that some sediment from the road surface will enter the Cowlitz River and tributaries from haul traffic, but also as a result of the road reconstruction and maintenance activities. In particular, small amounts of sediment are expected to reach riparian reserves from the 2.8 miles of non-paved roads (Alt 2 & 3) that will be used for haul within 100 feet of streams, as well as the 0.5 mile of road (Alt 2 & 3) within 100 feet of streams that will need repair or reconstruction. The operating season for road reconstruction and maintenance work and for hauling logs has been limited to include the months of June through October 1, unless dry conditions persist through the fall, in which case a waiver may be granted. This has been done to reduce the amount and duration of erosion that occurs from the road-related activities. Nevertheless, disturbance of the road surface both by construction-related activities and by hauling will generate sediment and dust, and some of this material will be transported to the aquatic system either during the time of disturbance or during subsequent periods of runoff.

Assuming all haul activities and road work occur during the dry months and that there are no unseasonable precipitation events, the amount of material actually transported to streams is expected to be relatively low during the period of haul and maintenance or reconstruction, except for those sites where temporary stream crossings will be constructed. The placement of temporary 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 bed prior to laying new pipe. Although best management practices will be used to minimize the actual sediment introduced to the stream (see Mitigation Measures), there is no way to completely avoid sediment introduction and disturbance of the stream channel in this process.

There are a total of approximately 4 temporary stream culverts to be placed for completion of this project under Alternatives 2 and 3 and one of these temporary crossings would be constructed under Alternative 4 (into Unit 3). All of these streams flow only intermittently and are expected to be dry at the time of the work. Streams that are dry during construction activities would not experience the increased turbidity until they are rewatered and as loose fill material and soil is mobilized and entrained in the flow. These effects would be relatively short term pulses of high turbidity and sediment movement in the impacted streams. As transportable material is removed from the site, the turbidity levels decrease rapidly to near pre-project levels.

Summer blading of the road surface, ditch cleaning, maintenance and reconstruction work and timber hauling will similarly create conditions that would allow increased erosion and sediment delivery to streams. Some sediment introduction would be expected during the summer months from the dust created by these activities and by subsequent vehicle traffic on the newly treated roads. But because the road work and hauling are scheduled for the dry months, most of the sediment delivery from these

actions would occur later in the fall when precipitation and runoff levels increase. During the first significant runoff event of the fall, there would be flushing of sediments from road surfaces and roadside ditches into tributaries and surface channels that are connected to the stream. Based on research conducted elsewhere in the state of Washington, turbidity and suspended sediment levels would climb rapidly as ditchflow 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).

Cumulative Effects of All Action Alternatives

The effects described above for Alternatives 2 through 4 would be cumulative with other forms of sediment production and introduction in the Upper Cowlitz Watershed. Roads and road uses from general forest uses contribute sediment to the Cowlitz River system, and would add to the sediment estimates provided in this analysis.

Some additional work may be completed by the Forest Service and other entities in this area in regards to road stabilization, closures, and stream-crossing improvements (Table 4.7.14). The Pinchot Partners Restoration Thin has identified 1.5 miles of roads that need reconstruction in the area. The Forest Service has identified an additional 3.6 miles for potential sites for road closures to restore hydrologic function, promote the establishment of native plants and wildlife, and to eliminate motor vehicle access. An additional 0.3 miles is also being considered for stream crossing improvements to meet a variety of objectives.

Fish passage restoration would be created at the FR 4700 crossing of the North Fork Willame Creek, FR 4725 crossing of Willame Creek, and at the FR 4740 crossing of Long Lake Creek. Culvert improvements on FR 4700 would replace an undersized pipe with a right-sized pipe to accommodate 100-year flows.

The cumulative effects for Cowlitz Thin sale will typically result in a trend toward restoring the long-term function and process of the aquatic ecosystem. Fine sediment may reach the stream through log haul and temporary road construction operations.

Table 4.7.14. Proposed Forest Service road activities within the analysis area.

Road Number	Treated Miles	Proposed road treatment
4710.023	0.6	Restore drainages, sub-soil and install road closure berm.
4700	0.2	Fish passage restoration at stream crossing on North Fork Willame Creek (T. 13N, R 8, Sec. 9 and 12) and upgrade a culvert at stream crossing that flows into Willame Creek, (T.13N, R 8, Sec. 12 and 13),
4700.019	0.5	Restore drainages, sub-soil and install road closure berm.
5200.200	0.1	Restore drainages, sub-soil and install road closure berm.
5290.424	0.8	Restore drainages, sub-soil and install road closure berm.
4725.030	0.4	Restore drainages, sub-soil and install road closure berm.
4740	0.1	Fish passage restoration at stream crossing on Long Lake Creek on (T. 13N, R 8, Sec 11)
4720.404	0.7	Restore drainages, sub-soil and install road closure berm.
4720.405	0.2	Restore drainages, sub-soil and install road closure berm.

4.8 Fisheries

This analysis addresses the effects of the Proposed Action and alternatives of the Cowlitz Thin Timber Sale which proposes commercial thinning of up to 613 of 760 acres in 15 harvest units in the Upper Cowlitz and Middle Cowlitz Watersheds. A combination of skyline and ground-based logging systems are proposed. Silvicultural prescriptions would treat Riparian Reserves by commercially thinning in the outer riparian reserve and felling trees to be left as down wood in the interior riparian reserves. All stream courses would be removed from commercial harvest by an inner no-harvest buffer by the placement of a variable width buffer that is based on inherent channel stability and stream class.

Up to 92 total acres of Riparian Reserves would be treated; trees would be removed from 61 acres of the outer riparian reserve, and 32 acres of inner riparian reserve would not be harvested. Both the inner and outer reserve area will receive a thinning treatment to produce down wood at a density of 5% and 3% respectively. The riparian silvicultural management objective is to develop late seral characteristics, structural and compositional diversity and promote channel stability (Appendix A).

One to 3.3 miles of temporary road would be built. New temporary road construction includes one temporary stream crossing on an intermittent stream. After logging operations are complete, these temporary roads would be subsoiled, seeded, and closed to vehicular traffic. No new permanent roads would be constructed. Up to 3.6 miles of road may potentially be stabilized, depending on the availability of additional funding.

Instream and Riparian Habitat

Current Conditions

Anadromous fish distribution in the Upper Cowlitz Watershed extends up the Cowlitz River into headwater streams including Skate, Butter and Willame Creek (Table 4.8.1). Anadromous fish have access to the first natural permanent migration barriers ranging from 1.98-17.47 miles upstream of the Cowlitz River confluence (USDA 1991, USDA 1994). Anadromous species documented as present in the planning area include Chinook salmon, coho salmon, and steelhead trout.

Of these fish, the National Marine Fisheries Service (NMFS) has listed Lower Columbia River steelhead trout (*Onchorynchus mykiss*), Lower Columbia River Chinook salmon (*O. tshawyscha)* and Coho salmon *(O. kisutch)* as threatened under the Endangered Species Act (1974) (Table 4.8.2). Chum salmon (*O. keta*) populations have never been documented above the Cowlitz River Dams and are not expected to be included in salmon reintroduction efforts above the mainstem Cowlitz River dams. Steelhead trout, Chinook and Coho salmon are transported (trucked) around the three dams on the Cowlitz River making the Cowlitz River and its tributaries accessible to these species.

Table 4.8.1. TES fish species presence within the upper Cowlitz River 5th Field Watershed (USFS Fish Distribution Database, 2006).

Stream Name	Species	Fish Distribution (RM)[1]	Habitat Length (RM)[2, 3]	Run Time
Butter Creek	Coho	0 - 2.75	2.75	Late fall
	Steelhead	0 - 2.75	2.75	Late winter
Skate Creek	Coho	0 - 17.47	17.47	Late fall
	Steelhead	0 - 17.47	17.47	Late winter
	Chinook	0 - 17.47	17.47	Spring
Willame Creek	Coho	0 - 1.98	1.98	Late fall
	Steelhead	0 - 1.98	1.98	Late winter
Cowlitz River	Coho	189.46 – 201.91	12.45	Late fall
	Steelhead	189.46 – 201.91	12.45	Late winter
	Chinook	189.46 – 201.91	12.45	Fall/spring
Unnamed Tribs	Coho	Varies	4.0	Late Fall

[1]RM – Total river miles within the analysis area
[2] Only a portion of the Hall and Coal Ck 6th field length is within the analysis area.
[3] Approximately 4 unnamed tributaries less than .5 miles each enter the Cowlitz river within the analysis area.

Timber harvest activities have the potential to adversely affect instream habitat conditions and aquatic species including resident trout, Chinook and coho Salmon, and steelhead trout, all of which are listed Threatened or Endangered species (TES) known to exist in the upper Cowlitz subwatershed. Increases in bedload fine material (channel substrate < 0.84 mm.) may have deleterious impacts on salmonid egg to fry survival and primary and secondary production. Reduction in channel complexity may reduce hiding and holding habitat through the physical alteration of channel micro habitat features (eg. instream large wood and pools).

Anadromous fish are not present within the Cowlitz Thin unit boundaries. Units 7 and 8 are within 0.25 miles of habitat within Butter Creek, however. An unnamed tributary of Coal Creek also has anadromous fish presence, and is located near Unit 3. Fish have been documented in this tributary stream, which is intermittent. However, fish migration is currently restricted by residential development, flood control structures, subterranean flows and the FR 5290 road alignment. Consequently, anadromous fish passage is limited to movement through a seasonally inundated ditch line with very marginal depth and velocity to allow fish passage. Given the break in connectivity to the Cowlitz River system and low likelihood of anadromous distribution near Unit 3, this analysis considers the closest quality fish habitat to be the Cowlitz River which is located approximately 0.5 miles away.

Table 4.8.2. The Evolutionarily Significant Units (ESU), proposed critical habitat, and candidate ESUs in the Cowlitz River Basin and Cowlitz Thin analysis area.

Species	ESU	Species Acronym	ESA Status	Federal Register Notice and Date of Listing
Chinook Salmon	Lower Columbia River	LCRC	Threatened, Designated critical habitat	64 FR 14308 3/24/99, 70 FR 52629 09/02/05
Steelhead	Lower Columbia River	LCRS	Threatened, Designated critical habitat	63 FR 13347 3/19/98, 70 FR 52629 09/02/05
Coho Salmon	Lower Columbia River	LCRCo	Threatened	70 FR 37160 6/28/05

Alternatives 2, 3 and 4

Silvicultural treatment in the riparian reserve may affect channel stability and sediment delivery which has the potential to indirectly affect habitat and channel conditions. Quantifiable measures of the risk of increased soil erosion is calculated based on potential ground disturbance on riparian soils prone to deep seated mass movement and/or surface soil erosion (USDA 1992). Potential risk to channel stability (Pfankuch 1975) is another variable used to measure potential effects to habitat and channel condition. Tables 4.8.3 and 4.8.4 summarize habitat and channel condition variables for the Cowlitz Thin project.

Most activities proposed as part of the Cowlitz Thin project, including thinning of uplands and riparian reserves and hauling would have a neutral effect on aquatic habitat. Transportation system management including road maintenance and reconstruction may have a negative short-term effect and a neutral long-term effect on instream habitat.

Commercial thinning in Riparian Reserves in anadromous watersheds is proposed on a total of 61 acres including units 3, 4, 5, 6, 8,14,15,16, 20, 25 and 26 under Alternatives 2 and 3. Alternative 4 would treat . A no-harvest buffer will provide an inner Riparian Reserve streamside protection zone ranging from 30-112 feet on non-fish-bearing streams and 85-112 feet on fish-bearing streams.

Thinning operations inside and outside the riparian area would produce an estimated 68 acres of disturbance from logging systems (skyline, temporary skid roads and landings). Logging systems including skid trails would be set back from streams more than 100 feet. Landings would not be created within Riparian Reserves, and 0.1 miles of road would be constructed and subsequently subsoiled in riparian reserves. Anadromous fish-bearing streams do not exist within harvest unit boundaries, and the closest quality spawning habitat is approximately 0.5 miles downstream from an intermittent stream crossing on Unit 3. Consequently, the effect of commercial thinning inside and outside the riparian is considered neutral.

Table 4.8.3. Summary of habitat condition and channel condition variables analyzed for Cowlitz Thin, Alternatives 2 and 3. Lewis County, Washington.

Unit	Harvest Area (acres)	Riparian Reserve Harvest Area[1] (Acres)	Channel Stability Risk[2] (Acres)	Fine Sediment - Surface Soil[3] (Acres)	Sediment - Mass Movement[4] (Acres)
3	9.0	5.1	5.1	5.1	0.0
4	27.0	17.4	27.8	33.1	19.6
5	16.0	5.6	7.1	0.9	0.0
6	123.0	3.5	4.2	7.8	0.0
7	28.0	0.0	0.0	0.0	0.0
8	50.0	2.0	3.2	4.1	0.0
9	13.0	0.8	0.9	0.0	0.0
14	47.0	14.7	18.7	30.2	0.0
15	9.0	3.3	4.6	0.8	0.0
16	89.0	1.7	3.2	3.2	0.0
17	39.0	0.0	0.0	0.0	0.0
19	7.0	1.6	1.6	0.0	0.0
20	45.0	4.1	6.1	0.7	0.0
25	14.0	0.4	0.4	0.0	0.0
26	26.0	1.3	2.4	0.9	0.0
	542.0	**61.4**	**85.2**	**86.7**	**19.6**

Table 4.8.4. Summary of habitat condition and channel condition variables analyzed for Cowlitz Thin, Alternative 4. Lewis County, Washington.

Unit	Harvest Area (acres)	Riparian Reserve Harvest Area[1] (Acres)	Channel Stability Risk[2] (Acres)	Fine Sediment - Surface Soil[3] (Acres)	Sediment - Mass Movement[4] (Acres)
3	9.0	5.1	5.1	5.1	0.0
4	27.0	17.4	27.8	33.1	19.6
5	16.0	5.6	7.1	0.9	0.0
7	28.0	0.0	0.0	0.0	0.0
8	50.0	2.0	3.2	4.1	0.0
15	9.0	3.3	4.6	0.8	0.0
19	7.0	1.6	1.6	0.0	0.0
20	45.0	4.1	6.1	0.7	0.0
25	14.0	0.4	0.4	0.0	0.0
26	26.0	1.3	2.4	0.9	0.0
Total	**231**	**40.8**	**58.3**	**45.6**	**19.6**

The proposed transportation management activity would not construct any new permanent roads. There would be a total of 3.3 miles of temporary road construction of which all but 0.1 mile will be located outside of the riparian reserve under Alternatives 2 and 3, and approximately 1.0 miles of temporary road construction under Alternative 1. Temporary road construction in unit 3 is approximately 0.5 miles from spawning habitat and the only temporary road development which has the potential to negatively affect fish and their habitat.

Direct and indirect effects

Proposed project activities including thinning inside and outside of riparian areas and haul activities are not expected to introduce measurable sediment into the area streams and will have a discountable probability of impacting downstream spawning. Riparian treatment is designed to avoid areas of instability and high risk sediment delivery from surface soil erosion and mass wasting. Because of streamside buffers, the low intensity and duration of disturbance, the impacts will be immeasurable. Riparian reserve treatments would be designed to maintain riparian function in the short-term and improve riparian function over the long term. The Forest Service would designate the location of skid trails outside of inner riparian reserves, limiting them to the out third of the reserve to minimize the potential to route water and sediment to streams. After the skid trails are no longer needed for this sale, the purchaser would subsoil the trails where compaction occurs to minimize the routing of water and sediment to stream courses. The combination of skid trail placement guided by project design criteria and best management practices and post harvest treatment is expected to have a neutral impact on the risk of routing sediment to streams.

Temporary road construction and reopening existing skid trails and non-system roads as proposed may have short-term negative impacts on aquatic and riparian habitat in Unit 3. Mitigation measures would treat disturbed areas post timber harvest and timing restrictions would be expected to reduce the rate and timing of sediment delivery by limiting work to the dry season. The combination of design features and restoration measures should successfully diminish sediment yield to a short term, but insignificant, increase in sediment is expected from initial transportation system preparation for haul.

There would be a positive effect from the treatment of existing non-system road and skid trail remnants, which are currently a source of sediment where past ground disturbance has resulted from previous harvest entries. Proposed subsoiling of remnant roads and skid trails should reduce routing of surface water and reduce potential sedimentation sources and delivery to streams.

The post harvest treatment of remnant skid trails and roads is expected to have a positive long term influence on the sedimentation. Additional projects funded from other sources would potentially improve drainage on an estimated 3.6 miles of system road proposed for stabilization and decommissioning. Project Design Criteria and construction best management practices would reduce sedimentation following decommissioning and stabilization activities. This work would be accomplished separately from this timber sale.

Transportation system management would have a short-term negative effect on proposed critical habitat. While insignificant amounts of sediment may be mobilized during initial transportation system development (blading, stream crossing repair, etc) there would be no long-term effects due to Cowlitz Thin's transportation system activities. Roads that are maintained or repaired for the project would be returned to a self-maintaining condition that would allow drainage and minimize the need for future maintenance. This would be achieved by restoring stream crossings, constructing cross drains, shaping the road surface, etc. Road maintenance and use are expected to be a chronic source of sediment but impacts should not elevate above baseline conditions.

Road stabilization post harvest includes several culverts removals of which five are associated with closure of four existing roads and one temporary road. Road stabilization will result in the reestablishment of runoff processes including hydrologic continuity within intermittent streams. This would result in a long-term positive effect on Riparian Reserves.

Harvest inside and outside of riparian areas would be expected to have discountable effects on sediment delivery due to silvicultural prescriptions that are effective at maintaining forest structure and protecting streams. Thinning activities would retain a post harvest canopy relative density closure ranging from 40-71 in Alternatives 2 and 4, and 55-71 under Alternative 3. Harvest prescriptions would increase down wood by adding 3% and 5% woody material in the riparian inner and outer reserve, respectively. Large wood, which adds structure and contributes to habitat formation and stream stability, would be maintained or enhanced by prescribed riparian treatment and should provide physical channel characteristics to scour pools and stabilizing lower stream banks. Prescriptions that enhance tree growth would accelerate the production of large trees that would become a future source of large wood. The no-harvest streamside buffers would protect stream banks from excessive erosion, sloughing, and compaction. Therefore there are no expected changes to physical channel or habitat conditions from the activities proposed in any of the action alternatives. The long-term trend would be an improvement in overall riparian and aquatic conditions in the vicinity of the Cowlitz Thin.

Timber haul activities have the potential to contribute sediment to streams. Haul traffic would cross riparian reserves on existing, maintained Forest roads. Depending on end-point location for thinning products, timber haul would occur along about 48 miles of road, with 78 perennial and intermittent stream crossings, most frequently crossing Willame Creek. The paved Forest Road 8400 connects to Forest Road 5200, which eventually reaches Washington State Highway 706. Small amounts of log haul-related sediment are expected to reach riparian reserves from the 2.8 miles of non-paved roads that will be used for haul within 100 feet of streams.

Sediment is efficiently trapped on the hillslopes. Road surface derived sediment from non-paved roads would be delivered to the forest floor and streams either directly or via ditches during higher flows (storm events or snow melt). Riparian reserve prescriptions within units should provide adequate filtration area and surface roughness to trap sediment in place within the riparian reserve and prevent the delivery of sediments to the streams from temporary roads, landings and skid trails. Vegetation effectively traps fine

sediments where drainage systems adequately facilitate the flow of water intercepted by roads via ditch relief pipes onto the forest floor.

Sedimentation due to log haul is considered short-term in duration, and minimized as long as it occurs during the dry season. Dust abatement using water may be used to minimize sediment delivery via suspension of dust particles. The duration of sedimentation due to log haul is expected to last one rainy season following harvest and hauling activities, which could occur over a two to three year period.

Most sediment is expected to be trapped and stored either on the forest floor or in tributary streams before reaching anadromous stream reaches. In the event sediment is delivered downstream to fish-bearing stream reaches, the magnitude of material transported to streambeds and the potential effects to substrate composition is expected to be insignificant.

Cumulative Effects

Planned and ongoing projects in the Upper and Middle Cowlitz subbaisns
There are no planned or ongoing projects which are Likely to Adversely Affect listed fish or their critical habitat in the Upper Cowlitz and Middle Cowlitz subbasin.

- Planned activities in the foreseeable future occurring in the Upper and Middle Cowlitz include 1,583 acres of pre-commercial thinning (see Appendix)
- 3.6 miles road decommissioning and culvert replacement projects (see Appendix)
- Approximately 250 acres of commercial thinning in the Davis Creek drainage, Upper Cowlitz River Watershed, Dry Burton Thin planned for sale in 2007
- Approximately 1500 acres of commercial thinning in the Upper Cowlitz River Watershed, Pinchot Partners Restoration Stewardship Sale planned for sale in 2008/2009
- 200 acres of bough sales,
- 200 acres of firewood collection
- 10 acres of riparian planting,
- Unknown acres of dispersed recreation development and decommissioning.

Twenty-one acres of commercial timber sale activity (Smoke Salvage) has occurred since the last updated of Watershed Analysis (1997) and baseline analysis (2002) in the Upper and Middle Cowlitz Watersheds.

Additional work may be completed by the Forest Service and other entities in this area including to road stabilization, closures, and stream-crossing improvements. The Pinchot Partners Restoration Thin has identified 1.5 miles of roads that need reconstruction in the area. The Forest Service has identified an additional 3.6 miles of potential sites for road closure and stabilization to restore hydrologic function, promote the establishment of native plants and wildlife, and to eliminate motor vehicle access. An additional 0.3 miles is also being considered for stream crossing improvements to meet a variety of objectives. Fish passage restoration would be created at the FR 4700 crossing of the North Fork Willame Creek, FR 4725 crossing of Willame Creek, and at the FR 4740 crossing of Long Lake Creek. Culvert improvements on FR 4700 would replace an

undersized pipe with a right-sized pipe to accommodate 100-year flows. A complete list of these additional Forest Service road projects can be found in Table 4.8.5.

The potential for the Cowlitz Thin project to contribute to cumulative effects is considered low, as the duration of potential effects, in particular sedimentation, to instream and riparian habitat is expected to be short-term and discountable. The silvicultural treatments within Riparian Reserves are expected to contribute to a long-term trend in the improvement of function of the aquatic and riparian ecosystem.

Other commercial thinning and restoration projects listed above are also designed to contribute to the overall restoration of aquatic and riparian habitat and ecosystems. Individually, all projects would have the potential to cause short-term pulses of sediment delivery to streams in the project vicinity and immediately downstream. All projects taken together may produce a short term, but larger pulse of sediment. Cowlitz Thin Timber Sale project design criteria and mitigation measures consider this potential by limiting harvest to the dry season, and implementing project design criteria and best management practices that reduce sediment delivery to Riparian Reserves and streams.

Endangered Species Act Effects Determination

Based on the analytical process documented in the Cowlitz Thin Fisheries Biological Assessment, the Cowlitz Thin would have neutral or a slightly positive effect on the following indicators at both the site and 6th field watershed scales: Riparian Reserves, Temperature; Large Woody Debris; Peak/Base Flows; Road Density & Location; Chemical Contamination/Nutrients; Physical Barriers; Pool Area: Pool Quality; Pool Frequency; Streambank Condition; Floodplain Connectivity; Disturbance History, and Refugia. Cowlitz Thin has a Neutral influence on essential features of proposed critical habitat rearing and migration.

Table 4.8.5. Proposed Forest Service road activities within the analysis area.

Road Number	Treated Miles	Proposed road treatment
4710.023	0.6	Restore drainages, sub-soil and install road closure berm.
4700	0.2	Fish passage restoration at stream crossing on North Fork Willame Creek (T. 13N, R 8, Sec. 9 and 12) and upgrade a culvert at stream crossing that flows into Willame Creek, (T.13N, R 8, Sec. 12 and 13),
4700.019	0.5	Restore drainages, sub-soil and install road closure berm.
5200.200	0.1	Restore drainages, sub-soil and install road closure berm.
5290.424	0.8	Restore drainages, sub-soil and install road closure berm.
4725.030	0.4	Restore drainages, sub-soil and install road closure berm.
4740	0.1	Fish passage restoration at stream crossing on Long Lake Creek on (T. 13N, R 8, Sec 11)
4720.404	0.7	Restore drainages, sub-soil and install road closure berm.
4720.405	0.2	Restore drainages, sub-soil and install road closure berm.

The analysis determined that there would be a short-term, slightly negative effect to the Sediment and Substrate indicators due to the possibility of minimal amounts of fine sediment entering unnamed tributaries to the Cowlitz River from a temporary road crossing in Unit 3. The crossing and haul activities would occur in the dry. Most fine sediment would be captured prior to entering anadromous fish-bearing portion of the channel located more than 0.5 river miles downstream. Therefore, the negative effect is expected to be of low intensity and low duration, minimized by lack of proximal activities. Discountable effects should be limited to the first precipitation event large enough to cause road surface run-off and a very minimal amount of fine sediment is predicted to be delivered to downstream habitat where listed and proposed fish species and their proposed critical habitat are found. The effects to Lower Columbia River/Southwest Washington ESU habitat are expected to be insignificant. Over the long-term there would be a positive trend toward improved sediment, and substrate conditions and Spawning habitat due to restored roads and natural channel restoration in the Upper and Middle Cowlitz watersheds.

The effects determination for the Cowlitz Thin Timber Sale is "**may affect, but is not likely to adversely affect**" (NLAA) Lower Columbia River steelhead trout, Lower Columbia River chinook salmon, and Lower Columbia River coho salmon, and designated critical habitat for LCR steelhead and LCR Chinook.

Project design criteria and analysis conclusions that contribute to the NLAA effect determination are summarized below:

- The proposed action contains project design features that will minimize or eliminate sediment delivery into streams including limited activity in riparian reserves, no-disturbance buffers on all streams, and obliteration and planting of temp roads and landings. No listed or proposed NMFS fish species' fish-bearing streams or proposed critical habitat are located within treatment areas.
- The proposed road work is reconstruction or reopening 3.3 miles that will occur on upper slopes distant from fish-bearing streams, thereby minimizing road-related sediment concerns. Currently washed-out roads will be stabilized after harvest is completed.
- Thinning in riparian reserves will only affect 61 acres and all riparian thinning will occur in the outer margins of the interim buffer width. Furthermore, canopy closure will be retained at a targeted 40-45 relative density. This is not expected to have any effect on stream temperature or LWD recruitment in listed fish habitat.
- Timber management is prescribed on harvest units no closer than 0.5 miles from quality habitat where there is listed fish.
- No new permanent roads are proposed.
- There is some potential for discountable amounts of sediment input into local streams from log haul transportation. However, potential sediment delivery will be minimized with the restriction of dry weather hauling, the majority of which will occur from July 15 to Oct 31. The haul roads adjacent to listed fish habitat in Skate, Butter and Willame Creeks will be improved or maintained with this proposal. Fine sediment may enter from a single stream crossing nearest to anadromous fish habitat but the amount of sediment produced is expected to be insignificant and will not elicit

an adverse effect to listed fish or critical habitat.

Essential Fish Habitat Analysis

The Sustainable Fisheries Act of 1996 (Public Law 104-267) amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) to require federal agencies to consult with NOAA Fisheries on activities that may adversely affect "Essential Fish Habitat" (EFH). Essential Fish Habitat is defined in the Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Essential Fish Habitat includes all freshwater streams accessible to anadromous fish, marine waters, and intertidal habitats.

Essential Fish Habitat in the Cowlitz River subbasin has been designated for coho and Chinook salmon (NOAA 2004). The analysis area is distinguished into two segments with the divide at the Cowlitz Falls dam (Table 4.8.6).

Key Risk Factors to EFH

Key issues with the proposed action impact to EFH include potential modification to water quality, water quantity and instream /riparian habitat. These issues are summarized as follows:

Water Quality. Cowlitz Thin Timber Sale proposed timber harvest and associated activities has the potential to impact water quality. Proposed timber harvest activities including felling and yarding, temporary road construction and may instigate surface soil disturbance, mobilize fine particles and generate stream sediment. Additionally, heavy equipment operation in and around streams may deliver oil or other contaminants to the water course.

Water Quantity. Cowlitz Thin proposed timber harvest and associated activities has the potential to impact water quantity and peak flows. Road development and soil compaction may increase the surface drainage area network, decrease infiltration rates and consequently increase the rate by which water reaches the stream channel. Physical alterations may modify the hydrograph timing and yield by increasing instantaneous peak flows and decrease the summer base flows to Upper and Middle Cowlitz Watershed.

Instream and Riparian Habitat. Cowlitz Thin proposed timber harvest may have adverse impacts instream habitat conditions and for aquatic species including resident trout along with Chinook and Coho Salmon and steelhead trout which are Threatened and Endangered species (TES) known to exist in the upper Cowlitz subwatershed. Increases in bedload fine material (channel substrate < .84 mm.) may have deleterious impacts on salmonid egg to fry survival and primary and secondary production.

Table 4.8.6. Essential Fish Habitat analysis area for Cowlitz Thin. Lewis County WA.

River Name	**4th Field Hydrologic Unit**	
	Name	**Code**
Cowlitz River	Lower Cowlitz	17080005
Cowlitz River	Upper Cowlitz	17080004

Reduction in channel complexity may reduce hiding and holding habitat through the physical alteration of channel micro habitat features (e.g. instream large wood and pools).

Evaluation Criteria

The key risk factors to EFH were assessed by quantitative analysis of eight indicators associated with proposed ground disturbing activity in Cowlitz Thin. Table 4.8.7 describes each evaluation criteria and quantitatively measures use for analysis.

The Matrix of Pathway Indicators analysis (USDA 1998, USDA 2004) supports the finding that the proposed action **may affect** EFH in the upper Cowlitz and will have **no effect** in the lower Cowlitz. EFH includes *"those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity*".

Effects Determination for Essential Fish Habitat (EFH) – Cowlitz Thin

The proposed action in Cowlitz Thin will have "No Effect" to EFH on the Lower Cowlitz for Lower Columbia River coho salmon and Lower Columbia River Chinook salmon. Table 4.8.8 provides a summary of the evaluation of EFH and Table 4.8.9 provides a summary of the EFH Effects determination. The effects of Cowlitz Thin will be unrecognizable to Lower Cowlitz EFH due the following key factors as follows: 1) the substantial physical separation (> 58 river miles) of downstream habitat and the proposed action; 2) the ameliorating effect of the three mainstem Cowlitz River Dams will capture any potential sediment before it is transported to the lower river; 3) the relatively minor level of disturbance from the proposed action will be indiscernible from the baseline level of natural sediment production in watershed. This activity is not expected to have a direct or indirect impact to EFH and is consistent with the fish Programmatic Biological Opinion which addresses road maintenance activities.

Minimal ground disturbance will result in low risk to EFH under the proposed action primarily due to sediment production related to log haul transportation. The impacts on riparian reserves will be minimized by the substantial retention of forest canopy and no harvest riparian buffer. Thinning activities in the outer riparian reserve will retain a canopy closure at a relative density of 35-40. If current average canopy closure conditions are below 50% then the area will not be treated. The inner approximate 30-120 feet of the riparian reserve will remain a no-harvest buffer. This treatment should retain adequate shade and channel stability for "at risk" streams.

Table 4.8.7. Evaluation criteria and quantitative measure applied to Essential Fish Habitat assessment for Cowlitz Thin. Lewis County, WA.

Factor ID	Topic	Description	Indicator	Measure
1	Water quality	Risk to increased stream sediment as a function of logging systems	Disturbance from yarding system (skid roads and skylines)	Acres
1	Water quality	Risk to increased stream sediment as a function of ground disturbance from log transportation	Disturbance from temp rds, & landings	Acres
1	Water quality	Risk to increased stream sediment as a function of crossing aquatic features	Aquatic crossings	Count
2	Water Quantity	Risk to timing and rate of *water yield* as a function of forest openings	Percent of watershed with closure <40%	Acres
2	Water Quantity	Risk to surface flow and infiltration rates as a function of surface roughness	Estimated surface roughness coefficient associate with down wood cover[4]	Percent
3	Instream & Riparian Habitat	Risk to channel stability as a function of managing unstable ground (Pfankuch 1975)	Riparian acres with high and risk of instability	Acres
3	Instream & Riparian Habitat	Risk of decreased large wood recruitment potential and associated instream habitat as a function of riparian harvest.	Acres of harvest in Riparian Reserve	Acres
3	Instream & Riparian Habitat	Risk to bedload and channel connectivity as a function of *mass wasting potential*	Disturbance of *high* and *moderate* risk soil types[2] *in RR*	Acres
3	Instream & Riparian Habitat	Risk to spawning success resulting from increased fine stream sediment as a function of *surface soil erosion*	Disturbance of *high* and *moderate* risk soil types[2] *in RR*	Acres

[1] Channel stability after Phanchuk (1975),
[2] RR = Riparian Reserve (based on tree site potential),
[3] Soil mapping interpretations from Soil Resource Inventory (USDA 1992).
[4]Down wood estimates based on average dia (dbh) and height to 6 inch top

Table 4.8.8. Summary of evaluation for Essential Fish Habitat and associated risk rating for Cowlitz Thin. Lewis County, WA.

Alt	Unit Count	Hrvest Area[1] (Ac)	Water Quality			Water Quantity		Habitat Conditions			
			Road Crssing[2] .(count)	Stream Sed From Log Systm[3] (Ac)	Stream Sed From Log Trnsprt[4] (Ac)	Surface water intercept – down wood[5] (% cover)	Increase water yeild - Forest opening[6] (%)	Ripn Rsv Hrvest[7] (Ac)	Channel Stability Increase Risk[18] (Ac)	Fine Sediment – Surface Soil[9] (Ac)	Sediment - Mass Movmnt[10] (Ac)
3	15	542.0	186	140.0	11.8	3-5%	0.0	61.4	85.2	86.7	19.6
Indicator Risk Assessment			Low	Low	Low	Low	Low	Low	Low	Low	Low

[1] total acres of proposed timber harvest excluding inner riparian reserves and skips
[2] measure of the number of stream crossing including existing and newly proposed crossing on entire haul route
[3] area (acres) of ground disturbing activities from combined logging systems including skid roads, skylines and landings
[4] area (acres) of ground disturbing activities from combined log transport including temporary roads
[5] measure of down wood remaining on the forest floor. Inner riparian reserves receive 5% cover and outer riparian areas receive 3% cover from down wood.
[6] measure of newly created forest opening that may increase water yield and change timing
[7] area (aces) of commercially harvested riparian reserve area
[8] measure of total disturbed riparian acres with high or very high stability risk as identified from Pfankuch (1975) channel stability surveys (USDA 1992)
[9] measure of total disturbed riparian acres with high potential risk of surface soil erosion as identified from GPNF Soil Resource Inventory
[10] measure of total disturbed riparian acres with high potential risk of mass wasting as identified from GPNF Soil Resource Inventory (USDA 1992)

Rational for Determination on EFH Common to Chinook and Coho Salmon

Rational for effect determination to EFH for Chinook and coho is similar to that made for the critical habitat effect determination. Effects determination for EFH (Table for chinook and coho salmon are based on the rational that actions proposed meet the criteria provided below:

1. Proposed timber management is limited in duration and intensity. Harvest prescriptions will retain forest structure and composition to maintain and/or improve aquatic ecological health.
2. Proposed management actions are consistent with and/or will not prevent the attainment of Aquatic Conservation Strategy Objectives (USDA, USDI 1994) at the 5th field watershed scale,
3. The Gifford Pinchot Land Resource Management Plan (LRMP) employs the three Aquatic Conservation Strategy (USDA,USDI 1994) components including watershed analysis, riparian reserves, and key watersheds designation intended to maintain species viability,
4. Proposed management actions are consistent with the LRMP Standards and Guidelines,
5. Proposed timber management and associated road development action is determined to pose a low risk to maintaining salmonid viability as per Consideration of Extinction Risk for Salmonids (Reimans et al. 1993),
6. Proposed mitigation measures to improve drainage, maintain or restore stream shade to moderate stream temperatures, develop stand structure to promote stream cover and large woody debris recruitment potential, and reduce sediment transport and erosion potential (see Mitigation Measures listed in EA, BA).
7. No new roads will be constructed with the Cowlitz Thin and all temporary road and skid roads and landings will be pre-approved and decommissioned following logging activity.

8. Lower Cowlitz River EFH is geographically separated from the proposed action and largely influenced by downstream dams and agricultural practices. For more information see *Salmon and Steelhead Habitat Limiting Factors, Water Resource Inventory Area 26* (Wade 2000).

Aquatic Conservation Strategy Consistency

The Cowlitz Thin was analyzed at the project scale for consistency with the nine Aquatic Conservation Strategy objectives at the 5th field and 6th field watershed scales. Table 4.8.10 provides a summary of the analysis at the project or 6th field scale.

Table 4.8.9. Summary of Cowlitz Thin Effect to Essential Fish Habitat in the Upper and Lower Cowlitz River

Species	Hydrologic Unit		Effects to EFH Determination
	Name	**Number**	
Coho salmon	Lower Cowlitz	17080005	No Effect
Spring chinook salmon	Lower Cowlitz	17080005	No Effect
Spring chinook salmon	Upper Cowlitz	17080004	May Affect
Coho salmon	Upper Cowlitz	17080004	May Affect

Table 4.8.10. Comparison of impacts to the Aquatic Conservation Strategy Objectives (ACSO) contained in the Northwest Forest Plan resulting from proposed activity in the three Cowlitz Thin action alternatives. Each ACSO begins with "Forest Service and BLM-administered lands within the range of the northern spotted owl will be managed to **maintain** (the Existing Condition) **and restore** (to the range of natural variability):

ACSO #	Text of Aquatic Conservation Strategy Objectives (ACSO)	Alternative 2 - Treat managed and unmanaged stands with 15 % skip areas and 3-5 % down wood	Alternatives 3 Treat managed and unmanaged stands with 30 % skip areas, 3-5 % down wood	Alternative 4 Treat managed stands with 15 % skips
1	… 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.	***Maintain and restore:*** Landscape scale diversity will be maintained through the system of no harvest riparian reserves on 32 acres of inner reserve. Riparian silvicultural treatment prescribes plant structural and species diversity on 62 acres. Maintaining high relative density in managed and unmanaged stands will maintain diversity. Selectively "skipping" 15 % harvest area including most relic old-growth features will maintain natural variability. Creating 3-5% down- wood in the outer and inner reserve will restore riparian bio-diversity. Overall low magnitude and duration treatment of 92 riparian acres is insignificant to the 54,298 acre analysis area.	***Maintain and restore:*** Landscape scale diversity will be maintained through the system of no harvest riparian reserves on 32 acres of inner reserve. Riparian silvicultural treatment prescriptions should restore plant structural and species diversity on 62 acres. Maintaining high relative density in managed and unmanaged stands along with selective "skipping" of 30% harvest area including the majority of relic old-growth features will restore natural variability. Creating 3-5% down- wood in the outer and inner reserve will restore riparian bio-diversity. Overall low magnitude and duration treatment of 92 riparian acres is insignificant to the 54,298 acre analysis area.	***Maintain and restore:*** Landscape scale diversity will be maintained through the system of no harvest riparian reserves on 19 acres of inner reserve. Riparian silvicultural treatment prescribes plant structural and species diversity on 41 acres. Maintaining high relative density in managed and unmanaged riparian stands along with selective "skipping" of 15% harvest area to include the majority of relic old-growth features will restore natural variability. Creating 3-5% down- wood in the outer and inner reserve will restore riparian bio-diversity. Overall low magnitude and duration treatment of 59 riparian acres is insignificant to the 54,298 acre analysis area.
2	… 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.	***Maintain and restore:*** Minor short term development of 0.1 mile of riparian temp road including 1 new stream crossing (unit 3) will all occur on an intermittent stream and will have insignificant impact on connectivity. Removing pre-existing stream crossings will restore connectivity (units 4, 5, and 15).	***Maintain and restore:*** Minor short term development of 0.1 mile of riparian temp roads including 1 new stream crossing (unit 3) will all occur on an intermittent stream and will have insignificant impact on connectivity. Removing pre-existing stream crossings will restore connectivity (units 4, 5, and 15).	***Maintain and restore:*** Minor short term development of 0.1 miles of temp roads including 1 new stream crossing (unit 3) will all occur on an intermittent stream and will have insignificant impact to connectivity. Removing pre-existing stream crossings will restore connectivity in (units 4, 5, and 15).
3	… the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	***Maintain****:* The riparian reserve setback will maintain the physical integrity of the aquatic system. Minor short term development of 0.1 mile of riparian temp road including 1 new stream crossing (unit 3) will all occur	***Maintain****.* The riparian reserve setback will maintain the physical integrity of the aquatic system. Minor short term development of 0.1 mile of riparian temp road including 1 new stream crossing (unit 3) will all occur on an	***Maintain****.* The riparian reserve setback will maintain the physical integrity of the aquatic system. Minor short term development of 0.1 mile of riparian temp road including 1 new stream crossing (unit 3) will all occur on an

ACSO #	Text of Aquatic Conservation Strategy Objectives (ACSO)	Alternative 2 - Treat managed and unmanaged stands with 15 % skip areas and 3-5 % down wood	Alternatives 3 Treat managed and unmanaged stands with 30 % skip areas, 3-5 % down wood	Alternative 4 Treat managed stands with 15 % skips
		on an intermittent stream and will have insignificant impact on connectivity. Removal and reconfiguration of three preexisting stream crossings will restore or maintain physical integrity of banks (units 4, 5, and 15).	intermittent stream and will have insignificant impact on connectivity. Removal and reconfiguration of three preexisting stream crossings will restore or maintain physical integrity of banks.	intermittent stream and will have insignificant impact on connectivity. Removal and reconfiguration of three preexisting stream crossings will restore or maintain physical integrity of banks.
4	… 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.	***No Effect:*** There should be no effect to water quality to an extent that will impact any life history of aquatic organisms. Local disturbance at 1stream crossing and 0.1 miles of new temp riparian road development may produce an insignificant level of sediment. Pre-existing log bunked stream crossing removal may have a short term insignificant increase in fine material and restore water quality in the long term. There should be no effect to water chemistry.	***No Effect:*** There should be no effect to water quality to an extent that will impact any life history of aquatic organisms. Local disturbance at 1stream crossing and 0.1 miles of new temp riparian road development may produce an insignificant level of sediment. Pre-existing log bunked stream crossing removal may have a short term insignificant increase in fine material and restore water quality in the long term. There should be no effect to water chemistry.	***No Effect:*** There should be no effect to water quality to an extent that will impact any life history of aquatic organisms. Local disturbance at 1stream crossing and 0.1 miles of new temp riparian road development may produce an insignificant level of sediment. Pre-existing log bunked stream crossing removal may have a short term insignificant increase in fine material and restore water quality in the long term. There should be no effect to water chemistry.
5	… 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.	***Maintain and Restore:*** The character of sediment delivery should remain at baseline levels. A system of riparian reserve no cut buffers along with high forest retention and down wood will serve to trap any potential sediment mobilized by an approximate 79.4 acres of disturbance (includes areas outside of riparian reserve). Timing restrictions and post harvest erosion control measures should help maintain near natural levels of sediment delivery. One new stream crossing may have a short term increase in sediment but it is likely to be short term, low duration and magnitude and therefore insignificant. Removal of 3 preexisting crossings should restore the transport function back into the aquatic system. .	***Maintain and Restore:*** The character of sediment delivery should remain at baseline levels. A system of riparian reserve no cut buffers along with high forest retention and down wood will serve to trap any potential sediment mobilized by an approximate 79.4 acres of disturbance (includes areas outside of riparian reserve). Timing restrictions and post harvest erosion control measures should help maintain near natural levels of sediment delivery. One new stream crossing may have a short term increase in sediment but it is likely to be short term, low duration and magnitude and therefore insignificant. Removal of 3 preexisting crossings should restore the transport function back into the aquatic system. .	***Maintain and Restore:*** The character of sediment delivery should remain at baseline levels. A system of riparian reserve no cut buffers along with high forest retention and down wood will serve to trap any potential sediment mobilized by an approximate 24.7 acres of disturbance (includes areas outside of riparian reserve). Timing restrictions and post harvest erosion control measures should help maintain near natural levels of sediment delivery. One new stream crossing and 0.1 miles of new temp road may have a short term increase in sediment but it is likely to be short term, low duration and magnitude and therefore insignificant. Removal of 3 preexisting crossings should restore the transport function back into the aquatic system. .
6	…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.	**No Effect** Impact to water yield should remain neutral due to high forest relative density (26-52) on 613 acres which will serve to intercept rain and dissipate excessive rates of snow melt and moderate peak flows. Approximately 3.3 total miles of road construction may have a short term effect to water yield but should return to baseline following road decommissioning.	**No Effect** Impact to water yield should remain neutral due to high forest relative density (26-52) on 613 acres which will serve to intercept rain and dissipate excessive rates of snow melt and moderate peak flows. Approximately 3.3 total miles of road construction may have a short term effect to water yield but should return to baseline following road decommissioning.	**No Effect** Impact to water yield should remain neutral due to high forest relative density (26-52) on 234 acres which will serve to intercept rain and dissipate excessive rates of snow melt and moderate peak flows. Approximately 1.0 total miles of road construction may have a short term effect to water yield but should return to baseline following road decommissioning.
	… the timing, variability, and	**No Effect** There is no ground disturbing	**No Effect** There is no ground disturbing	**No Effect** There is no ground disturbing activity

ACSO #	Text of Aquatic Conservation Strategy Objectives (ACSO)	Alternative 2 - Treat managed and unmanaged stands with 15 % skip areas and 3-5 % down wood	Alternatives 3 Treat managed and unmanaged stands with 30 % skip areas, 3-5 % down wood	Alternative 4 Treat managed stands with 15 % skips
7	duration of floodplain inundation and water table elevation in meadows and wetlands.	activity proposed in wetlands or meadows. There is no significant causal mechanism to change water yield (see ACSO #6), channel connectivity (see ACSO #2), nor the channel forming process (see ACSO #3) therefore this objective should be fully met.	activity proposed in wetlands or meadows. There is no significant causal mechanism to change water yield (see ACSO #6), channel connectivity (see ACSO #2), nor the channel forming process (see ACSO #3) therefore this objective should be fully met.	proposed in wetlands or meadows. There is no significant causal mechanism to change water yield (see ACSO #6), channel connectivity (see ACSO #2), nor the channel forming process (see ACSO #3) therefore this objective should be fully met.
8	… 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.	***Maintain and Restore*** The function and process of wetlands and riparian areas will be maintained by silvicultural prescriptions. High forest retention (26-52 RD) will maintain thermo regulation; recruitment of 3-5 % down wood will restore coarse woody material, which will restore stability and complexity to riparian areas. Selective skips in 15% of the harvest area will maintain moderate diversity.	***Maintain and Restore*** The function and process of wetlands and riparian areas will be maintained by silvicultural prescriptions. High forest retention (26-52 RD) will maintain thermo regulation; recruitment of 3-5 % down wood will restore coarse woody material, which will restore stability and complexity to riparian areas. Selective skips in 30% of the harvest area will restore diversity	***Maintain and Restore*** The function and process of wetlands and riparian areas will be maintained by silvicultural prescriptions. High forest retention will maintain shade; 3-5 % down wood will restore coarse woody material necessary to protect banks and physical character of riparian areas. Stimulating growth in managed stands will restore vigor and stability. Selective skips in 15% of the harvest area will maintain high diversity.
9	… habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.	***Maintain and Restore:*** Riparian habitat will be maintained in unmanaged stands and restored in managed stands. Thinning overstocked stand will promote structural diversity. Creating 3-5 % down wood will restore microhabitat necessary for most riparian species. No harvest buffers and 15% “skip” areas will maintain the physical integrity of the majority of legacy features.	***Maintain and Restore:*** Riparian habitat will be maintained in unmanaged stands and restored in managed stands. Thinning overstocked stand will promote structural diversity. Creating 3-5 % down wood will restore microhabitat necessary for most riparian species. No harvest buffers and 30% “skip” areas will maintain the physical integrity of most legacy features.	***Maintain and Restore:*** Riparian habitat will be maintained in unmanaged stands and restored in managed stands. Thinning overstocked stand will promote structural diversity. Creating 3-5 % down wood will restore microhabitat necessary for most riparian species. No harvest buffers and 15% “skip” areas will maintain the physical integrity of most legacy features.

4.9 Social Sciences: Historical and Present Use

Historical Human Uses

The Upper Cowlitz River Watershed Analysis (1997) provides a comprehensive history of the area, but a brief summary is provided here. The upper Cowlitz River valley is historically and culturally rich. Archaeological evidence from sites located in the Upper Cowlitz River Watershed reveals human use of the area as early as 7,000 years ago. More recently, during the 19th century, the Taitnapam, or upper Cowlitz Indians lived in settlements scattered along the Cowlitz River and larger tributaries between Mossyrock and Packwood. A cultural shift in human land use occurred between 1880 and 1890 when English-speaking immigrants replaced Sahaptin-speaking indigenous populations.

Homesteaders occupied the area as they took advantage of opportunities to supplement small-scale farming with subsistence hunting and fishing. A shift from an agricultural society to the exploitation of forest products occurred in the 1930's and 1940's.

Evidence of past human use in the form of prehistoric and historic archaelogical sites and features, standing historic structures, trails, and historic landscapes have been documented in the Upper Cowlitz Watershed. While many sites are documented; many undocumented sites are likely to exist throughout the area.

Cultural and Heritage Resources

Heritage surveys were conducted in the Cowlitz Thin project area. Current cultural Native American activities do occur in the Upper Cowlitz River Watershed; it was determined that there were no significant sites, and that the proposed project would have no effect on cultural and heritage resources.

Recreation, Forest Product Harvesting and Scenic Values

Recreational Activities

The planning area for the Cowlitz Thin Timber Sale contains many opportunities for dispersed recreation and trails or trailheads for hiking and snowmobiling. Two trailheads are within or accessed through the planning area. The boundary of the Tatoosh Wilderness, a congressionally designated wilderness, lies within ¼ mile of harvest unit 14 (Alternatives 2 and 3). Forest Roads 84, 5240, and 47 provide approximately 27 miles of groomed snowmobile trail in the winter months. Forest Roads 47 and 84 also provide access to popular huckleberry gathering areas, and driving for pleasure is a popular summer activity in this area as well. Numerous dispersed camp sites are located along Skate Creek, also within the planning area. In addition, there are a number of user developed trails within the planning area. These trails are used by a variety of user groups, primarily "local resident" hikers, stock users and motorized recreationists. Forest Plan direction is to prohibit unlicensed motorized vehicles (ATV's and non-street legal motorcycles) from traveling on Forest Roads or cross country. User developed motorized

trails are considered illegal trails, and motorized users would be given a Notice of Violation (NOV) if encountered by a Forest Service Law Enforcement Officer (LEO) or Forest Protection Officer (FPO).

Effects

Access to both trailheads on Trail #161 (North and South) within the Tatoosh Wilderness Area, will be affected by harvest activities. Approximately 550 individuals access these trailheads each year. These individuals will still be able to access the trailheads, however they may encounter slight traffic delays at times. A short section of the southern portion of Trail #161 is located less than one tree length from Unit 14. There may be short term effects to hikers as access may be limited or delayed during harvest activities. Mitigation measures require directional felling away from the trail. Mitigation measures also prohibit motorized vehicles from utilizing the trail.

The southeastern boundary of the Tatoosh Wilderness Area was surveyed and posted in 1990 as part of the mitigation for the Butter Butte Timber Sale. Cowlitz Thin Timber Sale mitigation measures require that the boundary signing be physically located prior to any harvest activities in Unit 14. Following this mitigation, there would be no possibility for encroachment within wilderness. There will be potential for increased sights and sounds of management activities occurring outside of the wilderness to be detected while hiking within the wilderness.

Snowmobiling is a very popular activity within the planning area and along the identified haul route for many of the units. The Washington State Winter Recreation Commission provides funding for a contractor to groom 27 miles of trail along Forest Roads 47, 84 and 5240. Snomobilers also ride Forest Road 52 as snow conditions permit, however it is not a groomed route. The Commission also provides funding for a contractor to plow to a SnoPark at the junction of Forest Roads 47 and 52 (Skate Creek SnoPark). The Forest Service receives funding from the Commission to maintain the SnoPark. The SnoPark may be in operation from November 1 to April 1, depending on snow levels. A typical season for the Skate Creek SnoPark is December 1 through April 1 because of its relatively low elevation. Harvest activities in Units 4, 5, 6, 16, 17, 19, 20, 25 and 26 (Alternatives 2 and 3) or Units 4, 5, 19, 20, 25 and 26 (Alternative 4) that would require plowing for access on Forest Roads 47, 84 and/or 52 during the winter snow season would effectively eliminate winter recreation opportunities in this area. Mitigation measures prohibiting the plowing of Forest Roads 47, 84 and/or 52 for access to harvest units between December 1 and April 1 have been identified in order to preserve winter recreation opportunities accessed from the Skate Creek SnoPark.

The cost to plow the haul route for winter access to units along the Forest Road 47 system would range from $85 to $185 per hour, depending on the type of equipment utilized. It is estimated that they can remove snow on approximately 1 mile per hour. There would be between 15.49 miles (Unit 20) to 23.13 miles (Unit 17) of snow removal to access these units (FR's 52, 84, 47). An average snow year would require plowing 5-6 times per season. This would result in an additional cost of operation ranging from

$6585 on the very low end ($85 x 15.49 x 5) to $25,674 on the high end ($185 x 23.13 x 6).

Forest visitors who recreate or gather forest products in the area may be impacted by log truck traffic or landing operations adjacent to units. Mitigation measures provide for signing and traffic management within the project area.

User developed trails within the harvest units will not receive mitigation measures to protect them. It is likely that sections of user developed trails will be obliterated through the harvest process. These trails are not maintained by the Forest Service and are not part of our inventoried recreational facilities. Mitigation measures have been identified to reduce illegal motorized access, particularly ATV access, in some of the harvest units. This includes obliterating and rehabilitating temporary roads, and re-closing roads that were temporarily opened for harvest activities.

Non-Timber Forest Products

Generalized information regarding harvest of non-timber forest products (NTFP) in the Upper Cowlitz River Watershed and the Cowlitz Thin planning area is based on anecdotal knowledge gleaned from permit administration records, law enforcement, Forest Service employees and forest visitors and harvesters.

The Cowlitz Thin provides opportunities for the collection of mushrooms, salal, boughs, personal use firewood and Christmas trees. Amounts of product collected within sub-watersheds are not known. Salal is present in many stands, and evidence of commercial harvest of salal has been observed in Unit 6. Chantrelles and matsutake mushrooms are purported to grow in the area.

Effects of all action alternatives on NTFPs

Thinning of units may affect the distribution of non-timber forest products. Chantrelles or other mushrooms and salal are the products most likely impacted from timber harvest activities. The potential effect to supply of products would be direct on site, where thinning and yarding occurs. While it is not known whether the project units have crops of mushrooms such as chantrelles, it is important to consider the potential effects.

Regeneration harvest and burning has the potential to set back production of chantrelles 20 to 30 years; thinning without burning is expected to have much less of an effect on mushrooms. Skyline harvest methods would likely be the least impacting, with ground-based yarding with the highest. Commercial and recreational harvesters may experience a local reduction in mushroom crops; this is not known. However, adjacent habitat is expected to provide sufficient sources and crops.

Salal may have a brief, negative response to thinning and harvest; however, most of the unit acreage is characterized as heavily stocked, with little to no understory. Thinning the canopy may promote the production of salal in some areas in the long-term. In the short-term, harvesters who currently utilize salal “stands” in Cowlitz Thin units may be displaced to other collection areas. Abundant habitat in adjacent collection areas is expected to provide sufficient sources of this crop.

Packwood Viewshed and Public Safety

Local residents and recreation property owners have expressed concerns regarding the effects of logging on the scenic views in the vicinity of Packwood. Increased logging traffic on public safety and local traffic is also of concern. Logging traffic safety concerns would be mitigated through signing and traffic management within the project area.

Visual Quality Objectives for the Cowlitz Thin Timber Sale include Retention, Modification and Roaded Modified. In general, thinning harvest is considered to meet retention objectives. There will be short term modification while harvest activities are ongoing.

Unit 5 is considered within the Packwood area viewshed. This unit is designed to be consistent with retention visual quality objectives. Unit 12, which was the most controversial unit because of its proximity to a residential area, was dropped from the proposed action for several reasons, including logging systems and access limitations, and the positioning and abundance of legacy features.

4.10 Economics – Financial Analysis

Purpose and need discussion

One of the aspects of the purpose and need (Section 2.2) is to provide forest products. In terms of volume outputs, all of the action alternatives would meet this objective while the no-action alternative would not. Alternative 4 would not treat natural or mature stands, in which case the purpose and need would be achieved to a lesser extent. In terms of the economic viability, each alternative would be slightly different as shown below.

One of the dual goals of the Northwest Forest Plan is to provide a sustainable level of forest products for local and regional economies and to provide jobs. The Northwest Forest Plan Final Environmental Impact Statement has an in-depth analysis of the economic basis behind the goal of providing forest products for local and regional economies. It also contains an analysis of the social and economic benefits and impacts of preservation, recreation and other values. To benefit local and regional economies, timber is auctioned to bidders. For contracts to sell they must have products that prospective purchasers are interested in and they must have log values greater than the cost of harvesting and any additional requirements.

There is often a concern about the viability of thinning timber sales that have small low-valued logs and high logging costs when compared to other types of timber sales. In the future it is likely that timber values would fluctuate with market conditions and logging costs may also change with fluctuations in fuel prices. The purpose of this analysis is to approximate the economic feasibility of timber sales, estimate the potential value generated and to provide a comparison of the alternatives.

Alternative 1 would not contribute to a Northwest Forest Plan goal of maintaining the stability of local and regional economies through the provision of forest products at this time. The action alternatives would provide for jobs associated with logging and sawmill operations and would contribute to meeting the current demand for forest products. The annual incremental contribution of each million board foot of wood harvested from National Forest is expected to provide approximately 8.3 jobs (NFP, p. 3, 4-297).

Table 4.10.1 displays a summary of the cost and benefits associated with the timber harvesting only, for each alternative. The table displays present value benefits, cost, and net value, as well as the benefit/cost ratio for each alternative as if it was sold as one timber sale. These figures display the relative difference between the alternatives. If timber prices or other factors fluctuate in the future, the relative ranking of alternatives would not likely change.

Table 4.10.1. Cowlitz Thin costs and benefits

	No Action (Alt.1)	Proposed Action (Alt. 2)	Modified Proposed Action (Alt.3)	Managed Stands (Alt.4)
Present Value - Benefits	0	$4,394,650	$2,916,550	$1,391,650
Present Value - Cost	$16,300	$1,604,291	$1,366,245	$623,059
Present Net Value	($16,300)	$2,790,359	$1,550,305	$768,591
Benefit/Cost Ratio	0	1.6	1.9	1.8

Present Value - Benefits: This is the present day value based on delivered log prices (estimated at $650/mbf).

Present Value - Cost: This is the present day value of the cost associated with harvesting (estimated harvesting cost is $144/mbf for mechanical, $195/mbf for skyline). Road maintenance costs (including base maintenance cost), and cost of snag creation and down wood are included. Road maintenance costs are calculated on a per volume basis, which explains why costs for Alternative 2 are higher than Alternative 3. Alternative 3 snag and down wood costs are highest, which reduces the PNV compared to the other alternatives.

Present Net Value: This is the present net value of the alternative, which is based on the value of delivered logs to a mill minus the value of cost associated with harvesting.

Benefit Cost Ratio: This is a ratio derived from dividing the "Present Value – Benefits" by the "Present Value – Cost".

The bidding results of the timber sales sold recently indicates substantial competition for forest products in the Region and high demand for forest products from the Gifford Pinchot National Forest. This demand represents an opportunity to provide forest products consistent with the Northwest Forest Plan goal of maintaining the stability of local and regional economies now and in the future.

Administrative costs are not included in the analysis above. Administrative costs for planning are already spent and would be the same for all alternatives including the no-action alternative. Other costs for timber sale preparation and sale administration for the action alternatives would be approximately proportional to the acres of each alternative.

4.11 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 this 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 temporary roads and landings would not be anticipated despite efforts to reclaim these areas. The losses in productivity from the above would occur on a small part of the planning area. Project design criteria and mitigation measures included with all action alternatives are designed to minimize potential losses in productivity (see Section 4.6, Soils).

Rock Resource

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

Old Growth

No late-successional (>170 years old) or old growth stands or trees are proposed for harvest in any alternative. Some of the stands proposed for thinning harvest may contain individual old growth trees. They would be included as leave trees in the thinning harvest units.

Irretrievable Commitments

Irretrievable commitments are opportunities for resource uses that are foregone 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 the net production of timber (for example capturing

mortality) 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 disturbance are discussed above in Irreversible Commitments of Resources.

Relationship to Other Agencies and Jurisdictions

The Washington State Department of Ecology (DOE) is responsible for enforcing the Clean Water Act of 1972. A Memorandum of Agreement (2003) 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 Washington State Forest Practices Rules. The project design criteria and mitigation measures listed in Chapter 2 comply with terms and conditions of the Memorandum of Agreement.

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 Washington State Department of Fish and Wildlife and the Forest Service entered into an agreement in the form of a Memorandum of Understanding (USFS, WDFW 2005). The MOU provides standard provisions and serves as a Hydraulic Project Approval for instream work. The project design criteria and mitigation measures listed in Chapter 2 incorporate and comply with terms and conditions of the Memorandum of Understanding.

The United States Department of Interior Fish and Wildlife Service (FWS) is responsible for the protection and recovery of threatened and endangered species. The effects determination for Northern Spotted Owl is "May Effect and is Not Likely to Adversely Affect". The Forest Service has consulted with the FWS, and gained concurrence with this determination. A letter of concurrence is expected in May 2007.

The United States Department of Commerce National Marine Fisheries Service (NMFS) is responsible for the protection and recovery of Threatened and Endangered fish species. The effects determination for Lower Columbia River steelhead, Lower Columbia River Chinook, and Designated Critical Habitat is " May Effect and is Not Likely to Adversely Affect ". Informal consultation was initiated with NOAA-Fisheries; a letter of concurrences is expected in May 2007.

All steps in the cultural resource process are coordinated with the Washington State Historic Preservation Office (USDA, 1990). Cultural Resource Site Reports are filed 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 the implementation of any alternative.

Prime Farm Land, Range Land, and Forest Land

There are no prime farm lands or prime range lands within the Cowlitz Thin 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.

Environmental Justice

Executive Order 12898 (February 11, 1994) directs federal agencies to focus attention on the human health and environmental condition in minority communities 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 populations and low-income populations.

Environmental Justice is simple: 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, none of the alternatives is expected to have a disproportionately high and adverse human health or environmental effect on minority populations and low-income populations.

Minority communities may harvest timber and non-timber forest products from the project area (Section 4.9). Travel to and from harvest sites along Forest roads may be affected by log truck traffic. Signage and posting signs communication location and time periods of harvest and haul would mitigate this potential effect.

Wetlands and Floodplains

There would be no adverse effects to wetlands or floodplains due to the implementation of project design criteria and mitigation measures included with the action alternatives. Unit 26 has moist areas dominated by black cottonwood, which would be protected with buffer consistent with the Northwest Forest Plan standards and guidelines.

5.0 CONSULTATION AND COORDINATION

The Forest Service consulted the following individuals, Federal, State, and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

Interdisciplinary Team Members

Karen Thompson: North Zone Planning Team Leader

Ron Pfeifer: Silviculturist, Pfeifer Forestry Consulting

Tom Kogut: North Zone Wildlife Biologist

Ken Wieman: North Zone Fisheries Biologist

Amy Lieb: North Zone Hydrologist

Marie Tompkins: Hydrology Technician

Steve Freitas: Heritage and Cultural Resources

Cheryl Mack: Forest Archaeologist

Linda Swartz: North Zone Botanist

Aldo Aguliar: Soil Scientist

Patty Bennett and Steve Hanson: Logging Systems and Presale

Diane Bedell: Recreation Planner

Tom Griffith: Fire Management Specialist

Dean Lawrence: Engineering and Transportation Systems Specialist

Federal, State, and Local Agencies

Vince Harke: U.S. Fish & Wildlife

Tami Black: NOAA Fisheries

Tribes

The following Tribal representatives were contacted during the scoping process:

John Barnett, Chairman, Cowlitz Indian Tribe
Lee Carlson, Yakama Indian Nation
Dave Lopeman, Chairman, Squaxin Island Tribe
Karen Lucei, Env. Rev. Coord., Yakama Indian Nation
Joan Ortez, Chair, Steilacoom Tribe
Carrol Palmer, Dir. Natural Resources, Yakama Indian Nation
Dorian Sanchez, Chairman, Nisqually Indian Community Council

Bill Sterod, Chairman, Puyallup Tribal Council

Others

Representatives of environmental groups, participants of the Pinchot Partners, a local collaborative working group, and members of the Packwood Community were actively involved and provided comments regarding design and silvicultural prescriptions. Comments were solicited from individuals, tribal representatives and other agencies.

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