United States Department of Agriculture

Forest Service

2014

Environmental Assessment
Grove Thinning

Clackamas River Ranger District, Mt. Hood National Forest
Clackamas County, Oregon
The project is located in T.5 S., R.6 E.; T.5 S., R.7 E.; T.5 S., R.8 E.; T.6 S., R.6 E.; T.6 S., R.7 E.; T.6 S., R.8 E.; Willamette Meridian.

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An example of a stand before thinning

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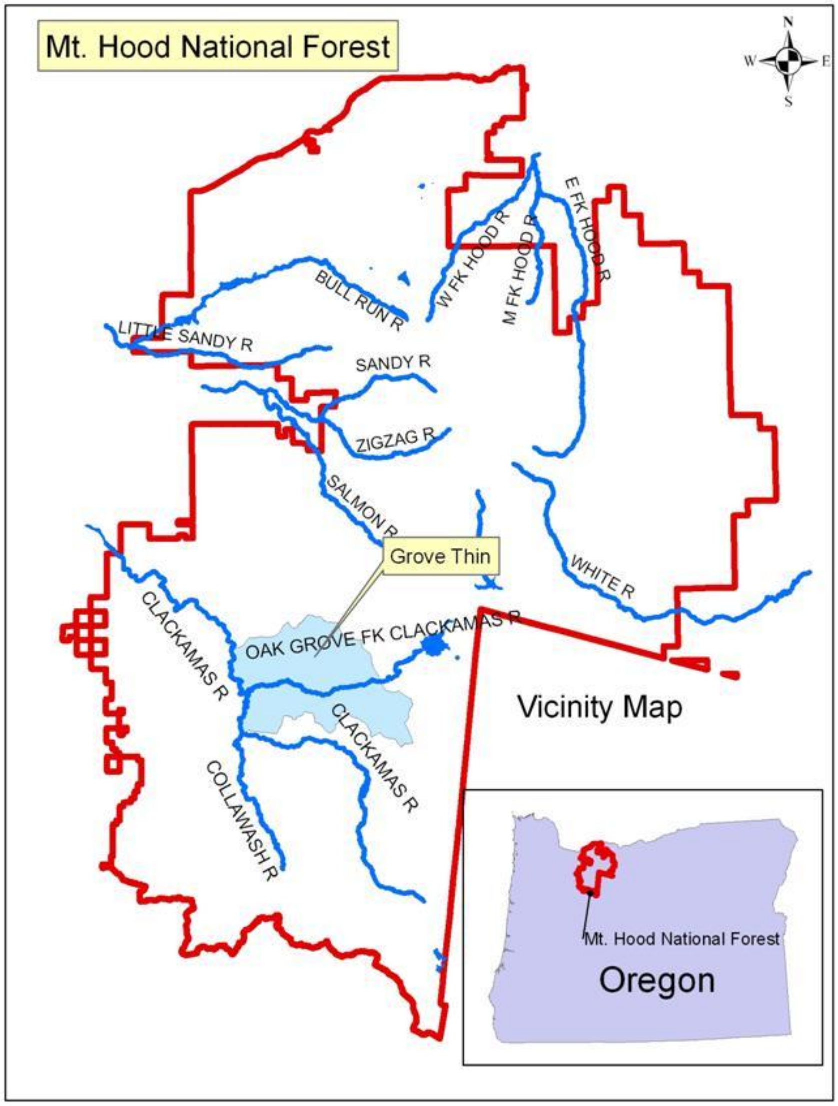
Summary



The project is located in the Clackamas River Ranger District, Mt. Hood National Forest, Oregon. The Mt. Hood National Forest proposes a thinning project in mid-aged stands ranging in age from 30 to 60 years old. The Mt. Hood National Forest is referred to as 'the Forest' in this document.

The purpose of this project is to increase the health and growth of trees and to provide forest products to the local economy. Other opportunities that can be accomplished at the same time include enhancing diversity within riparian reserves, late-successional reserves and matrix lands, enhancing forage for deer and elk, reducing sediment impacts from roads used by the project, and reducing hazardous fuels in the wildland-urban interface.

1.0 INTRODUCTION

1.1 Document Structure

The Forest Service has prepared this document in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This document discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. This document uses a section number system. This paragraph for example is in section 1.1 and may be referred to as s. 1.1. The document is organized into the following parts:

- *Summary*
- *Introduction:* This section includes the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section includes design criteria. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Alternatives:* This section provides a description of alternative methods for achieving the stated purpose. These alternatives are developed based on issues raised by the public and other agencies. Finally, this section provides a comparison 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. Within each section, the existing situation is described first, followed by the effects of the alternatives. The no-action alternative provides a baseline for evaluation and comparison of the other alternatives.
- *Consultation and Coordination:* This section provides a list of preparers and agencies consulted during the development of this assessment.
- *References and Appendices:* The appendices provide more detailed information to support the analyses presented in the assessment.

  Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Estacada Ranger Station in Estacada, Oregon.

1.2 Project Location

The proposed project area is located near Ripplebook Guard Station and overlaps two watersheds: the Oak Grove Watershed and the Middle Clackamas Watershed. The planning area encompasses approximately 44,000 acres, while thinning would occur on 1,756 acres within this larger area. Maps can be found in Appendix A. The planning area was delineated and chosen because:

- It encompasses a concentration of homogeneous young and mid-aged stands that have grown to become very dense and slow growing;
- The landscape has a similar terrain features;
- The transportation system in this location provides logical access for management activities; and
- The area has similar management direction from the Forest Plan, as amended.

After focusing on this landscape, all mid-aged stands were examined and compared to desired conditions from the Forest Plan. While the project area contains many thousands of acres of mid-aged stands of various ages, approximately 1,756 acres are currently in a condition where variable density thinning treatments are appropriate to move stands toward desired conditions (s. 1.3.1.3 to s. 1.3.1.6). If some of this work were to be deferred, there would be a backlog of mid-aged stands that would begin to develop as described for the No-Action Alternative (s. 3.1.3, & s. 3.2.3). An important element of this project is to avoid this backlog by treating as many mid-aged stands as possible within the parameters of the Forest Plan to move them toward desired conditions in an operationally efficient manner.

1.3 Purpose and Need for Action

The purpose of this project is to enhance the productive capacity of mid-aged stands by thinning and to treat a sufficient number of stands to meet Forest Plan goals related to forest product outputs. For more in-depth discussion, refer to sections 1.3.1.3 & 1.3.1.4.

- **Health and Growth** - There is a need to increase health and growth of stands because mid-aged stands within the project area are experiencing a slowing of growth due to overcrowding and some are experiencing suppression related mortality. *This need is described in the Forest Plan on pages Four-5, Four-91, FW-372 & Four-292.* The accomplishment of this objective is measured by acres treated, the change in average tree diameter in 40 years, and the change in tree growth rates in 40 years. See sections 1.3.1.3, 2.4 & 3.1.

- **Forest Products** - There is a need to keep forests productive to sustainably provide forest products now and in the future. Actions need to be designed to be economically viable and efficient. *This need is described in the Northwest Forest Plan on page 26 and Forest Plan on pages Four-3 & Four-26.* The accomplishment of this objective is measured by volume of timber removed and acres treated in the matrix for long-term forest productivity. Economic viability and efficiency would be assessed using professional judgment considering fluctuating market conditions as described in section 1.3.1.4. See sections 2.4, 3.1, & 3.17.

While achieving these primary purposes and needs, there are additional opportunities that can be accomplished at the same time, in or adjacent to some of the targeted stands, where existing conditions deviate from desired conditions:

- **Diversity** - There is an opportunity to gain greater variability of vertical and horizontal stand structure in some stands. There is an opportunity to make some of these changes in Riparian Reserves, Late-successional Reserves and Matrix to promote desired conditions in these land allocations. *These desired conditions are described in the Forest Plan on page Four-67 and in the Northwest Forest Plan on pages B-5, B-6 and C-32.* The accomplishment of this is measured by acres treated, the change in tree species composition, the change in the abundance of other desired plants, the change in vertical canopy layers, the change in horizontal structure with skips and gaps, and the changes to snags and down logs. See sections 1.3.1.5, 2.4, 3.1, 3.2 & 3.8.

Diversity of forests and stands is a complex topic. During the early stages of this planning effort, the scale of the opportunity to address diversity was considered and focused on the stands needing thinning and not on a landscape scale.

- **Forage** - There is an opportunity to enhance forage for deer and elk because forage is declining across the landscape. Thinning techniques can be adjusted in the Matrix where site-specific needs are identified to achieve greater sunlight to the forest floor to release palatable browse plants. *This desired condition is discussed in the Forest Plan on pages Four-22 & Four-71.* The accomplishment of this is measured by acres treated for forage enhancement areas and gaps. See sections 1.3.1.6, 2.4, 3.8.3.4.

  During the early stages of this planning effort, the scale of the opportunity to address forage enhancement was considered and was focused on the stands needing thinning and not on landscape-scale needs. While the project addresses some of the need for forage it does not attempt to provide all of the forage that deer and elk need.

- **Roads** - There is an opportunity to accomplish needed road work on the roads used to access thinning. These opportunities include road maintenance and repair to provide a more efficient and safe transportation system while reducing effects to natural resources. There is also an opportunity to decommission certain roads after use to reduce future road maintenance costs and reduce impacts to aquatic resources. *These desired conditions are described in the Forest Plan on pages Four-3, Four-5 & Four-34 and the Northwest Forest Plan on page C-32.* The accomplishment of this is measured by miles of roads treated. See sections 1.3.1.7, 2.4, 3.3, 3.4 & 3.12.

  During the early stages of this planning effort, the scale of the opportunity to address road issues was considered and focused on the roads needed to access thinning and not on landscape-scale issues. While the project addresses some of the need by repairing some roads and decommissioning others, it does not attempt to examine all of the roads in the broader landscape. Other system road needs will be addressed in a separate Forest-scale Travel Analysis Plan.

- **Fuel Break** - Some of the stands targeted for thinning are adjacent to the Ripplebrook and Timber Lake Administrative sites. There is an opportunity to tie thinning treatments and additional adjacent fuels treatments to provide greater fire safety in the wildland-urban interface both for fire suppression forces and local residents. If no action is taken, a large scale wildfire would put firefighters, residents and employees at greater risk. *This desired condition is described in the Forest Plan on pages Four-4, Four-5 and Four-25.* The accomplishment of this is measured by acres treated. See sections 1.3.1.8, 1.4.6.6, 2.4, & 3.15.

1.3.1 Background

The following sections have greater detail on the resources highlighted in the purpose and need and opportunity statements and provide some rationale for the development of the proposed action that follows in section 1.4.

1.3.1.1 Disturbance Regime

Fire is the dominant landscape-scale disturbance agent in the planning area. Stand replacing fires would be expected occur at a frequency of approximately 300 years.

Fire suppression has resulted in a landscape where there are few large patches of young fire-created stands. While this area is often described as "wet," the summer and fall conditions can become very dry which results in high fire danger levels. Dry weather combined with heavy fuel loading and steep slopes provide concerning conditions for large fire growth. This area is prone to summertime lighting storms. Fires are usually contained while still small but recently fires have increased in size and complexity (USDA 2013b).

While fire has played a role in influencing the macro-scale of forest structure, there are other disturbance factors that have influence at a smaller scale.

Micro-scale disturbance agents in the project area affect individual trees, small groups of trees or large areas of susceptible species. Disease, insects and wind have been the secondary disturbance agents in the proposed treatment area. Small (1/4 acre) to large (1-3 acre) isolated pockets of laminated root rot (*Phellinus weirii*) and armillaria root disease (*Armillaria solidipes*), are present throughout these stands. Neither of the root diseases, when present at low to moderate levels seriously compromise timber productivity, however, these diseases are creating openings of various sizes where highly susceptible species would never attain large size, mainly because they are being killed before they reach such size. Trees weakened are usually blown over or sheared by the wind and often sustain a secondary attack by bark beetles and carpenter ants. Velvet-top fungus (*Phaeolus schweinitzii*) is also present at low levels and is causing trees to break or shear, particularly small-diameter Douglas-fir.

Insect species that have substantially affected disturbance regimes are Douglas-fir bark beetle (*Dendroctonus pseudotsugae* Hopkins) and spruce budworm (*Choristoneura fumiferana*). At this time, populations of these insects are at relatively low endemic levels; however, populations can increase during periods of drought stress.

Windthrow is a term used to describe trees blown over by normal high-wind events. Some trees that have root diseases are blown down by wind, but as the infection spreads and the decay progresses they would eventually fall even in the absence of wind. Episodes of large scale windthrow in the planning area are not historically common. Generally, windthrow only involves a single tree or small groups of trees scattered over a wide area. The most recent windthrow event that had Forest-wide impact occurred in 1989-90. It primarily blew down mature trees along the edges of regeneration harvest units.

1.3.1.2 Past Management

Road construction and logging of old-growth stands intensified in the mid-1940s in the planning area. A sawmill was in operation in the area that is now occupied by the Timber Lake Job Corps Center. Most of the logging in the area was by regeneration harvest which was subsequently replanted to create the plantations of today. Approximately 15,628 acres of forest stands (36% of the planning area) have been converted to plantations. In order to access the forest, the project area once contained approximately 260 miles of system roads. Approximately 32 miles of these roads have been decommissioned since the inception of the Northwest Forest Plan (1994); therefore, there are currently about 228 miles of roads within the planning area.

The planning area once contained large patches of mature Douglas-fir and western redcedar typical of the disturbance regime, but now it is fragmented by plantations. The current vegetation pattern contains more edge habitat and less connectivity of mature forest than the pattern created by the natural disturbance regime. Plantations are uniform in size, regularly shaped, and evenly dispersed across the landscape. The plantations in the watershed have a wide range of ages and densities (from age 20 to 60). Some plantations have already been thinned, while many others have not received treatment.

In addition to past management vegetation and road management the following developments are located within the planning area:

- A large power line transmission corridor (operated by Bonneville Power Administration) crosses the southeast corner of the planning area.

- The planning area has also been affected by hydro power developments. The power plant at Three Lynx (just outside the planning area) began production in 1924 and is operated by Portland General Electric (PGE). The water is diverted from the Oak Grove Fork at Lake Harriet and is then transported across the planning area in a large pipe before reaching the power plant where the water reenters the Clackamas River.

- The administrative sites of Ripplebrook and Timber Lake Job Corps are in the planning area. These compounds contain many buildings including residential housing and office space for several hundred people. They also contain infrastructure features including roads, power lines, water lines and a sewage treatment plant.

1.3.1.3 Tree Growth and Health

The stands included in this project have been examined and have been found to be overstocked. When trees are too closely spaced they experience a slowing of growth due to competition for sunlight, moisture and nutrients. Suppressed, slow-growing trees have begun to die and have become susceptible to diseases and wind damage.

Trees that have been uniformly spaced at planting interact differently when developing through inter-tree competition during the stem-exclusion phase compared to stands seeded in after a fire or other stand-replacement disturbance. Trees have less of a chance to express dominance when they have been planted from genetically similar seed sources and maintained at relatively even spacing. Therefore, when these stands reach density levels in which individual trees are competing with each other for growing space it may take longer for individuals to express dominance. If trees are not thinned, competition would increase, stems would continue to grow in height, but diameter growth would drastically slow. These trees would become more dependent on neighboring trees for support. When trees develop in this manner they are more likely to blow down in large groups or be more susceptible to disturbance agents.

Failure to provide trees sufficient spacing while they are young can have consequences lasting the life of the stand (Oliver 1996). The overstocked condition of current stands in the planning area would continue to result in stands with reduced vigor, small size, and increased susceptibility to stressors such as insects, diseases and weather.

One term used later in this document to describe the degree of crowdedness of individual trees within a stand is Relative Density (RD). It is a scale that ranges from 0 (no trees) to 100 (maximum biological potential) (Ellen 1983) (Curtis 1982). When a stand reaches or exceeds a RD of 55, suppression, mortality and stand decline is expected. Both tree and stand characteristics (tree growth rates, crown structure and mortality, as well as understory development and natural regeneration) are all closely related to relative density. Relative densities in the stands proposed for thinning range from 55 to 85 with an average diameter of approximately 12 inches.

Management direction provided by the Forest Plan as amended, indicates the desire for productive healthy forest stands, and where the existing stands are overstocked, thinning is a technique that can be used to reduce tree density to achieve their growth potential and maintain their health (s. 3.1).

1.3.1.4 Forest Products

One of the goals of the Forest Plan as amended by the Northwest Forest Plan is to provide a sustainable level of forest products for local and regional economies and to provide jobs. Wood is used to make many important products needed by society. The value of wood drives rural economies as logs are removed from the forest and processed into a myriad of eventual products. Much of the wood from this project would be used to make houses. With an estimated 19 million board feet, this project would produce enough wood to build several thousand houses. Other products that would come from the removed trees include chips for paper manufacturing and firewood.

Even though timber harvest from Federal lands has declined in the past two decades, the forest products industry in Oregon remains an important component of rural economies and provides approximately 25,000 living wage jobs in forest management and manufacturing. Locally, approximately 4,400 of these jobs are in Clackamas County. The annual incremental contribution of each million board feet of timber is approximately 8.3 jobs (Oregon 2012). At this rate, the proposed thinning project would generate or maintain 116 jobs. Jobs include woods workers who cut and remove the timber, equipment operators who repair and maintain roads, mechanics who service equipment, mill workers who process the raw materials, and craftsman who assemble wood products into their final usable form. The Northwest Forest Plan (p. 3&4-297) contains an in-depth analysis of employment in the timber industry and the ripple effect that wood products have throughout local and regional economies.

The project has the potential to generate approximately 19 million board feet of wood products, which is approximately half of the Forest's goal for one year, though it is likely that the timber from this project would be harvested over multiple years. For the State of Oregon, the project represents 0.5% of the State's annual timber production (Oregon 2012). In terms of one local sawmill in rural Clackamas County, this volume represents approximately 19% of their annual needs.

In addition to the generation of wood products and jobs now, the thinning of mid-aged stands to keep them healthy and productive would provide sustainable levels of wood products into the future.

In addition to covering the cost of thinning and logging, the value of the wood also covers the cost of Forest road repair, road maintenance, road rehabilitation and road decommissioning. Those roads not rehabilitated or decommissioned would be improved to the benefit of other Forest users, such as those seeking special forest products, hunters and other recreationists.

The economic viability of thinning mid-aged stands is always a concern. Several factors contribute to a situation that requires planners to carefully examine projects to ensure that they are efficient and viable. Factors include:

- Trees are small and have relatively low value. Volume removed per acre can be relatively low. These factors make logging this type of material more expensive than larger, older timber.
- Since the decline of old-growth logging in the 1990s, many roads have not received sufficient maintenance and there is sometimes a backlog of road

repairs and maintenance that need to be funded by the value of the timber removed.
- Thinning opportunities are often widely scattered across the landscape, which can add to the cost of mobilizing equipment.
- Sometimes the proposed logging method uses helicopters. This logging is marginal given the high cost of jet fuel. The accomplishment of these marginal helicopter units is affected by the fluctuations of the timber market and the cost of jet fuel at the time of bidding, and the appropriate mix of less expensive ground-based and skyline systems.

For this work to be achieved the value of the timber needs to exceed costs. The Forest has considerable experience packaging high cost portions of a project, such as road repairs or helicopter units, with lower cost portions to gain operational efficiency and to develop a project that is likely to receive bids. Based on past experience with thinning similar stands with similar prescriptions, it is likely that there would be sufficient value of timber removed to accomplish thinning and the other important work of this proposal.

1.3.1.5 Diversity

Diversity is the distribution and abundance of different native plant and animal communities and species. There are many ways to look at diversity and several scales to consider. Diversity in forests can be categorized by variations in genetics, structure and species composition. Biodiversity is a term sometimes used to describe the abundance of native plant and animal species. At the landscape scale, a mix of forest types and ages can provide habitat for a wide range of plants and animals. At the stand scale other elements become more relevant such as species composition, snag abundance or the number of canopy layers.

Both human actions and natural processes or events have the potential to alter diversity. Some actions or natural processes or events may seem to benefit one aspect of diversity while at the same time be less advantageous to another. For example, a wildfire may kill most of the trees in its path: it would create an abundance of snags and down logs which are very important for many species, but at the same time the fire could reduce live tree canopy making the area unusable for species that depend on dense trees and shade. When considering wildfire at the landscape scale, it is likely that there would be sufficient habitats to provide for all native species.

Plantations sometimes lack certain elements of diversity and complexity. They often do not contain the mix of tree species that were present in the original stand and they are relatively uniform in terms of size and spacing. When the original clearcut harvesting occurred within the project area, all of the large trees and snags were removed. The plantations have minimal variability of vertical and horizontal stand structure and little sunlight reaches the forest floor resulting in low levels of diversity of ground vegetation.

At a landscape scale, the logging that created the plantations fragmented mature forest stands. Prior to the 1940s, the forests in the project area were relatively uniform mature forest that became fragmented by clearcuts as plantations were established. This likely benefited certain species such as elk because of the temporary levels of forage created, but likely harmed species such as spotted owls that require large blocks of contiguous mature habitat.

The age and density of stands, and management strategies affect a variety of ecosystem functions including: wildlife species use and migration, nutrient cycling, hydrologic function, production of snags and coarse woody debris, and disturbance processes (fire, insects, disease, and windthrow). Many species evolved to use the large snags and logs that were historically abundant in the landscape. While these structures are still abundant outside plantations, the loss of snag and log density from plantations affects species that depend on those structures such as woodpeckers and cavity nesters. The distribution of snags and fallen trees is partly a function of elevation, aspect, slope, soils and other site factors that contribute to overall site productivity; but, the history of stand disturbance and inter-tree competition can have even greater influence. Under natural conditions, disease, fire, insect infestation and the proximity of the trees to each other as the stand develops are factors that contribute to tree mortality, and create snags and/or down wood.

In the past, thinning focused primarily on tree growth and productivity and resulted in continued uniformity. There are opportunities while designing a thinning project to both enhance growth and provide for greater diversity. The science behind the concepts of variable-density thinning has been evolving in recent years (Carey 2003) (Chan 2006) (Tappeiner 1999) (RIEC 2013). Diversity can be enhanced by using techniques such as retaining minor species, retaining down wood and non-hazardous snags, and creating snags, skips and gaps.

Plantations are relatively dense with one canopy layer (s. 3.1). The plantations were planted primarily with Douglas-fir in the lower elevations; in some areas other species such as noble fir were planted. Other tree species, such as western hemlock, grand fir, Pacific silver fir and western redcedar, are present but uncommon because they seeded in from adjacent sources. Thinning while retaining minor species can result in greater representation of these species throughout the stand.

Gaps are small areas where most or all trees are removed in patches scattered through a thinned stand. Gaps can provide breaks in an otherwise uniform canopy allowing sunlight to reach the ground. Where gaps are created, seedlings and ground vegetation would naturally regenerate resulting in a multi-storied canopy with both vertical and horizontal diversity.

Skips are small areas where no trees are cut in patches scattered through a thinned stand. Skips provide dense shade and a place to optimize quantities of snag development, although in the short term, snags would be relatively small.

Thinning that incorporates these features can change a uniform plantation into one with more variable vertical and horizontal structure and greater species diversity. These changes are beneficial to a wide range of plants and animals. As the stands continue to grow they would acquire the characteristics of old-growth forests sooner than if left untreated, while simultaneously meeting the goals of providing forest products to local economies, as described in the Mt Hood LRMP and the NFP. The fragmented nature of the landscape would become less evident as plantations blend in with surrounding mature forest stands. This is particularly important in LSRs and riparian reserves to restore them to the desired conditions for the key species that rely on unfragmented mature forest conditions.

Recent research (Carey 2003) (Chan 2006) (Tappeiner 1999) has compared variable density thinning with traditional thinning and non-treatment, and found that introducing variability resulted in greater numbers of species of birds, lichens, bryophytes, fungi, and small mammals. Many species that are particularly at risk such as threatened species (including spotted owls and anadromous fish), sensitive species, and survey and manage species are at risk because their required habitats have been altered by clearcutting in the past (USDA USDI 1994b). Variable density thinning to enhance diversity would benefit these species.

1.3.1.6 Forage

Deer and elk were selected as management indicator species because they are economically important game animals. Deer and elk utilize a wide range of forest types for both foraging and cover. Recent research has indicated that cover is not as important as was once thought and that forage quality and abundance is much more critical (s. 3.8.3.4). With the reduction in timber harvest on the Forest in the past two decades and continued tree growth, cover habitats now far exceed the desired levels for optimal and thermal cover but openings for forage are becoming scarce. As the change in forest management has moved from widespread regeneration harvest to variable density thinning, past harvest units that once provided forage have grown a thick stand of young trees that shade out the grasses and forbs. Currently 13% of the project area is in early-seral habitat and that figure is declining each year. While 13% is within the expected range of natural variability, the trend is declining as a large percentage of the landscape is managed for late-successional species.

There is an opportunity to adjust thinning prescriptions to get additional sunlight to the ground and increase the productivity of forage plant species.

1.3.1.7 Road Decommissioning

In order to better manage the Forest's transportation system, the Forest has embarked on several planning processes that address travel and access management. Some planning efforts focused exclusively on road decommissioning and some, like Grove, are primarily vegetation management projects that have included some road decommissioning as connected actions.

The Forest's desire to examine the transportation system and the risk it poses to aquatic habitat was reinforced with the information found in the Forestwide Roads Analysis (2003). The Roads Analysis, which addressed both the access benefits and ecological impacts of roads, highlighted the fact that Forest Service budgets have not kept pace with what it costs to maintain all roads so they are functioning properly. If the Forest is not able to adequately keep up with road maintenance needs, then the Forest's backlog of roads needing maintenance could impact hydrologic function. In response, the Roads Analysis recommends decommissioning road segments having high environmental risk factors coupled with low access needs. It also recommended keeping roads on the Forest's system, but closing and stormproofing them where they present lower risk and higher levels of future need.

The Forest is examining the watersheds incrementally, as funding allows, to assess travel and access management needs. While many decommissioning assessments have been completed across the Forest in the past 15 years, the Forest has made a recent effort to review the road decommissioning needs in high priority watersheds. Simultaneously, the Forest is conducting the Travel Analysis Plan as outlined in 36 CFR 212.5(b).

Although the majority of roads will likely be considered in a later planning effort, there is an opportunity to consider a few roads now for closure, stormproofing and decommissioning that have already been examined as haul roads for the Grove Thin project.

1.3.1.8 Fire Hazard in the Wildland Urban Interface

The project area includes a wildland urban interface. Timber Lake Civilian Conservation Center (TLCCC) is the site of a Job Corp technical training facility. The center has 50 buildings on site including: dormitories, classrooms, offices, and a water treatment plant. There are approximately 320 students, staff and residents that live and work at this site. Ripplebrook Guard Station (RGS) has 36 buildings including: offices, a fire station, a heli-base, residential housing and a contractor-operated convenience store. There are approximately 20 individuals living in the housing area. During the summer months there can be 30-40 individuals that live and work at the RGS. These two facilities are one mile apart at the west edge of the planning area. Refer to maps in appendix A. The 2012 Clackamas County Wildfire Protection Plan has identified this area as a Community at Risk and a Fuels Reduction Priority.

While west-side stands and ecosystems are often described as "wet," the summer and fall conditions can have very high fire danger levels, particularly in drier years. This area is prone to summertime lighting storms, which spark multiple fires each year on the district. Ever increasing levels of public recreation add an additional threat of wildfire to this area through improper care for campfires and other careless acts. These fires are usually small, but recently fires have increased in size and complexity. Evacuations could be difficult due to the large number of residents in the area.

Fuels can be treated around these facilities and the adjacent roads to create a more defensible space and to give fire suppression forces a broader range of tactical options in the event of a wildfire in the vicinity.

1.3.2 Management Direction

The proposed action has been designed to meet the goals and objectives of the documents listed below. This assessment is tiered to the following Environmental Impact Statements and the listed plans are incorporated by reference.

- The Mt. Hood National Forest Land and Resource Management Plan Record of Decision and Final Environmental Impact Statement (USDA 1990a) and Standards and Guidelines (USDA 1990b), as amended, are referred to as the **Forest Plan**. The FEIS discusses environmental effects for Forest-wide programs and sets the stage for project level analysis. The Forest Plan contains standards and guidelines applicable to this project. Consistency is addressed in each resource topic of section 3.0.

- The Forest Plan was amended by the Northwest Forest Plan Record of Decision and Final Supplemental Environmental Impact Statement (USDA, USDI 1994a) 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 1994b) (hereafter referred to as the **Northwest Forest Plan** or NFP). The NFP contains standards and guidelines for Matrix, Riparian Reserves and Late-Successional Reserves. Consistency is addressed in certain resource topics of section 3.0.

- The Forest Plan was amended by the 2005 Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program, hereafter referred to as the R6 2005 FEIS. The R6 2005 FEIS culminated in a Record of Decision (USDA 2005). Standards and guidelines from the 2005 FEIS are addressed in section 3.14.

1.3.2.1 Land Allocations

The project has many overlapping land allocations. For example, where streams flow through Late-Successional Reserves (LSR), the standards and guidelines for both Riparian Reserves and LSRs apply. The following table shows the acreage inside proposed thinning units: some units have two or three land allocations on the same ground. Appendix A contains maps showing the proposed actions, land allocations and other details.

Allocation	Approximate Acres
Matrix	
B2 – Viewsheds	568
B8 – Earthflow	560
C1 – Timber Emphasis	192
Riparian Reserve	412
Late-Successional Reserve (LSR)	32
A1 - Wild and Scenic Rivers	24

For each of the land allocations, thinning is an appropriate tool to use to move the area towards the desired conditions. The following is a brief summary of the goals of these land allocations and their existing and desired conditions. These are all elaborated further in chapter 3.

- The **Matrix** land allocations have primary or secondary goals of maintaining healthy stands and providing forest products through a variety of timber management practices. Thinning provides an immediate source of forest products, while making stands more resilient, allowing for a sustainable supply of forest products in the future.

    - The **viewshed** land allocation is designed to provide attractive, visually appealing forest scenery. It would ensure that vegetation management practices create the desired landscape character. Approximately 714 acres of the project units are in this land allocation. Thinning with skips and gaps to add variability can move the viewshed toward the desired condition by softening the edges of unnatural patchwork patterns and diversifying uniform dense stands. The portion of the viewshed that does not overlap LSRs or Riparian Reserves is considered matrix, or approximately 568 acres. Scenery is addressed in section 3.9.

    - The **earthflow** land allocation is designed to maintain hydrologic and physical balances to prevent reactivation or acceleration of large, slow-moving earthflow areas. Approximately 744 acres of the project are in this land allocation. Appropriate levels of thinning can move earthflows toward the desired condition by enhancing the health of stands. Density management allows individual trees to maintain healthy live crowns and increased root growth. The portion of the earthflow that does not overlap LSRs or Riparian Reserves is considered matrix, or approximately 560 acres. (Note: Earthflows are relatively stable, are appropriate places for thinning, and should not be confused with landslides. See more detail in section 3.5.)

- The **timber emphasis** land allocation is designed to provide lumber, wood fiber, and other forest products. Thinning provides an immediate source of forest products, while making stands more resilient, allowing for a sustainable supply of forest products in the future. Approximately 192 acres are in the timber emphasis land allocation. See sections 3.1 & 3.17.

- **Riparian reserves** are part of the Aquatic Conservation Strategy and are designed to protect the health of the aquatic system and its dependent species. The B7 – General Riparian land allocation of the Forest Plan is entirely encompassed by riparian reserves of the Northwest Forest Plan and has similar objectives. Riparian reserves are located adjacent to streams and other water bodies and wetlands. The project area has many streams, some of which flow through or adjacent to potential thinning stands. Approximately 412 acres of the project are in riparian reserves. Mid-aged stands within riparian reserves are overstocked with relatively uniform tree size and distribution, have low to moderate amounts of small diameter coarse woody debris, lack understory development and have low levels of large snags. These stands do not exhibit mature or late-successional characteristics; they are not able to fully meet the needs of riparian dependent species. The trees do provide some shade to streams and provide some small size woody debris. Thinning with appropriate buffers, can move riparian reserves toward the desired condition by accelerating the development of mature and late-successional conditions. Approximately 8 of the 412 acres overlap LSRs and in the overlap the guidance from both land allocations is relevant. Riparian reserves are discussed in sections 3.3 & 3.4.

- **Late-successional reserves** are designed to serve as habitat for late-successional and old-growth related species, including the northern spotted owl. The North Willamette LSR Assessment (USDA USDI 1998) contains recommendations for management. Approximately 32 acres of the project are in late-successional reserves. These mid-aged stands are overstocked with relatively uniform tree size and distribution, have low to moderate amounts of small diameter coarse woody debris, lack understory development and have low levels of large snags. These stands do not exhibit mature or late-successional characteristics; they are not able to fully meet the needs of dependent species. Variable density thinning, including skips and gaps, can move late-successional reserves toward the desired condition by accelerating the development of mature and late-successional conditions. Approximately 8 of the 32 acres overlap Riparian Reserve and in the overlap the guidance from both land allocations is relevant. See section 3.7.

- The Clackamas River has recreational and scenic segments under the **Wild and Scenic River** system. The objective is to design projects that are consistent with the river's outstandingly remarkable values. Approximately 24 acres of the project are in this land allocation. Thinning can move the river corridor toward the desired condition by accelerating the development of mature and late-successional conditions. All of the 24 acres overlap LSRs. See section 3.11.

1.3.2.2 Forest Plan goals, standards and guidelines

The Forest Plan contains, at its core, management goals and desired future condition statements that direct how the Forest is to be managed (p. Four-1 to Four-44). It also contains a multitude of standards and guidelines that were designed to guide projects to meet management goals and move the landscape toward the desired future condition.

Each resource heading in section 3 contains a discussion of management goals and standards and guidelines applicable to that resource. The Forest Plan describes the process for documenting exceptions to "Should" standards and guidelines (p. Four-45). The Forest Plan does not require a Forest Plan amendment for project level exceptions to these standards and guidelines. Where exceptions are appropriate to achieve Forest goals, the interdisciplinary project planning environmental analysis documents the rationale.

1.3.2.3 Other Relevant Management Direction

Survey and Manage
The Forest Plan was 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, USDI 2001). The project is exempt from the provisions of survey and manage because the stands are less than 80 years old and fit within the Pechman exemptions.

LSR Assessment
Approximately 32 acres of the proposed action are in late-successional reserves. The North Willamette LSR Assessment (USDA USDI 1998) covers these units. This assessment recommends thinning plantations (p. 6-17). The assessment specifically recommended actions to accelerate late-seral structure similar to the current proposed action for Grove including:

- Thinning to produce large trees, or to release advanced regeneration of conifers, hardwoods or other plants.
- Killing trees to make snags and coarse woody debris.
- Developing multiple canopy layers, canopy gaps, and the development of patchy understory.

The Regional Ecosystem Office (REO) reviewed this project and found it to be consistent with LSR standards and guidelines (REO 2012).

Roads Analysis
A Forest-wide Roads Analysis was completed in 2003 (USDA 2003). Section 3.12 discusses roads for this project and how they relate to the Forest-wide analysis. Some road decommissioning has been included.

1.3.2.4 Relevance of Recommendations of Watershed Analyses

The Oak Grove Fork Watershed Analysis (1996) and the Lower Clackamas Watershed Analysis (1996) are incorporated by reference and summarized below. They contain in-depth discussions with maps, of the setting, the ecological processes, the resource conditions and the history of management. Since the watershed analyses were written, the delineation of watersheds changed. The old Lower Clackamas was once considered a separate watershed but it is now a small subset of the current Middle Clackamas Watershed. The delineation of the Oak Grove Fork did not change. The following is a brief summary incorporating those topics which relate to the Grove project.

The project is on the west slope of the Cascade Mountain Range. The terrain ranges from relatively gentle slopes to rugged and steep, with elevations ranging from approximately 1,200 to 4,800 feet. The planning area has a relatively wet, temperate climate.

A portion of the planning area has a wide spectrum of stability issues ranging from rapidly moving landslides and debris flows to slow-moving dormant earthflows. Earthflows are ancient landslide deposits, portions of which move imperceptibly on geologic time scales while other portions can be either static or chronically unstable. Additional discussion of this topic can be found in the Geologic Stability section (s. 3.5). Landslides occur on unstable slopes and can affect the vegetation, the condition of streams and fish habitat, as well as roads and the cost of maintaining them. Dormant earthflows are relatively gently sloping and are very productive in terms of tree growth. The Forest's slope stability specialist examined the components of the proposed action to ensure that actions are on lands that are sufficiently stable.

Most of the planning area is in the western hemlock and Pacific silver fir plant associations with Douglas-fir the primary tree species. Most of the large conifer stands in the planning area are between 200 and 350 years old. The stands of smaller trees are early and mid-seral stands ranging in age from 20 to 60 years that originated primarily from replanting following earlier harvests.

Both watershed analyses recommended implementation of a Conceptual Landscape Design that had the objectives of increasing the connectivity of late-seral habitats, increasing the amount of interior forest habitat, increasing the patch size of early-seral openings (to more closely resemble the natural disturbance regime), and they provide for prioritization of the quantities, methods and distribution of timber harvest to achieve landscape objectives and timber harvest goals.

Since those recommendations were made in 1996 many changes have occurred that should be considered to determine whether they are still relevant today. These changes include:

- There is much less early-seral and more mid-seral habitat.

- The predicted and recommended quantities of regeneration harvest in mature forest were not achieved and there are few large patches of early-seral openings.
- The large and small openings recommended for mature forests were not achieved.
- Forage, particularly for deer and elk was plentiful then but is now in short supply because plantations have grown up and shaded out forage.
- The current level of timber harvest is approximately ½ the level considered appropriate in the watershed analyses.
- There is a new northern spotted owl recovery plan (USDI 2011b).

Because regeneration harvest has not occurred in recent years, the recommendations for connectivity and continuous forest cover are less relevant today than they might have been if all of the recommendations were pursued to their fullest extent. The current proposal puts greater emphasis on thinning and the creation of forage openings in mid-aged stands.

The purpose and need and proposed action are consistent with the recommendations of the watershed analyses: thinning is recommended for most landscapes (Oak Grove - Chapter 10) and (Lower Clackamas – Chapters 5 and 6).

This project has adopted the concepts for riparian reserve delineation described in the watershed analyses. The site-potential tree height for this project is 180 feet. Also included in riparian reserves are certain unstable geological features. While streams, rivers, ponds, wetlands and certain unstable geological features were shown on maps in the watershed analyses, they were conceptual based on data available at the time with limited field verification. For this project, maps were refined based on field inspections. For example, some streams shown on the watershed analyses maps were found to not be present while other unmapped streams were discovered. There is also newer information about fish presence. The project areas have been examined by a geologist to determine the presence or absence of unstable landforms. All of this field-verified information was used to create a more accurate riparian reserve map. This new map is not considered a change to the recommendations put forward in the watershed analyses or the Northwest Forest Plan but simply a more accurate refinement of the intent of those documents.

1.3.2.5 Stewardship Authority

The Forest acting alone cannot achieve the thinning designed to meet the primary goal of increasing health and growth of stands or the other opportunities. The proposal is to offer the rights to remove and utilize the timber to qualified contractors in exchange for accomplishing the variable density thinning and other important work of the proposed action. This project is large enough to be broken into three or more contracts, and the Forest typically uses a mix of traditional Timber Sale Contracts and Stewardship Contracts. The type of contract used is outside the scope of this analysis and would be determined at a later date depending on site-specific circumstances.

Since stewardship contracting is new to some, the following is a brief overview comparing the contract types.

Legislation permanently authorizing stewardship contracting was included in the 2014 Farm Bill. It allows the Forest Service to enter into contracts to meet land-management objectives to reduce wildland fire risk and improve forest health. Stewardship contracts focus on producing desired results on the ground that improve forest health and provide benefits to local communities. Among other things, the stewardship contracting authority allows the value of forest products to be exchanged for ecological restoration services. Some key factors to qualify for stewardship contracting are that the logging component has some restorative elements and that a collaborative public participation process occurs. These things are not required for traditional timber sale contracting and a timber sale contractor cannot be required to do projects unrelated to the timber removal.

Traditional Timber Sale contracts are still an important tool and are used where appropriate. These contracts typically return monetary value to federal and local governments, and allow the Forest to retain funds for post-contract work. In traditional timber sale contracting, the contract is awarded to the high bidder; whereas stewardship contracts are awarded on a best value basis. The award of a stewardship contact is based on a proposal that addresses five factors, including how they would utilize the local work force to accomplish the work. Stewardship contracts also can include required stewardship projects to achieve a wide range of restoration objectives. Recent stewardship projects have included fire hazard reduction, huckleberry enhancement, road repairs, road decommissioning, snag creation, precommercial thinning, culvert upgrades, riparian planting, stream restoration, and restoration of unauthorized off-highway vehicle damage. Stewardship contracting authority also allows for any cash value that remains after funding the required stewardship projects to be retained and pooled with the receipts retained from other stewardship contracts. This pool of money is used to pay for restoration projects, even ones that are off-Forest. Some large projects require the pooled funding from several stewardship contracts.

The stewardship authority has a key collaborative element; local collaborative groups help the agency evaluate restoration proposals. For this project, the Clackamas Stewardship Partners (CSP) has been involved. The Clackamas Stewardship Partners is a collaborative group that describes itself as “a group of diverse stakeholders dedicated to restoring ecological function of the Clackamas River Basin while benefiting local economies.” CSP meetings are open to the public. The CSP has a wide range of diverse participation such as environmental groups, the Clackamas River Basin Council, local water providers, Clackamas County, Oregon Department of Fish and Wildlife, local saw mills, and hunting groups. The Forest has been collaborating with this group since 2004. The CSP has been involved with this project since its inception and participated in field trips. The CSP has collaborated on several million dollars of stewardship projects that have been generated through stewardship contracting in the Clackamas basin. Recent stewardship contracts have provided retained receipts funding that was pooled and used as matching dollars to leverage more funding for larger projects. For example, culverts that were blocking fish passage where Porter road crosses Delph Creek were replaced by a bridge. This off-Forest project was facilitated by CSP with $90,000 of retained receipts from Stewardship Contracts that leveraged the $355,000 of the total cost for the project (CSP 2012).

1.4 Proposed Action

To meet the needs and opportunities described above, the Forest proposes to alter vegetative structure, density, and composition. These activities would be applied slightly differently depending upon the individual resource objectives emphasized by the individual land allocation they would occur within. The proposed action is to thin and harvest wood fiber from approximately 1,756 acres of mid-aged stands while achieving some of the opportunities discussed above. This acreage figure represents the sum of all of the stands considered for treatment at this time. There would actually be fewer acres treated after accounting for stream protection buffers and other leave areas. It is estimated that approximately ¾ of these acres would actually be thinned.

1.4.1 Design Features Applicable to All Areas:

- Leave-tree spacing would vary within units and between units. Tree density would be measured by basal area, trees per acre or relative density depending on the circumstances for each unit (s. 3.1). Where the objective is to delay the time at which the stand reaches the stem exclusion stage, a heavy variable-density thinning would be prescribed (wide leave-tree spacing). In other areas the objective would be to have stands reach the stem exclusion stage sooner and they would have moderate or light variable-density thinning.
- Skips and gaps would be created in a variety of sizes. The sizes and total quantity would vary within and between units. (Skips are areas where no trees would be removed; gaps are areas where most or all trees would be removed.)
- Skips may be placed where there are special features such as clumps of minor species, large snags, wet areas, or locations of rare or uncommon species.
- Gaps would be no larger than one acre in size.
- Some units are too small to accommodate skips and gaps inside their boundaries. Units smaller than 7 acres may not have skips or gaps inside unit boundaries unless warranted by site-specific circumstances.
- Leave trees may include minor species.
- Leave trees may include trees with the elements of wood decay.
- All non-hazardous snags would be retained.
- Existing down logs would be retained.

- Legacy trees would be retained if present. Legacy trees are large remnant old-growth trees that predate the original clear cut logging. Very few legacy trees are known to exist in the proposed thinning units.

1.4.2 Streamside Riparian Reserves - For this project, riparian reserve widths are 180 feet for non-fish-bearing streams and 360 feet for fish-bearing streams. In riparian reserves the thinning outside the protection buffers would be designed to create conditions suitable for tree growth and to enhance diversity while providing sufficient quantities of large wood for future recruitment. The intention is to enhance riparian reserves by accelerating the development of mature and late-successional stand conditions. Protection buffer widths are discussed in section 1.4.9.A1.

Riparian Skips & Gaps - The protection buffers along streams may be considered skips. Skips would be created outside of protection buffers that would vary in size and would be up to 5% of each unit. Gaps would be created within riparian reserves but they would be farther than the protection buffer width or 100 feet from a stream, whichever is greater. For units adjacent to listed fish habitat (LFH), gaps would be 180 feet or farther from listed fish habitat. Gaps would be 0-10% of the available riparian component.

1.4.3 Other Riparian Reserves – There are some small seeps and wet areas. Riparian features that are not perennial or intermittent streams such as seeps, springs, ponds or wetlands would be protected by the establishment of protection buffers that incorporate the riparian vegetation. The protection buffers along ponds, seeps and wet areas may be considered skips.

1.4.4 Late-Successional Reserve - Thinning in LSRs would be designed to accelerate the development of mature and late-successional stand conditions and to enhance diversity. Where riparian reserves overlap late-successional reserves, the relative densities, protection buffers, and skips/gaps as described for riparian reserves would be used. Outside of skips, riparian buffers and gaps, trees would be retained at a relative density of approximately 30. Trees would be retained so that the average canopy cover including riparian reserves, skips and gaps equals at least 40% canopy cover. In late-successional reserves, trees would not be cut if they are greater than 20 inches in diameter (at a height of 4.5 feet) unless they need to be cut for skyline corridors, skid trails, landings or temporary roads, in which case they would be left on the ground. (The LSR units contain few trees of this size.) Hardwood trees across a range of size classes would be favored, including large trees that occupy mid-canopy and higher positions.

LSR Skips & Gaps - Skips would vary in size and comprise a minimum of 10% of each unit. Where riparian reserves overlap late-successional reserves, the protection buffers adjacent to streams may be counted as skips. Gaps would be created on 3 to 10% of each unit.

1.4.5 Matrix - In the matrix, thinning would be designed to increase health and growth that results in larger wind-firm trees and to enhance diversity and forage. Trees would be retained at a relative density of 20 to 25 (s. 3.1).

Matrix Skips & Gaps - Skips would vary in size and comprise up to 5% of each unit. Where riparian reserves cross through matrix, the protection buffers adjacent to streams may be counted as skips. Gaps would be created on up to 5% of each unit to help create variability and diversity while meeting stand-level objectives.

1.4.6 Other Connected Actions

1.4.6.1 Snags & Down Wood - Except in certain root rot patches where snags are abundant, live trees would be treated within harvest units and protection buffers to provide future snags and down wood. Tree topping is generally the technique used to create longer lasting snags and to create live trees with decay. Girdling is the technique used to create snags quickly but they decay and fall over sooner and become down wood. Some trees are felled to get immediate down wood. After thinning, and after one or two winters elapse, the units would be examined to determine whether trees died or fell down. In areas where the following target levels are not already met, additional trees would be topped, felled or girdled. In LSRs, there should be three trees per acre with broken tops, five trees per acre should be dead and two trees per acre should be on the ground. Outside LSRs, there should be one tree per acre with a broken top, and two trees per acre should be either dead or down. If trees need to be treated to meet these number, they would be treated farther than one tree height from system roads and improvements such as power lines, pipe lines and buildings to minimize safety issues and potential losses from firewood gathering.

1.4.6.2 Down wood in streams – Within the stream protection buffer zone of proposed thinning units, some second-growth trees would be felled into streams. Some existing down logs that cross a stream but are not in the water would be bucked to drop them into the stream. This is proposed to create habitat diversity and to restore some natural stream processes.

Treatment is proposed for units 8, 94, 186, 190, 203 and 204. Live trees would be felled or pushed/pulled over to meet the desired frequency of 20 trees per 1,000 lineal feet of stream. Approximately 41 live trees would be added. A fisheries biologist would select the trees to fell from areas that are fully stocked with trees and would select the existing down logs to buck.

1.4.6.3 Heavy thins - would be created leaving approximately 40 trees per acre on up to 10% of each unit in the matrix land allocation.

1.4.6.4 Forage - Certain units in the matrix have been identified for additional forage enhancement based on observed vegetation and use by deer and elk. Forage areas, 3 to 5 acres in size, would be created leaving approximately 20 trees per acre. Approximately 32 acres of forage enhancement would be created in units 4, 54, 180, 210, 216 and 224. Follow up treatments may include planting palatable species.

1.4.6.5 Brushing – Parts of some of the proposed thinning stands have areas of sparse stocking where thinning is not viable but silvicultural treatments are proposed to release trees so they can grow to their full potential. Brushing and cutting of small trees would occur in parts of units where brush is competing with conifers.

1.4.6.6 Fuels Reduction – A fuel break of approximately 49 acres would be created. Fuel treatments including thinning small trees, cleaning up ground fuels and limbing trees to reduce ladder fuels are proposed for the area around the administrative sites of Timber Lake Job Corps and the Ripplebrook facilities. The thinning units that are in the vicinity of administrative sites include 110, 112, 114, 174, 176 and 178. In addition to treatments inside these units, a series of linear defensible spaces approximately 100 feet wide along roads and 200 feet wide around structures would be created to reduce fuels and to improve safety for residents, employees and fire suppression forces. Small trees and shrubs would be cut and all remaining trees would be limbed up as high as practical. Existing ground fuels larger than 8 inches in diameter would remain onsite. Existing ground fuels less than 8 inches in diameter and slash from the thinning would be piled and burned on site or chipped and taken to an offsite location.

Outside the wildland-urban interface, branches and tops and other debris created by the thinning would be retained on the ground to decompose naturally to enhance soils and site productivity. In units operated with a harvester machine, branches and tops would be placed in front of the machine and compressed. Previous experience with similar thinning has shown that snow pack and natural processes of decay cause the debris to break down and compress quickly to the point where fire hazard is not a concern. Some incidental quantities of debris typically end up coming to the landing where it would be piled. If it is not removed for firewood or as biomass it would be burned. Based on previous experience with similar treatments, approximately 27 tons per acre of debris would be retained in the units.

1.4.6.7 Other Tree Removal – Several areas have been identified (inside units) for providing firewood while meeting thinning objectives. Also some small areas of thinning would be achieved by providing “fish logs” for stream restoration projects that are approved by other NEPA documents.

1.4.7 Roads

Road work is proposed for both system roads and temporary roads. This table provides an overview of the detail that follows below (see definitions in s. 1.4.7.2 below).

Proposed Action (mileage is approximate)	miles
System Road Repair and Maintenance (s. 1.4.7.1)	85
System Roads Decommissioned – Stabilize* (s. 1.4.7.2)	1.5
System Roads Decommissioned – Entrance Management* (s. 1.4.7.2)	3.14
System Roads Stormproofed & Closed** (s. 1.4.7.2)	11.61
System Roads Closed*** (s. 1.4.7.2)	1.84
New Temporary Roads Constructed & Rehabilitated (s. 1.4.7.3)	0.20
Existing Road Alignments That Were Once System Roads, Reused as Temporary Roads & Rehabilitated (s. 1.4.7.3)	2.0
Existing Road Alignments That Were Once Temporary Roads, Reused as Temporary Roads & Rehabilitated (s. 1.4.7.3)	3.35

* Of the roads proposed for decommissioning, 0.89 miles are currently open and 3.75 miles are currently closed.

** Of the roads proposed for Stormproofing and closure, 5.72 miles are currently open and 5.89 miles are currently closed.

*** These roads are currently open.

A total of 8.45 miles of roads currently open would be closed.

1.4.7.1 System Road Repairs and Maintenance

Road Number	Length (miles)	Cost $	Notes
4600.000	1.87	$196	Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
4600.021	0.60	$3,049	Brushing, Blade & Shape, Recondition 1 Culvert, 30 cubic yards Pit Run rock, Danger Tree Felling
4600.034	0.20	$2,969	Brushing, Blade & Shape, 60 cubic yards Spot Rock
4600.200	0.92	$4,971	Brushing, Blade & Shape, 80 cubic yards Spot Rock, Danger Tree Felling
4600.245	0.05	$161	Clearing, Blade & Shape, Danger Tree Felling
4630.000	4.21	$18,988	Brushing, Blade & Shape, 150 cubic yards Spot Rock, Clean Culverts Inlets, Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
4630.000	0.22	$349	Paved. Brushing, Clean Culvert Inlets, Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
4630.000	2.2	$10,787	Brushing, Blade & Shape, 100 cubic yards Spot Rock, Clean Culverts Inlets, Danger Tree Felling
4630.012	0.51	$5,846	Brushing, Blade & Shape, 100 cubic yards Pit Run rock, Danger Tree Felling
4630.013	0.16	$2,334	Clearing, Blade & Shape, Roadbed Reconditioning, Pit Run as needed, Danger Tree Felling

Road Number	Length (miles)	Cost $	Notes
4630.016	0.21	$738	Brushing, Roadbed Recondition, 1 Water Bar, Danger Tree Felling
4630.017	0.15	$1,292	Remove & Replace Berm, Brushing, Blade & Shape, Clean Culvert, 1 Drain Dip, Danger Tree Felling
4630.021	0.16	$982	Remove & Replace Berm, Brushing, Blade & Shape, Danger Tree Felling
4630.022	0.07	$502	Brushing, Roadbed Recondition, Danger Tree Felling
4630.024	0.05	$176	Brushing, Roadbed Recondition, Danger Tree Felling
4630.025	0.11	$409	Clearing, Roadbed Recondition, Danger Tree Felling
4630.027	0.03	$470	Remove & Replace Jersey Barriers, Brushing, Blade & Shape, Clean 2 Culverts, Danger Tree Felling
4630.031	0.50	$2,003	Remove & Replace Berm, Clearing, Blade & Shape, Danger Tree Felling
4630.160	0.60	$1,665	Blade & Shape, Brushing, Danger Tree Felling
4630.170	1.00	$27,960	Brushing, Blade & Shape, Danger Tree Felling, **1. MP 0.35 to MP 0.45:** Cut 50 feet New Ditchline, Rebuild Roadway with 120 cubic yards Pit Run, Clean Existing Culvert, Install 2 Drivable Dips **2. MP 0.6:** Dewater site, Excavate drainage way, Place 4 cubic yards pipe bedding, Set new 36" x 40 ft culvert, Backfill with 30 cubic yards Pit Run, Clean 50 feet Ditchline, Install Drivable Dip at Low Point **3. MP 0.75:** Excavate bench at -4 ft below surface grade, Set 10 cubic yards Class 4 Riprap keyed into Bench, Backfill to -6" with 6 cubic yards Aggregate, and Place and Compact 3 cubic yards 3" minus Surface Aggregate to a depth of 6"
4630.225	0.20	$2,757	Brushing, Blade & Shape, Clean Culvert, 40 cubic yards Spot Rock, Danger Tree Felling
4631.000	2.43	$3,268	Brushing, Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
4631.014	0.95	$1,667	Brushing, Clean Culverts, Danger Tree Felling
4631.016	0.30	$2,205	Brushing, Blade & Shape, Danger Tree Felling
4631.130	0.05	$140	Brushing, Danger Tree Felling
4631.140	0.55	$850	Brushing, Clean Culverts, Danger Tree Felling
4635.000	5.50	$34,780	Blade & Shape, Road Recondition MP 4.3 to MP 4.5 and add 80 cubic yards Surface Rock, Brushing, Clearing, 170 cubic yards Sluff Removal (Ditch Cleaning), Clean Culverts, 200 cubic yards Spot Rock, Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
4635.120	2.50	$10,625	Brushing, Blade & Shape, Recondition 1 Cross Drain, 50 cubic yards Pit Run, 40 cubic yards Ditch Cleaning, Danger Tree Felling, 7 Water Bars, Berm
4635.126	0.30	$926	Brushing, Blade & Shape, 10 Water Bars, Danger Tree Felling,
4640.000	4.00	$21,600	Brushing, Blade & Shape, 150 cubic yards Sluff Removal, Clean 10 Culverts, 150 cubic yards Spot Rock, Danger Tree Felling
4640.011	0.68	$3,386	Clearing, Blade & Shape, Danger Tree Felling, Hardened French Drain, 12 Water Bars
4640.013	0.13	$383	Brushing, Blade & Shape, Danger Tree Felling
4640.015	0.13	$374	Brushing, Blade & Shape, Danger Tree Felling
4640.016	0.10	$288	Brushing, Blade & Shape, Danger Tree Felling
4640.017	0.12	$362	Remove & Replace Berm, Brushing, Blade & Shape, Danger Tree Felling, 4 Waterbars
4640.027	0.22	$773	Brushing, Road Reconditioning, 4 Water Bars, Danger Tree Felling
4640.120	0.82	$2,825	Remove & Dispose of Guardrail, Brushing, Roadbed Reconditioning, Danger Tree Felling

Road Number	Length (miles)	Cost $	Notes
4640.130	0.38	$2,419	Brushing, Blade & Shape, 3 Water Bars, Danger Tree Felling, reinforce closer with boulders
4640.140	0.20	$2,289	Remove & Replace Berm, Brushing, Blade & Shape, Danger Tree Felling, 4 Water Bars
4640.150	1.00	$14,645	Remove & Replace Guardrail, Brushing, Blade & Shape, 250 cubic yards Spot Rock, Danger Tree Felling
4645.000	1.13	$1,602	Brushing, Clean 6 Culverts, Danger Tree Felling
4645.000	2.13	$10,173	Remove & Replace Berm, Blade & Shape, Brushing, 100 cubic yards Spot Rock, Danger Tree Felling
4645.130	0.08	$236	Blade & Shape, Brushing, Danger Tree Felling
4645.135	0.57	$1,679	Blade & Shape, Brushing, Danger Tree Felling
5700.000	7.50	$1,313	Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
5700.014	0.16	$482	Blade & Shape, Brushing, Danger Tree Felling
5700.120	1.05	$6,467	Blade & Shape, Brushing, 60 cubic yards Spot Rock, 30 cubic yards Ditch Clean, Clean 12 Culverts, Danger Tree Felling
5700.120	0.70	$3,651	Remove & Replace Berm, Blade & Shape, Clearing, 30 cubic yards Ditch Cleaning, Danger Tree Felling
5700.150	0.20	$883	Blade & Shape, Brushing, 20 cubic yards Ditch Cleaning, Danger Tree Felling, 6 Water Bars
5710.000	6.49	$13,098	Brushing, Roadway Drainage Maintenance at Intersections, 100 cubic yards Spot Rock, Danger Tree Felling
5710.116	0.10	$585	Berm, Blade & Shape, Brushing, Danger Tree Felling
5710.120	0.25	$2,136	Remove & Replace Berm. Blade & Shape, Brushing, 3 Water Bars, Danger Tree Felling
5720.000	2.80	$3,770	Brushing, Clean 12 Culverts, Danger Tree Felling
5720.120	0.43	$1,706	Blade & Shape, Brushing, Clean 11 Culverts, Danger Tree Felling
5720.130	0.20	$809	Blade & Shape, Brushing, Clean 3 Culverts, Danger Tree Felling
5720.140	0.85	$4,374	K-2 Quarry - Maintain Access for Pit Run Material; Blade & Shape, Clearing, 40 cubic yards Spot Rock, Clean 4 Culverts, Danger Tree Felling
5730.000	2.32	$22,566	Brushing, 30 cubic yards Remove Ravel, Clean 6 Culverts, Danger Tree Felling, AC Patch 500 ft at MP 0.35-0.45 (95 tons)
5730.000	7.24	$24,714	Blade & Shape, Brushing, Clean 12 Culverts, 150 cubic yards Spot Rock, Danger Tree Felling
5730.014	0.16	$1,103	Blade & Shape, Clearing, 2 Drivable Dips, Danger Tree Felling
5730.130	1.65	$9,507	Blade & Shape, Clearing, 100 cubic yards from Ditch Cleaning, Clean 2 Culverts
5730.168	0.50	$3,208	Remove & Replace Berm, Blade & Shape, Brushing, Danger Tree Felling, 4 Waterbars
5800.000	3.05	$534	Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
5800.130	0.13	$1,443	Blade & Shape, Light Brushing, 30 cubic yards from Ditch Cleaning, 3 Water Bars, Danger Tree Felling
5810.000	3.34	$10,396	Brushing, 45 cubic yards from Ditch Cleaning, Clean 11 Culverts, Pothole Repair, Pavement Protection, Danger Tree Felling
5810.020	0.23	$723	Blade & Shape, Clearing, Danger Tree Felling
5810.021	0.28	$881	Blade & Shape, Clearing, 9 Water Bars, Danger Tree Felling
5810.130	0.18	$830	Blade & Shape, Brushing, 1 Drivable Dip, Danger Tree Felling
5810.132	0.15	$2,212	Road Reconditioning, Clearing, 4 Water Bars, Danger Tree Felling
5810.150	2.20	$14,759	Blade & Shape, Brushing, 200 cubic yards Spot Rock, Clean 7 Culverts, Danger Tree Felling

Road Number	Length (miles)	Cost $	Notes
5810.160	1.60	$6,132	Remove Berm at MP 1.33 and Reberm at MP 0.05, Blade & Shape, Clearing, 2 Water Bars, Danger Tree Felling
5830.000	1.65	$12,859	Blade & Shape, Brush, 200 cubic yards Spot Rock, Clean 7 Culverts, Danger Tree Felling if needed: not likely needed as this road is a main recreation route and examined regularly for danger trees.
5830.120	0.83	$3,404	Blade & Shape, Brushing, Install French Drain at MP 0.83, Recondition 16 Culverts, Danger Tree Felling

1.4.7.2 System Road Changes

Individual treatments would be tailored to site-specific conditions using one or more of the following methods:

- Road closure with a berm or gate (remains a system road at maintenance level 1).

- Stormproofing usually involves waterbars or other structures to provide drainage (remains a system road). Culverts would be retained unless specified. Where appropriate, the depth of fill material over culverts would be reduced.

- Decommission with entrance management - Installing one or more large earth berms or deep trenches, deeply decompacting approximately 1/8 mile. Culverts would be retained unless specified.

- Decommission with stabilization – any combination as necessary of either removing culverts, reestablishing former drainage patterns or natural contours at stream channels, installing water bars, removing gravel surfacing, decompacting road surfaces, pulling back unstable fill slopes or road shoulders, scattering slash on the roadbed, applying erosion control mulch or seed on disturbed areas, and blocking and disguising the former road entrance to prevent motorized vehicle traffic.

A decommissioned road is removed from the Forest's transportation system data base, is not maintained and is closed to the public.

It is likely that some decommissioned system road alignments may be needed again for future management. The reuse of decommissioned road alignments in the future would require analysis through the NEPA process including public participation and evaluation of environmental effects. The reuse of existing alignments is consistent with Forest Service policy as described in Forest Service Manual 7703.22.

System Road Changes

Road Number	Length	Treatment
4630.170	1.00	Maintenance Level 1, Stormproof
4630.016	0.21	Maintenance Level 1, Stormproof
4630.022	0.07	Close with Boulders
4630.023	0.12	Decommission - Entrance Management, Stormproof
4635.120	2.50	Maintenance Level 1, Stormproof with drivable waterbars, install Gate
4640.011	0.68	Decommission - Entrance Management
4640.013	0.13	Decommission – Single berm at entrance, Stormproof
4640.015	0.13	Decommission - Entrance Management
4640.017	0.12	Decommission - Entrance Management
4640.027	0.22	Decommission - Entrance Management
4640.120	1.02	Decommission – Stabilize, remove intermittent stream culvert
4640.130	0.49	Maintenance Level 1, Stormproof, place boulders to augment closure
4640.140	0.56	Maintenance Level 1, Stormproof
4640.150	1.85	Maintenance Level 1, Stormproof
4645	0.26	Decommission - Entrance Management last 0.26 mile of road. Rest remains Maintenance Level 1.
4645.135	0.57	Decommission - Entrance Management
5700.014	0.16	Decommission - Entrance Management
5700.150	0.56	Decommission - Entrance Management, Stormproof
5710.116	0.92	Maintenance Level 1, Stormproof, Berm
5720.120	2.09	Maintenance Level 1, Stormproof, closed with gate
5720.011	0.19	Decommission - Entrance Management
5730.130	1.65	Maintenance Level 1, gate
5730.014	0.16	Maintenance Level 1, Stormproof, closed by 130 gate
5730.015	0.10	Maintenance Level 1, Stormproof, closed by 130 gate
5800.130	0.13	Decommission – Stabilize
5810.021	0.53	Maintenance Level 1, Stormproof, Berm
5810.130	1.20	Maintenance Level 1, Stormproof, Berm
5810.132	0.15	Decommission – Stabilize
5830.120	0.20	Decommission – Stabilize last 0.2 mile of road, construct turnaround. Rest remains Maintenance Level 2.
PGE roads	0.12	Two roads in units 93 & 102 that access the pipe line would be closed with boulders.

1.4.7.3 Temporary Roads

Temporary roads are roads that are built or reconstructed to access landings and are rehabilitated upon completion of logging until they are needed again. Maps in Appendix A show the location of these roads.

For this document, the term rehabilitation is used to describe the type of closure that is standard practice now for temporary roads. After use, temporary roads are bermed at the entrance, water barred, decompacted and roughened as needed with the jaws of a loader or excavator, and debris such as rootwads, slash, logs or boulders are placed on the surface where available. Most of the existing old temporary roads were not rehabilitated after clearcutting, which was a common practice at that time (30 to 60 years ago).

Some road alignments from previously decommissioned system roads are referred to as temporary roads if they are used again and rehabilitated after use. The reuse of existing alignments is consistent with Forest Service policy as described in Forest Service Manual 7703.22. Because past practices for closing temporary roads and past practices for system road decommissioning varied and differ from current practices, the existing alignments used as temporary roads are all different and unique (s. 1.4.7.4). Some of them have small trees or brush growing on them while many do not. Even with vegetation growing on them, these road alignments are considered the best place to temporarily reestablish a road because it results in less total ground disturbance compared to building another road somewhere else to access the thinning stands.

Existing road alignments were assessed to determine whether they are needed for the current thinning proposal. Approximately 5.35 miles of existing road alignments would be reused as temporary roads. Of these 5.35 miles, approximately 1.82 miles were never actively decommissioned or rehabilitated in the past.

Three new temporary roads are proposed to access landings where the existing system roads and old road alignments do not adequately access the ground to meet the purpose and need. Approximately 0.2 mile of new temporary roads would be constructed and rehabilitated upon project completion.

1.4.7.4 Temporary Road Construction and Reconstruction

Unit	Miles	Notes * indicates additional notes below
4	0.56	Never was a system road, Never actively rehabilitated.
34	0.11	Never was a system road
36	0.13	No longer a system road
38	0.06	Never was a system road
44	0.11	Never was a system road
46	0.06	Never was a system road
52	0.2	Never was a system road

Unit	Miles	Notes * indicates additional notes below
56	0.19 0.27 0.19	Never was a system road No longer a system road, Never actively decommissioned No longer a system road, Never actively decommissioned
58	0.05	Never was a system road
60	0.07	Never was a system road
62	0.46	No longer a system road
66	0.21	Never was a system road
68	0.2	* No longer a system road
70	0.5	* No longer a system road
86	0.12	Never was a system road
88	0.08	Never was a system road, Never actively rehabilitated
100	0.04	New temporary road
112	0.24	Never was a system road, Never actively rehabilitated
138	0.17	Never was a system road
140	0.06	Never was a system road
142	0.13	* Never was a system road, Never actively rehabilitated
158	0.16	Two new temporary roads
166	0.13	Never was a system road
176	0.06	No longer a system road
178	0.02	No longer a system road, Never actively decommissioned
196	0.17 0.33	* No longer a system road Never was a system road, Never actively rehabilitated
204	0.15	Never was a system road
206	0.08	Never was a system road
208	0.03	Never was a system road
209	0.09	Never was a system road
218	0.03	Never was a system road
224	0.09	Never was a system road

Units 68 and 70 – The NEPA decision for these roads authorized closure, stormproofing, and keeping the roads on the Forest's system as maintenance-level-one roads because it was known that they would be used again in the near future. However since they were treated aggressively with deep subsoiling, large waterbars and berms they look like roads that have been purposefully decommissioned. These roads would be opened as temporary roads and then rehabilitated.

Unit 142 – Temporary road was never rehabilitated and has a very small culvert to allow water from a seep to pass. This road would be rehabilitated and culvert removed after project completion.

Unit 196 - The first section of this road alignment (0.17 mile) was a system road that was decommissioned up to a seep crossing, the rest of the road (0.33 mile) was a temporary road that was never rehabilitated. The proposal is to reopen this road as a temporary road. A French drain would be incorporated at the seep area. This road would be rehabilitated after project completion.

1.4.8 Logging Systems

Logging systems are estimated based on aerial photo interpretation, terrain considerations and field visits. Further detailed analysis is needed in the field particularly for skyline systems to verify that they would work appropriately. Project design criteria are considered standard operating procedure when analyzing the feasibility of the type of logging system. A logging systems report is in the analysis file and is incorporated by reference. It includes initial estimates of the extent and location of certain logging system features such as landings.

	Estimated Acres
Ground Based	1,131
Skyline	554
Helicopter	71

1.4.8.1 Landings

The project includes the use of landings. Landings are areas on or directly adjacent to roads where logs are brought to be loaded onto log trucks. Landing sizes vary based on the logging system and the types of equipment that need to be safely accommodated. For similar projects on the west side of the Forest, the following landing sizes are typical:

> An average ground-based logging landing is 50-feet wide by 70-feet long; allowing room for tractors to come and go, a loader to sort logs, and room for a log deck.
>
> An average skyline logging landing is 40-feet wide by 70-feet long; allowing room for a yarder, a loader to sort logs, and a log deck. The standard practice today is to use parallel skyline settings wherever possible. This practice results in much smaller disturbed area: no additional landing construction is needed because the landing overlaps the road prism and requires very little additional clearing. Often in the original clearcut logging, fan shaped settings were used that resulted in larger landings and greater levels of ground disturbance as corridors converge at the landing. In thinning operations, parallel skyline settings avoid this disturbance. Some landings provide access for a tractor unit on one side of a road and a skyline unit on the other side.
>
> An average helicopter landing size is approximately 100-feet wide by 200-feet long with some additional trees removed for the flight path coming into the landing. Some service landings approximately 60-feet wide by 60-feet long are

also needed where helicopters land and are refueled. Where possible, helicopter landings utilize existing openings such as rock quarries or road intersections. Since helicopters were not used for the original clearcut logging, many units that are proposed for helicopter logging today have existing skyline or ground-based landings that would not be reused.

The thinning units were logged before and have existing landings that would be reused where feasible. Some existing landings have brush or small trees growing on them that would need to be removed.

Approximately 15 landings would be used for helicopter log landings equating to approximately 7 acres and 6 landings used for service landings equating to approximately a 1/2 acre. All helicopter and service landings are located in previously used landings, roads, or rock quarries. For tractor and skyline units, approximately 222 existing standard landings would be reused, resulting in little to no new ground disturbance, although some level of blading and reconditioning would occur on these areas, totaling approximately 16 acres. For parallel skyline landings where little or no additional ground disturbance would be required outside the road prism, approximately 3 have been used before (1/4 acre) and approximately 74 have not been used before (5 acres). Approximately 28 new standard size landings would need to be constructed (2.3 acres). In total, landings would occupy about 31 acres, with most of the disturbance occurring within road prisms or other created openings that remain on the landscape from past timber management activities.

The final landing locations, quantity and sizes are approved by contract administrators using the project design criteria (PDC). The PDCs include minimum spacing away from streams and post-harvest restoration.

1.4.8.2 Unit Table

Unit #	Acres	Unit #	Acres	Unit #	Acres
2	1	88	14	162	7
4	26	90	1	164	5
8	13	91	1	166	10
10	3	92	1	170	4
12	3	93	13	172	4
14	1	94	25	174	7
15	2	95	2	176	2
16	4	96	3	178	2
17	1	100	8	180	69
20	1	102	8	182	1
22	8	103	8	184	39
24	2	104	2	186	23
26	3	105	2	188	2
28	4	106	4	190	20
30	33	110	5	191	2
34	26	112	12	192	8
36	30	114	10	194	4

Unit #	Acres	Unit #	Acres	Unit #	Acres
38	32	116	5	196	37
42	4	118	10	198	5
44	37	120	33	200	1
46	26	122	6	202	11
50	8	124	1	203	3
52	33	126	1	204	17
54	36	128	1	206	15
56	63	130	1	208	2
57	2	132	16	209	6
58	79	134	5	210	35
60	97	136	10	211	5
62	58	138	11	212	20
64	40	140	8	213	1
66	41	141	8	214	25
68	24	142	12	216	36
70	30	148	13	218	10
72	13	152	26	220	7
74	16	154	3	222	16
78	2	155	1	224	30
82	20	156	3	226	26
84	28	158	17	228	28
86	34	160	17		

1.4.9 Project Design Criteria

These are practices that are part of the proposed action. They were developed to minimize effects to resources but do not necessarily eliminate all impact. The effects and benefits of these practices are included in the analyses of effects in section 3. In some cases they are standard practices that are used in all similar projects and in other cases they are specifically tailored to this project based on site-specific factors such as the underlying land allocation and associated standards and guidelines. Some of these practices are a project-specific implementation of the National Core Best Management Practices (BMP) Technical Guide (USDA 2012b) to minimize impacts to water quality. Effectiveness is addressed in s. 3.3.6. The National Core BMP Program was developed to improve agency performance and accountability in managing water quality consistent with the Federal Clean Water Act (CWA) and State water quality programs, and represents the best available science regarding best management practices. The 2012 Technical Guide (USDA 2012b) is incorporated by reference and detailed in the BMP checklist in the project file.

In this section the ‘dry season’ is generally June 1 to October 31 depending upon seasonal conditions, and the ‘wet season’ is the rest of the year.

A. Stream Protection Buffers

A1. Streams within the project area would be protected with buffers. Stream buffers are measured using slope distance from the edge of active channel (stream banks) on both sides of the stream. Within these buffers, tree felling or yarding would not occur (with the exceptions for danger trees, approved skyline corridors and down wood enhancement projects described in B1).

The following are minimum stream protection buffer widths:

Intermittent Streams	Perennial Streams Hill Slope < 30%	Perennial Streams Hill Slope 30 to 60%	Perennial Streams Hill slope > 60%
30 feet	70 feet	75 feet	85 feet

The streams that have a connection to listed fish habitat (LFH) were examined by the fisheries biologist and the minimum widths above were adjusted based on the proximity to listed fish habitat, and other factors such as stream gradient and orientation and the cumulative quantity of other past management along these streams.

Intermittent streams downstream of Lake Harriet would have a 50 foot buffer.

Perennial Streams

- The protection buffer from the Oak Grove Fork is 180 feet. This applies to unit 94.
- Unit 94 (other perennial streams) = 112
- Units 93 & 96 = 112 feet
- Units 110, 114, 186 & 190 = 108 feet
- Units 102, 103, 203, 204 & 216 = 106 feet
- Unit 90 = 93 feet
- Units 22, 154, 156, 158, 160, 176, 180 & 191 = 75 feet

National Core BMP Technical Guide – Plan 3 and Veg 3.

A2. In certain instances, the buffer widths in A1 may be expanded, as directed by the District Ranger, based on recommendations by the unit fisheries biologist, hydrologist or geologist. Adjustments include unstable areas and areas with high water table such as wetlands, or seasonally saturated soils.
National Core BMP Technical Guide – Plan 3 and Veg 3.

B. Tree Felling in riparian reserves

B1. Trees would not be felled within the stream protection buffers with the following exceptions:

a) A stream enhancement project within the stream protection buffer zone of certain proposed thinning units involves the felling of some second-growth trees into streams. A fisheries biologist would select the trees to fell from areas that are fully stocked with trees and would avoid unstable areas or areas with a high water table.

b) Hazard trees may be felled from stream protection buffers where necessary for safety. Felled trees would be left in place unless they land on a road.

c) In some units, skyline cables would cross streams to tie off on the other side to gain needed lift. Where logs are yarded from one side of the stream to the other as described below in C1,2 and 3, a corridor less than 15 feet wide would be created. Where no logs are yarded from one side to the other and only a cable crosses to gain needed lift, few if any trees would be cut in the stream protection buffer. Any trees in the stream protection buffer felled for skyline corridors would be left in place. Skyline corridors would cross stream channels for only two Grove units (units 156 and 204).

National Core BMP Technical Guide - Plan 3 and Veg 3.

B2. Harvested trees that would be yarded would be felled away from streams, springs, or wetlands, or parallel to the stream buffer. Trees that are inadvertently felled into the stream protection buffer would be left on site. *National Core BMP Technical Guide - Plan 3, AqEco 2, Veg 3, Veg 4 and Veg 5.*

B3. The distance separating a gap from LFH would be greater than 180 feet. The distance separating a gap from all other streams would be at least 100 feet. Gaps in riparian reserves would be one acre or less in size. *National Core BMP Technical Guide - Plan 3 and Veg 3.*

C. Skidding, Yarding and Equipment Use

C1. Skyline yarding over streams with LFH would not occur. *National Core BMP Technical Guide - Plan 3, AqEco 2, Veg 2, Veg 3, Veg 4 and Veg 5.*

C2. Skyline yarding over non-LFH streams is acceptable if the logs are fully suspended over stream channels and the ground within their protection buffers. One-end suspension would be required in skyline corridors outside the protection buffers. During lateral yarding, use one-end suspension to the extent practicable. *National Core BMP Technical Guide - Plan 3, AqEco 2, Veg 2, Veg 3, and Veg 5.*

C3. Where skyline corridors are created by tree felling as described in C2, the number of skyline yarding corridors over perennial streams would be limited to no more than five corridors per 1,000 lineal feet of stream. Individual corridor widths would not exceed 15 feet. Corridors would be spaced at least 100 feet apart (along the stream). *National Core BMP Technical Guide - Plan 3, AqEco 2, Veg 3, and Veg 5.*

C4. Existing landings would be used where feasible. Landings would be limited to the area needed for safe and efficient yarding and loading operations and would have proper drainage. Where necessary, straw bale catchments or silt fences would be used to minimize sediment transport to road ditches or streams. The catchments would be located to intercept runoff from the landing prior to reaching any road ditch or stream. *National Core BMP Technical Guide - Plan 3, Veg 2, Veg 3, Veg 4 and Veg 6.*

C5. New landings would not be constructed within 500 feet of LFH or within 200 feet of any other stream. *National Core BMP Technical Guide - Plan 3, Road 1, Road 5, Veg 2, Veg 3 and Veg 6.*

C6. The use of existing landings within the following distances of streams would not occur without the approval of the District Ranger based on recommendations from a fisheries biologist:
a) within 200 feet of LFH,
b) within 200 feet of a non-LFH stream, if the potentially affected stream reach is within 0.5 mile of LFH, or
c) within 100 feet of any stream channel.

If an existing landing is approved for use within these distances, erosion control measures would be installed prior to use where appropriate to prevent soil movement downslope from the landing. Erosion control measures may include, but are not limited to, use in the dry season, straw bales around landing perimeter, and rock surfacing. The portion of the landing outside a system road prism would be rehabilitated (compacted soils fractured, seeded and mulched) after use. *National Core BMP Technical Guide - Plan 3, Veg 2, Veg 3, and Veg 6.*

C7. Landings used in the wet season, may need to be surfaced with aggregate material, dependent upon soil moisture conditions. *National Core BMP Technical Guide - Veg 2, Veg 3, Veg 6 and Veg 7.*

C8. Use existing landings and skid trails to the maximum extent possible. Within riparian reserves, the maximum amount of new soil compaction (defined as management-caused crowding of soil particles which causes a decrease in soil porosity of 50% or more, and an increase in soil bulk density) caused by skid trails, harvester paths, corridors, and landings associated with activities in the proposed action would not be more than 10% of the riparian harvest area. *National Core BMP Technical Guide - Plan 3, Veg 2, Veg 3, Veg 4 and Veg 6.*

C9. Skid trails would not be constructed through areas with a high water table, or be located in areas that would channel water onto unstable headwall areas, or located down swale bottoms. *National Core BMP Technical Guide - Plan 3, Veg 2, Veg 3, and Veg 4.*

C10. Adjacent to stream protection buffers there would be additional restrictions for certain ground-based equipment. Only mechanical harvesting equipment used for tree falling would be allowed within 180 feet of listed fish habitat, or within 100 feet of other perennial streams, or within 80 feet of intermittent streams. Distances are measured slope distance in the direction of the slope aspect. Exceptions may be made for the use of existing skid trails by the District Ranger based on recommendations from the unit fisheries biologist or hydrologist. *National Core BMP Technical Guide – Plan 3, Veg 2, Veg 3, Veg 4 and Veg 5.*

C11. All ground-based skidding equipment would be confined to pre-approved skid trails, temporary roads and landings during yarding. Existing skid trails would be reused where possible unless they are hydrologically connected to a naturally occurring stream channel.

Where new skid trails are needed: skid trails would be spaced a minimum of 150 feet apart except where converging; skid trails would be located to minimize the alteration of surface hydrology; uphill skidding would generally be on slopes less than 20% except on short pitches; and downhill skidding would generally be less than 30%.

Where existing skid trails are needed: some ground-based logging would occur on slopes steeper than 30% where existing skid trails are available and not hydrologically connected. Skid trails in these situations are typically contouring or diagonally constructed skid roads with cut and fill. In these areas, equipment would stay on approved skid trails and directional felling and winching of logs would occur.
National Core BMP Technical Guide – Veg 2 and Veg 4.

C12. Mechanical harvesting equipment used for tree falling would be limited to a single pass on each pathway unless operating on continuous slash-covered paths. The layer of slash would be as thick as possible given the slash available from harvested trees. Slash is not required when equipment is moving on approved skid trails. Mechanical harvesting equipment would generally operate on slopes less than 35%. Mechanical harvesting equipment may operate on slopes from 35 to 40% outside of riparian reserves if equipment stays on existing approved skid trails or moves straight up and down the slope without turning. *National Core BMP Technical Guide – Veg 2 and Veg 4.*

C13. Rutting within skid trails would not exceed 12 inches in depth over more than 10 percent of a designated skid trail system. *National Core BMP Technical Guide – Veg 2 and Veg 4.*

C14. Whole-tree yarding would not be permitted except in units 110, 112 and 178. This requirement may be waived if sufficient slash and woody debris is retained in the units to provide for long-term soil productivity. *National Core BMP Technical Guide - Veg 1, Veg 4 and Veg 8.*

D. Temporary Road Construction and Reconstruction

D1. New temporary roads would not be constructed within 500 feet of LFH or within 200 feet of any other stream. *National Core BMP Technical Guide - Plan 3, Road 1, Road 5, Veg 2, Veg 3 and Veg 6.*

D2. Emphasize the reuse of existing road alignments rather than the construction of new roads where appropriate. Where stream crossings are needed on existing alignments, they would be designed to minimize impacts to listed fish using techniques such as French drains, log fords and temporary culverts that would be used and removed the same season. *National Core BMP Technical Guide - Plan 3, AqEco 2, Road 1, Road 5, Road 7, Veg 3.*

D3. New temporary road construction would generally occur on or near stable ridgetop locations, or on stable, relatively flat topography. Sidecast road construction techniques would not occur when the hill slope exceeds 30%. *National Core BMP Technical Guide - Plan 3, Road 1, Road 5, Veg 2, and Veg 3.*

D4. New temporary roads would not increase the permanent stream drainage network (i.e. roads would be outsloped, or the outflow of new ditch relief culverts or other drainage structures would not drain to streams). *National Core BMP Technical Guide - Plan 3, AqEco 2, Road 1, Road 5, Veg 2, and Veg 3.*

D5. When constructing new temporary roads the width of the compacted surface and ditch line would be less than 24 feet wide except at landings. *National Core BMP Technical Guide - Road 5 and Veg 1.*

D6. Temporary roads and landings adjacent to system roads would not obstruct ditch lines. Temporary obstructions of ditch lines or drainage ways may be approved if French drains or drivable dips are installed to provide effective drainage and prevent erosion. *National Core BMP Technical Guide – Road 1, Road 2, and Road 5.*

D7. Rock would only be used when necessary to reduce erosion, puddling and compaction on landings and temporary roads. To provide an efficient substrate for vegetative growth and water infiltration, rock would be removed and/or incorporated into the roadbed by ripping or scarification following harvest activities. *National Core BMP Technical Guide – Road 1, Road 5, Veg 2 and Veg 6.*

D8. Temporary roads and landings on temporary roads that are used by the operator would be subsoiled to a depth of at least 18 inches or decompacted to a depth of at least 18 inches with a loader or excavator. Cross-drains or water bars would be installed every 150 feet, or more frequently where slopes exceed 5%. Actual placement distances may vary with topography to ensure proper drainage. Temporary culverts would be removed. Available logging slash, logs or root wads would be placed across the road and landing surface. Where slash, logs or root wads are not available in sufficient quantities, bare soils would be seeded and mulched. Post-harvest motorized access to temporary roads would be prevented by construction of a berm (minimum height of 4 feet). *National Core BMP Technical Guide – Road 5, Road 6, Veg 2 and Veg 3.*

E. System Road Renovation, Reconstruction, and Maintenance

E1. Limit soil disturbing road renovation and reconstruction activities to the dry season, unless the road segment has no hydrologic connection. *National Core BMP Technical Guide - AqEco 2, Road 3, Veg 2, and Veg 3.*

E2. During road maintenance activities, existing desirable vegetation (e.g. grass) growing in ditches that discharge to streams would not be removed unless an effective sediment trap is installed and maintained until vegetation is reestablished. This does not restrict brush or tree cutting that leaves roots intact. The fill slopes at stream crossings would be vegetated or otherwise stabilized such that road surface sediments are retained prior to entering the stream channel. Roads approaching stream crossings would have adequate cross drainage to divert potential ditch sediment toward slopes where material can be trapped. Stream crossings that do not fully meet these standards would be repaired, reconstructed, or mitigated as directed by the District Ranger based on input from the unit fish biologist, hydrologist or soil scientist by inclusion of erosion control measures such as silt fences, straw bales, matting, mulch, slash, water bars, grass seed [or other products], etc. This work would occur prior to the wet season. *National Core BMP Technical Guide – Road 4.*

E3. Material removed from ditches would not be graded onto the road surface where the road surfaces are within 200 feet of LFH or 100 feet of non-LFH. Material that must be removed from ditch lines within these distances would be removed and stored farther than 200 feet of LFH or 100 feet of non-LFH and where they cannot flow directly to a stream. *National Core BMP Technical Guide – Plan 3, AqEco 2, Road 4, Veg 2, and Veg 3.*

E4. Excavated materials from ditch cleaning or other operations would be disposed of at approved sites. Material would be spread evenly over an appropriate area in non-conical shaped piles with a maximum layer thickness of three feet. Bare material would be seeded and mulched at the completion of operations. *National Core BMP Technical Guide – Road 4.*

E5. Where new cross drain culverts are needed, they would be located to drain to a stable hill slope with porous soils, allowing for water infiltration, with a low probability of erosion, and where no new channel would connect to an existing stream. *National Core BMP Technical Guide –AqEco 2, Road 3, Road 4, Veg 2, and Veg 3.*

E6. Woody material removed from stream channels during culvert maintenance would be retained in the stream network. Typically this would entail repositioning wood located upstream from a culvert to a location downstream of the culvert. *National Core BMP Technical Guide –AqEco 2, Road 4, Road 7 and Veg 3.*

E7. Close and waterbar native surfaced roads prior to the wet season and between operating seasons to prevent use and reduce erosion. *National Core BMP Technical Guide –Road 1, Road 4, Road 6, Veg 2, and Veg 3.*

E8. At the termination of the contract, native surfaced roads would have drainage structures (e.g., waterbars) installed, and the road closed to prevent use if the road is hydrologically connected to any stream. National Core BMP Technical Guide –AqEco 2, Road 1, Road 3, Road 4, Road 6, Veg 2, and Veg 3.

E9. Where water is needed for dust abatement, road maintenance, reconstruction or construction, it shall not be withdrawn from streams or rivers classified as Listed Fish Habitat. See Appendix A maps. Drafting from other water sources would be isolated in space and time so that multiple drafting operations would not occur simultaneously in the project area. Furthermore, water withdrawal would not reduce flow at the time of withdrawal by more than 50 percent. Pipe intakes would be screened to prevent fish entrainment. All drafting sites would be pre-approved by fisheries personnel prior to water withdrawal.

F. Timber and Rock Transport (Haul)

F1. Haul routes that require travel over unstable road segments would be reconstructed or stabilized to prevent sediment delivery to streams. *National Core BMP Technical Guide – AqEco 2, Road 1, Road 4 and Veg 3.*

F2. Haul would be stopped immediately, even in the dry season, if road use is causing rutting of the road surface, ponding of water on the road, failure of any drainage structure, or any other action occurs which increases the sediment delivery to a stream. Roads would be restored or repaired before haul resumes. *National Core BMP Technical Guide – AqEco 2, Road 1, Road 4, Veg 2, Veg 3 and Veg 7.*

F3. Haul on aggregate surfaced and natural surfaced roads is allowed during the dry season if the approach and crossing of each LFH stream is paved or has a high quality, well drained, and recently maintained aggregate surface. *National Core BMP Technical Guide – AqEco 2, Road 1, Road 4, Veg 2, and Veg 3.*

Wet Season Haul

F4. Haul would not occur on native surfaced roads during the wet season. *National Core BMP Technical Guide – Road 1, Road 4, Veg 2, Veg 3 and Veg 7.*

F5. Haul may occur during the wet season on paved roads or on aggregate surfaced roads if the following criteria are met:
a) Haul would not occur on aggregate surfaced routes that cross LFH, or cross other tributary streams that are within 1,000 feet from LFH or are closer than 500 feet of LFH at any given point. This restriction may be waived based on site-specific conditions if approved by the District Ranger based on input from the unit fish biologist, hydrologist or soil scientist and if appropriate erosion control measures are used such as spot rocking, silt fences, straw bales, matting, mulch, slash or water bars. This restriction applies to portions of road 4630 adjacent to units 91, 92, 93, 94, 95 and 96.
b) Haul routes would be inspected weekly, or more frequently if weather conditions warrant. Inspections would focus on road surface condition, drainage maintenance, and sources of soil erosion and sediment delivery to streams. If sediment traps are used they would be inspected weekly during the wet season and entrained soil would be removed when the traps have filled to ¾ capacity. Removed materials would be deposited in a stable site which is not hydrologically connected to a stream.
National Core BMP Technical Guide – Plan 3, AqEco 2, Road 1, Road 3, Road 4, Road 7, Veg 2, Veg 3 and Veg 7.

F6. One means to estimate when it is too wet for haul is to measure precipitation on site. Generally haul would not occur when there has been 1.5 inches of precipitation or greater within any given 24 hour period as measured at the lowest elevation aggregate road. A temporary rain gauge may be installed near the transport route; otherwise precipitation would be measured at a nearby RAWS or SNOTEL station. The District Ranger with input from a unit fish biologist, hydrologist or soil scientist would consider precipitation quantity along with a visual inspection of roads and professional judgment to indicate when haul should be stopped to prevent road related impacts to streams. *National Core BMP Technical Guide – Plan 3, AqEco 2, Road 1, Road 3, Road 4, Road 7, Veg 2, Veg 3 and Veg 7.*

F7. To protect the integrity of roads, haul would not occur when the temperature of the road surface, as measured at the lowest elevation along the route on system roads, is between 28 and 38 degrees F. or when it is determined that freeze-thaw conditions exist along the route. *National Core BMP Technical Guide – Road 4.*

F8. If snowplowing occurs, snow would be removed in a manner which protects the transportation resource and all other adjacent or connected resources. Upon completion of snowplowing, windrows and snow berms would be removed or breached to avoid accumulation or channelization of snow melt on the road. Breaching would avoid the discharge of water from the road into streams or onto erosive slopes. Any loss of roadway surfacing materials as a result of snowplowing operations would be replaced in kind by the operator. The operator would repair or replace any roadway structures that are damaged as a result of snowplowing operations. *National Core BMP Technical Guide – Road 8 and Veg 7.*

G. Soil and Erosion

G1. No operation of off-road ground-based equipment would be permitted in the wet season. This restriction applies to the ground-based portions of harvest units. It applies to off-road ground-based equipment such as tractors, skidders, harvesters or equipment used for fuels treatment. The District Ranger may waive this restriction if soils are dry, frozen or snow covered, based on input from a soil scientist.

If soil moisture exceeds 20%, waivers may be considered for operations on approved skid trails as long as ruts do not exceed 12 inches in depth over more than 10 percent of a designated skid trail system.

For frozen conditions waivers may be considered if the following conditions are met:

Soil not frozen	Need 10 inches of machine-packed snow
2 inches of frozen soil	Need 6 inches of machine-packed snow
4 inches of frozen soil	No snow cover necessary

National Core BMP Technical Guide - Veg 2, Veg 4, and Veg 7.

G2. Erosion control measures would be implemented to prevent off-site movement of disturbed or exposed soil associated with road and landing construction and use (including cutbanks, fills, ditches, etc.) on road segments that have the potential to directly or indirectly deliver sediment to any stream channel. Erosion control measures include silt fences, straw bales, matting, mulch, slash, water bars, grass seed [or other products], etc. This work would occur prior to the wet season. *National Core BMP Technical Guide – Veg 2, Veg 3, Veg 4, Veg 5 and Veg 6.*

G3. Erosion control measures would be implemented to prevent off-site movement of disturbed soils from logging, fuel treatments, road rehabilitation and other uses not described in G2. Areas of soil displacement on steep slopes resulting from

yarding systems would be treated to prevent rill and gully erosion and possible sediment delivery to stream courses. Where appropriate, erosion control treatment on bare soils may include water bar placement, hillslope contouring, creating small ditches or diversions to redirect surface water movement, scattering slash on disturbed soils, placement of mulch, and application of approved seed. Mulch may be used on slopes greater than 20%. Effective ground cover would be installed prior to October 1 of each year. The coverage of effective ground cover would be sufficient to prevent off-site movement of soils as guided by Forest Plan standard and guideline FW-025 and by Forest Service Handbook 2509 (R6 supplement).
National Core BMP Technical Guide – Veg 2, Veg 3, Veg 4, Veg 5 and Veg 6.

G4. Native plant materials are the first choice in revegetation of bare soils, [e.g., blue wildrye (*Elymus glaucus)*, California brome (*Bromus carinatus*), slender hairgrass (*Deschampsia elongate*), and broadleaf lupine (*Lupinus latifolius*)]. Non-native, non-invasive plant species may be used if native plant materials are not available or as an interim measure designed to aid in the re-establishment of native plants.[e.g., annual ryegrass (*Lolium multiflorum)* and Madsen sterile wheat.] Non-native invasive plant species would not be used.

H. Invasive species

H1. All off-road equipment is required to be free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds prior to coming onto National Forest lands. Contracts would include provisions to minimize the introduction and spread of invasive plants. These provisions contain specific requirements for the cleaning of off-road equipment.

H2. Gravel or rock used for roads would come from weed free sources.

H3. Road blading, brushing and ditch cleaning in areas with high concentrations of invasive plants would be conducted in consultation with invasive plant specialists.

H4. Seed used for erosion control or other reasons would preferably be grown under government-supervised contracts, or certified by the state of Oregon to assure noxious weed free status. In certain cases, non-certified seed may be used if it is deemed to be free of Oregon State Class A & B noxious weeds.

H5. When straw and mulch are utilized for erosion control, it would be annual ryegrass straw or spring wheat straw certified by the State of Oregon, or would originate from fields which grow State of Oregon certified annual ryegrass seed, or originate from Willamette Valley Oregon fields which grow only annual ryegrass seed for large-scale commercial seed production. In place of straw, wood fiber mulch may be used.
National Core BMP Technical Guide – Veg 4.

I. Road Decommissioning and Rehabilitation
National Core BMP Technical Guide – Road 6 and Road 7.

I1. For road removal projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the greatest degree possible. If natural contours are greater than 2 to 1 ratio, then slopes would be shaped to a 2 to 1 ratio or less.

I2. For those road segments immediately adjacent to the stream or where the road fill is near the wetted stream, consider using sediment control barriers such as certified weed-free straw bales or silt fencing between the project and the stream.

I3. Where decompaction is prescribed, 50-75% of the road surface would be de-compacted through the sub-grade and native vegetation could be placed on road surface no more than one layer deep. The road surface would be decompacted to a minimum depth of 18 inches. If native soil material is greater than 18 inches deep the road surface would be decompacted to that depth.

I4. Following earthwork, the disturbed area would be treated as described in PDC G3 above. Where slash is not available, mulch would be applied at approximately 2,000 pounds per acre or so that there is completed coverage of the bare soil surface and the mulch is 4 inches deep. If seed is applied, it would during conditions favorable for germination.

I5. Drainage features would be spaced to hydrologically disconnect road surface runoff from stream channels.

I6. Dispose of slide and waste material in stable sites out of the flood prone area. Waste material other than hardened surface material (asphalt, concrete, etc) may be used to restore natural or near-natural contours.

I7. Minimize disturbance of existing vegetation in ditches and at stream crossings to the greatest extent possible.

I8. Conduct activities during dry-field conditions – low to moderate soil moisture levels. Road decommissioning activities would be suspended if there is more than one inch of rain in a 24 hour period or more than two inches of rain for the entire storm event as defined as precipitation in the last 48 hours at the Red Box Remote Automated Weather Station (http://www.wrh.noaa.gov/mesowest/getobext.php?sid=RXFO3&table=1&banner=off). If this site is not functioning, then use the information at the Peavine Ridge SNOTEL site (http://www.wrh.noaa.gov/mesowest/getobext.php?wfo=&sid=PVRO3&num=168&raw=0&dbn=m&banner=off), or as determined by the Contracting Officer. Project operations would be suspended if soil moisture is recharged and streamflows rise above baseflow levels (Clackamas River at Three Lynx above 2,000 cfs).

I9. The Oregon Department of Fish and Wildlife Guidelines for Timing of In-Water Work would be followed. Exceptions to these guidelines for timing of in-water work may be requested from appropriate regulatory agencies.

I10. Activities associated with culvert removal in streams with active streamflow would be suspended if there is an increase of 10 NTU's (Nephlometric Turbidity Units) below the project area. Also, activities could be suspended if turbidity criteria are exceeded as determined by appropriate Forest Service personnel.

I11. Operations would be scheduled and conducted so as to prevent soils from entering any waterway. Live streams would be diverted from work areas prior to excavation of culverts, or any other stream crossing structure. A stream diversion plan would be developed prior to starting of excavation in live streams.

I12. Excavations to remove stream culverts would be matched to the approximate bed elevation and bank-full stream width of the existing streambed. Cuts would match natural bank slopes.

I13. At culvert removal sites, the road would have waterbars or other drainage features constructed to route surface water away from the newly excavated slopes.

I14. Dispose of side-cast and waste material (asphalt, concrete, etc) in stable sites out of the flood prone area. Native soils and rock used to construct the road may be used to restore natural or near-natural floodplain and bankfull contours, which were altered by the road and associated ditches and structures.

I15. When removing a culvert from a first or second order, non-fishing bearing stream, project specialists would determine appropriate measures such as the use of temporary sediment retention devices such as biobags, strawbales or burlap.

I16. For culvert removal projects, restore natural drainage patterns (floodplain and bankfull) and when possible promote passage of all fish species and life stages present in the area. Evaluate channel incision risk and construct in-channel grade control structures when necessary.

I17. In addition to all U.S. Army Corps of Engineers (USACE) permit conditions, the following 401 Water Quality Certification (WQC) conditions apply to all National Water Program (NWP) categories certified or partially certified by this 401 WQC, unless specified in the condition. Additional 401 WQC Category Specific Conditions follow, which must also be complied with as applicable.

Turbidity: All practical Best Management Practices (BMPs) on disturbed banks and within the stream shall be implemented to minimize turbidity during in-water work. OAR 340-041-0036 states that turbidity shall not exceed 10% above natural stream turbidities, except where allowed by the rule. This rule also states that limited duration activities necessary to accommodate essential dredging, construction or other legitimate activities and which cause the turbidity standard to be exceeded may be authorized provided all practical turbidity control techniques have been applied and a section 401 water quality certificate has been granted.

a. Monitoring: Turbidity monitoring shall be conducted and recorded as described below. Monitoring shall .occur each day during daylight hours when in-water work is being conducted. A properly and regularly calibrated turbidimeter is recommended, however, visual gauging is acceptable.

i. Representative Backqround Point: a sample or observation must be taken every four hours at a relatively undisturbed area approximately 100 feet upcurrent from in-water disturbance to establish background turbidity levels for each monitoring cycle. Background turbidity, location, and time must be recorded prior to monitoring downcurrent.

ii. Compliance Point: Monitoring shall occur every four hours approximately 100 feet down current from the point of discharge and be compared against the background measurement or observation. The turbidity, location, and time must be recorded for each sample.

b. Compliance: Results from the compliance points should be compared to the background levels taken during each monitoring interval. Exceedances are allowed as follows:

MONITORING WITH A TURBIDIMETER		
ALLOWABLE EXCEEDANCE TURBIDITY LEVEL	ACTION REQUIRED AT 1st MONITORING INTERVAL	ACTION REQUIRED AT 2nd MONITORING INTERVAL
0 to 5 NTU above background	Continue to monitor every 4 hours	Continue to monitor every 4 hours
5 to 29 NTU above background	Modify BMPs & continue to monitor every 4 hours	Stop work after 8 hours at 5-29 NTU above background
30 to 49 NTU above background	Modify BMPs & continue to monitor every 2 hours	Stop work after 2 hours at 30-49 NTU above background
50 NTU or more above background	Stop work	Stop work
VISUAL MONITORING		
No plume observed	Continue to monitor every 4 hours	Continue to monitor every 4 hours
Plume observed	Modify BMPs & continue to monitor every 4 hours	Stop work after 8 hours with an observed plume

When monitoring visually, turbidity that is visible over background is considered an exceedance of the standard.

If an exceedance over the background level occurs, the applicant must modify the activity and continue to monitor every four hours or as appropriate (above). If an exceedance over the background level continues after the second monitoring interval, the activity must stop until the turbidity levels return to background. If, however, turbidity levels return to background at second monitoring level due to implementation of BMPs or natural attenuation, work make continue with appropriate monitoring as above.

If an exceedance occurs at: 50 NTU or more over background; 30 NTU over background for 2 hours; or 5-29 NTU over back ground for 8 hours, the activity must stop immediately for the remainder of that 24-hour period.

c. **Reporting:** Copies of daily logs for turbidity monitoring shall be available to DEQ, USACE, NMFS, USFWS, and ODFW upon request. The log must include: background NTUs, compliance point NTUs, comparison of the points in NTUs, and location, time, and tidal stage (if applicable) for each reading. Additionally, a narrative must be prepared discussing all exceedances with subsequent monitoring, actions taken, and the effectiveness of the actions.

d. **Minimizing In-stream Turbidity:**

   i. Sequence/Phasing of work - The applicant would schedule work activities so as to minimize in-water disturbance and duration of in-water disturbances;
   ii. Bucket control - All in-stream digging passes by excavation machinery and placement of fill in-stream using a bucket shall be completed so as to minimize turbidity. All practicable techniques such as employing an experienced equipment operator, not dumping partial or full buckets of material back into the wetted stream, adjusting the volume, speed, or both of the load, or by using a closed-lipped environmental bucket shall be implemented;
   iii. Limit the number and location of stream crossing events. Establish temporary crossing sites as necessary at the least impacting areas and supplement with clean gravel or other temporary methods as appropriate;
   iv. Machinery would not drive into the flowing channel;
   v. Excavated material would be placed so that it is isolated from the water edge or wetlands and not placed where it could re-enter waters of the state uncontrolled; and,
   vi. Use of containment measures such as silt curtains, geotextile fabric, and silt fence would be implemented and properly maintained in order to minimize in-stream sediment suspension and resulting turbidity.

I18. The contractor would, on a daily basis, remove all trash and refuse from the project work area.

I19. During road decommissioning, if danger trees need to be cut for safety reasons they would be left on site.

I20. For culvert removal projects, an experienced professional fisheries biologist, hydrologist or technician would be involved in project design.

J. Wildlife

J1. **Northern Spotted Owl:** There are restrictions during the breeding season for certain activities based on the type of activity and the distance to activity centers. Details on the restrictions and rationale are in the U.S. Fish and Wildlife Service's Letter of Concurrence. There is a restriction for the use of large Type 1 helicopters (other than KMAX). Their use is restricted within 768 yards of an activity center between March 1 and September 30 (this applies to Unit 209 and a portion of Unit 94). Smaller helicopters produce less noise and have a different seasonal restriction: their use is restricted within 448 yards of an activity center between March 1 and July 15 (this applies to only 1 acre of Unit 94). Helicopter restrictions apply both during yarding and transit to other sites. Restrictions also apply to the use of chainsaws (392 yards) and heavy equipment (363 yards) between March 1 and July 15. Portions of Units 36, 94, 95 and 132 are within these distance zones.

J2. **Deer and Elk Winter Range:** No harvest operations, road construction, use of motorized equipment or blasting would be permitted in Crucial or High Value winter range areas between December 1 and March 31. The restriction would be waived in the High Value zone if snow accumulation levels are less than 12 inches or if it is determined that the area is not being used by elk. Units 90 to 120, 136 to 191, 202 to 206, and 212 to 224 are in the crucial zone. Units 2 to 10 and 226 to 228 are in the High Value zone.

No haul or snow plowing would be permitted on roads 4630, 4631, 4635, 4640, 4645, 5700120 or 5710 between December 1 and March 31.

J3. **Peregrine Falcon:** No helicopter use below 1,500 feet Above Ground Level would be permitted from January 15th to July 31st. This applies to units 204, 209, 211 and 228. These restrictions may be waived if the nest site is unoccupied or if nesting efforts fail and there is not possibility of re-nesting. Documentation of nesting failures can be finalized no earlier than June 30th due to the possibility of re-nesting.

J4. **Snags & Down Wood:** To enhance diversity, variable-density thinning would include the retention of snags and wildlife trees. The snags within plantations are small planted trees that have died. Few if any legacy snags are present.

Snags would be retained in all units where safety permits. If snags must be cut for safety reasons they would be left on site.

To increase the likelihood that snags would be retained, they may be included in skips.

Certain live trees would also be selected as leave trees that have the "elements of wood decay" as described in the DecAID advisor (s. 3.8.2). This may include trees with features such as dead tops, broken tops and heart rot. They may be retained in skips.

Old down logs currently on the forest floor would not be removed.

Additional down woody debris would be generated by thinning. This would include the retention of cull logs, tree tops, broken logs and any snags that would be felled for safety reasons.

Some units have standing trees that were girdled or topped in the past. These would be protected where feasible.

K. Operations

K1. **Spill Prevention** - An approved Spill Prevention Control and Containment Plan (SPCCP) would be created, as required by contract clause G.3.4.1, which describes measures to prevent or reduce impacts from potential spills. The SPCCP would include a description of the hazardous materials that would be used; and a spill containment kit would be located on-site. All trucks used for refueling would carry a hazardous material recovery kit. All vehicles and machinery would be free of petroleum leaks. Any leaks that occur would be immediately repaired. Power equipment would be refueled at least 150 feet from water bodies to prevent direct delivery of contaminants into a water body. If local site conditions do not allow for a 150-foot setback, then refueling would be as far away as possible from the water body. For all immobile equipment, absorbent pads would be used. All petroleum products being transported or stored would be in approved containers meeting Occupational Safety and Health Administration standards and Oregon Department of Transportation. All vehicles hauling more than 300 gallons of fuel would have an approved communication system with which to report accidental spills. Any contaminated soil, vegetation or debris must be removed from National Forest System lands and disposed of in accordance with state laws. *National Core BMP Technical Guide – Road 10.*

K2. Where **helicopters** are used in close proximity to open roads, flaggers would be utilized or traffic temporarily detoured to other routes. Operations that require the restriction of traffic on highway 224 or roads 46 or 57 would not occur on Fridays, Saturdays or Sundays between the Memorial Day and Labor Day weekends.

K3. **Residential Areas** – Certain noisy operations in the vicinity of residential areas would not occur between the hours of 10 pm and 8 am. Helicopter use within ¼ mile; noisy operations in units 112 and 114; and truck traffic along road 4631 between Highway 224 and road 4631140 would not occur within these hours.

K4. **Safety** – Flaggers would be used where logging or other operations occur close to heavily used roads such as Highway 224 near Ripplebrook.

K5. **Scenery –** The following would occur **w**ithin 100 feet of Highway 224: stumps would be cut close to the ground (6 inches or lower), slash and other debris would be removed using techniques such as whole tree yarding, if paint is used it would be applied on the back side of trees (where not visible from highway), and a thinning prescription with greater leave tree density would be used.

K6. **Firewood** would be made available to the public at landings where feasible. Certain units or portions of units may be made available for the removal of green biomass and firewood as part of the thinning prescription. A mix of commercial and personal use removal may occur where feasible.

K7. Contracts would contain provisions for the protection of **heritage resource** sites found during project activities. In the event that sites are located during implementation, project activities would be halted until consultation with the Forest Archeologist can determine appropriate site-specific mitigation. Protection measures would be developed in consultation with the Oregon State Historic Preservation Officer (SHPO), appropriate Tribes, and, if necessary, the Advisory Council on Historic Preservation.

K8. **Protecting Improvements** – Operations would be conducted to protect improvements and facilities such as buildings, power lines, pipe lines and other features.

L. Roads

L1. **Signing** - All signing requirements on roads that are open for public use within the Forest would meet applicable standards as set forth by the Manual of Uniform Traffic Control Devices (MUTCD). Some roads accessing State and County highways may require additional signing to warn traffic of trucks entering onto or across the highway. Temporary Roads and National Forest System Roads (system roads) which are designated for 'project use only' would be signed at the entrance to such roads with "Logging Use Only" signs and make every reasonable effort to warn the public of the hazard and to prevent any unauthorized use of the road.

L2. **Clearing** - National Forest System Roads that are open to the public and which have asphalt or bituminous surfacing would have the traveled way cleared of materials introduced by project operations that pose a hazard to safe travel. These materials include, but are not limited to, mineral soil, rock, limbs, bark, wood chips, or trash.

L3. Steel tracked equipment would not be operated on asphalt or bituminous surfaced roads unless they are first protected by matting materials such as wood chip or crushed rock.

L4. Temporary roads and landings located on or intersecting system roads that are asphalt or bituminous surfaced would have 3” minus or finer dense graded aggregate placed at the approach to prevent surface damage. The material would be placed so that the approach flares are wide enough to accommodate the off-tracking of vehicles entering onto or leaving the site.

L5. Temporary roads and landings adjacent to aggregate surfaced system roads could introduce mineral soil contamination which would degrade and reduce the load bearing capacity of the aggregate road surface. All appropriate measures would be taken to prevent or reduce such contamination. If contamination occurs, the operator would repair contaminated areas with specified aggregate surfacing.

M. Large Wood Enhancement in Streams (s. 1.4.6.2)

M1. The project fisheries biologist would select trees and ensure that project design criteria are incorporated into implementation contracts. The fisheries biologist would regularly coordinate with the project Contracting Officer Representative to ensure the project design criteria are being followed.

M2. Only live trees or down logs within the stream protection buffer of the unit would be added to streams.

M3. Only live trees that are between 10 and 15 inches diameter would be felled or pushed over. Where appropriate, down wood lying above a stream would be bucked so that at least one end falls into the stream.

M4. Trees or logs would be placed in a manner that creates new aquatic habitat and does not block fish passage.

M5. The Oregon Department of Fish and Wildlife Guidelines for Timing of In-Water Work would be followed. Exceptions to these guidelines for timing of in-water work may be requested from appropriate regulatory agencies.

M6. When operating chainsaws near streams, a vegetable based bar oil would be used.

M7. A post-project review would be conducted after winter and spring high flows and adjustments would be made where necessary to provide for fish passage or to minimize bank erosion.

N. Fuel Break and Burning

Prescribed fire burn plans would follow the Interagency Prescribed Fire Planning and Implementation Procedures Guide 2008 as well as the Best Smoke Management Practices to minimize smoke effects:

N1. Pre-identify smoke management concerns and incorporate measures in burn plans to minimize effects.

N2. Include contingency plans for discontinuing prescribed burning under undesirable smoke conditions such as when smoke affects local residents.

N3. Identify potential affects to transportation systems users.

N4. Adhere to smoke management direction provided by the Oregon Department of Forestry.

N5. Implement prescribed fire using meteorological conditions, including favorable smoke mixing days, discontinuing ignition early to reduce or eliminate smoke during inversion conditions, and burning piles in cool wet weather.

N6. Implement prescribed fire prescriptions that increase combustion efficiency and reduce smoldering. Burn when fuels are dry. Piles would be covered if necessary. Minimize dirt in piles.

N7. Cooperate with interagency partners when competing for burn days.

N8. Utilize test fires to assess potential smoke impacts.

N9. Conduct smoke monitoring as defined in the monitoring element of the prescribed fire burn plan.

N10. Fuel break treatments would not occur within 100 feet of streams.

O. Botany

O1. One location of the lichen *Peltigera pacifica* is in unit 218 and would be included in a skip of approximately 75 feet radius. The location is at the following coordinates: 057562 4988401, NAD 83.

O2. One location of the lichen *Usnea longissima* is in unit 94 and would be included in a skip of approximately 75 feet radius. The location is at the following coordinates: 578953 4993122, NAD83.

1.4.10 Monitoring

Prior to and during implementation, a multi-stage process is used on the Forest to ensure that a project is implemented as planned. Before beginning the on-the-ground presale process, which includes layout of the units, designating the trees to retain, and cruising the timber, the Presale Forestry Technicians and Presale Crew members meet with the Interdisciplinary Team (IDT) to transition to the implementation phase of the project. Resource specialists identify any resource concerns in individual units or highlight any key project design criteria on a unit-by-unit basis. After the presale work is completed, the project moves into the appraisal and contract preparation phase. One of the first steps in the process is to complete the Contract Project Design & Implementation Crosswalk Form. The purpose of the crosswalk is to ensure that all components of the NEPA Decision, including the project design criteria and terms and conditions from consultation, are incorporated into the contract. For each required component of the NEPA decision, the crosswalk identifies how and what stage in the process the component would be addressed (e.g., presale, contract, sale administration, post contract monitoring). The information generated from the crosswalk process is used to guide the contract preparation process and to identify any issues that need to be addressed by resource specialists. The crosswalk is usually prepared by the primary person responsible for developing the appraisal and contract, and signed by the District Ranger.

Prior to advertisement, a final review is conducted to ensure that the contract is prepared with the proper contract provisions and language; the project design criteria are properly inserted and contractually enforceable; and the contract and appraisal meets Forest Service Handbook, Forest Service Manual and Stewardship Guide (where applicable) regulations and direction. This final review may be informal or may be formalized in a Forest-level review or "Plan-in-Hand." "Plan-in-Hand" reviews are randomly selected and may or may not include this project. The goal of this formal review is to monitor and evaluate forest resource management prescriptions, to measure compliance with goals and objectives, and to make adjustments when needed. The "Plan-in-Hand" review is summarized in a letter to the Forest Supervisor which is included in the final appraisal/contract packet.

During implementation, the Sale Administrator in conjunction with the Forest Service Representative and Contracting Officer are responsible to ensure that the contract is administered properly throughout all stages of implementation. The sale administration team monitors compliance with the contract which contains the provision for resource protection, including but not limited to: seasonal restrictions, snags and coarse woody debris retention, stream protection, erosion prevention, soil protection, road closure and protection of historical sites. The Sale Administrator records observations demonstrating compliance as well as any concerns/issues on inspection reports that are signed by both the Forest Service and Purchaser Representative. The inspection reports would also document any resolutions that have been identified. As needed during the implementation process, the sale administration team may request a resource specialist or Line Officer to come for a field visit to discuss a resource issue that has been identified. Also, a resource specialist may visit a project to conduct monitoring and to help insure that the project is being implemented as intended by the NEPA decision.

Monitoring is also conducted at the Forest level as part of the Forest Plan implementation, including monitoring of noxious weeds and BMPs. The monitoring of noxious weeds and invasive plants would be conducted where appropriate to track changes in populations over time and corrective action would be prescribed where needed.

The project would be part of a pool of completed units available for randomly selected BMP monitoring. More detail on monitoring can be found in section 3.3.

1.5 Decision Framework

The deciding official will review this document in order to make the following decisions and determinations:

- What the optimal method of accomplishing the purpose and need (s. 1.3) for this project should be;
- Whether or not Forest Plan exceptions are appropriate for standards and guidelines;
- Whether the selected alternative should be modified in any way;
- What design criteria or best management practices should occur;
- Whether this action is in compliance with the Forest Plan as amended and Forest Service policies and procedures.

1.6 Public Involvement

For this project, a collaborative process with the Clackamas Stewardship Partners began in 2011; a process that built on years of collaboration on similar thinning projects dating back to 2004. A scoping process to request public input for this project was conducted. A letter describing the proposed project and requesting comments was sent out on March 12, 2012. The Forest publishes a schedule of proposed actions (SOPA) quarterly. The project first appeared in January 2012 and in subsequent issues. Public field trips were conducted on August 9, 2011 and July 10, 2012 to visit the project area and discuss the purpose and need and issues. The legal notice for the 30-day comment period for this project was published in the Oregonian on February 28, 2014. Responses to substantive comments are included in Appendix B. A list of persons and organizations that were sent notice is in the analysis file along with a list of commenters and the complete text of comments.

This project is subject to the new objection regulations. Section 428 of The Consolidated Appropriations Act of 2012 included a provision establishing a pre-decisional objection process (36 CFR 218) for projects and activities implementing land management plans in lieu of the post-decisional appeal process (36 CFR 215) used by the agency since 1993. Since this project is a non-fuels reduction project it is subject to the Project-Level Pre-Decisional Administrative Review Process (Objection process) as identified in 36 CFR 218, Subparts A and B.

Rather than being able to seek higher-level review of unresolved concerns after a project decision has been made under 36 CFR 215 (Appeal process), those who are eligible will be able to seek that review before the project decision has been signed under 36 CFR 218 (Objection process). The Forest Service believes that considering public concerns before a decision is made aligns with our collaborative approach to public land management and increases the likelihood of resolving those concerns resulting in better, more informed decisions. The Forest Service also believes this will aid in our efforts to be more efficient with documenting environmental effects.

Individuals and entities (non-governmental organizations, businesses, partnerships, state and local governments, Alaska Native Corporations, and Indian Tribes) who submit timely, specific written comments regarding a proposed project or activity during any designated opportunity for public comment may file an objection. Opportunity for public comment on this project includes scoping, a 30-day comment period and a 45-day public review period. Written comments are those submitted to the Responsible Official or designee during a designated opportunity for public participation provided for a proposed project. Specific written comments should be within the scope of the Proposed Action, have a direct relationship to the Proposed Action, and must include supporting reasons for the responsible official to consider.

1.6.1 Issues and Concerns

While many concerns were raised with scoping, field trips and the 30-day comment period, they are not considered key issues for the purpose formulating fully developed alternatives. Issues serve to highlight effects or unintended consequences that may occur from the proposed action and alternatives, giving opportunities during the analysis to reduce adverse effects and compare trade-offs for the Responsible Official and public to understand. Issues are statements of cause and effect, linking environmental effects to actions, including the Proposed Action (Forest Service Handbook 1909.15, 12.4). Issues are used to generate additional action alternatives to the Proposed Action. None of the comments received were considered issues. Concerns identified during scoping were used to refine the proposed action as well as the effects analysis presented in Chapter 3. The following highlights some of the concerns raised by the public:

1.6.1.1 Roads

Comments received from several public sources raised a concern about the reopening of old road alignments and the construction of new temporary roads. They stated that ground disturbance associated with this work particularly where it is in close proximity to streams could affect aquatic resources.

Some public commenters stated that it's inappropriate to spend money to decommission a road if that road is going to be used again in the future. Some public commenters stated that once money is spent to decommission a road that it would be wasted if the road were used again.

Some public commenters stated that if trees or other vegetation begin to grow in a road it should not be used again but that recovery should be allowed to continue.

In order to avoid any potentially undesirable impacts to aquatic resources, new temporary roads would be strategically located on gentle slopes and would not cross any streams. Two of the existing road alignments proposed for reconstruction have seep crossings; however, they are designed to minimize impacts to aquatic resources (s. 1.4.7.4). The proposed action would rehabilitate the temporary road alignments after project completion. Road work included in the proposed action includes only those road segments that do not pose an adverse impact on aquatic resources and are needed to efficiently achieve the vegetation, health and diversity objectives discussed in section 1.3.

The reuse of existing alignments is consistent with Forest Service policy as described in Forest Service Manual 7703.22:

> "Motor vehicle use off designated roads, trails, and areas may be authorized by a contract, easement, special use permit, or other written authorization issued under federal law or regulation (36 CFR 212.51(a)(8); FSM 7716.2). This option may be particularly desirable when motor vehicle use off the designated system is associated with a single event or other authorized uses, such as grazing, vegetation management, and hazardous fuels reduction."

Individuals and groups stated that decommissioned, rehabilitated or overgrown roads should never be used again and that roads in general cause inappropriate environmental impact. There is no basis to eliminate all road reconstruction without regard for site-specific circumstances such as road length, landform, proximity to streams, the intensity of actual decommissioning, cost to open and rehabilitate, the impacts of alternate access methods, and the benefits of variable density thinning. The 0.2 mile of new temporary road construction is estimated to impact less than one half acre of ground, while the 5.35 miles of reconstruction would re-disturb about 10 acres of ground along existing road alignments; all temporary roads would be rehabilitated and covered with slash or other effective ground cover after use. The environmental impact of reusing existing road alignments has been fully analyzed and disclosed in Chapter 3; the effects were found to be minimal. Sections 1.4.7.3&4 discuss the details for these roads and section 3.3.3 discusses the impacts to aquatic resources. The analysis found the impacts to be sufficiently mitigated by project design criteria (s. 1.4.9). Forest Plan standards and guidelines would be met (s. 3.3.5 & s. 3.4.8) and the project would be consistent with the Aquatic Conservation Strategy (s. 3.4.8.1).

These comments were considered during the development of the proposed action because they highlight the public concern about the effects of roads on the environment. For example, additional road closures, decommissioning and storm proofing was added to the project; roads that access thinning units were carefully examined for potential to repair problem areas; new temporary roads were carefully located; and the reconstruction of old road alignments was only proposed where minimal impact would occur and where post use rehabilitation would be effective.

1.6.1.2 **Decadence** (dead trees, down logs and trees with disease)

Public comments raised a concern about decadence and recent scientific findings. They stated that there is an excessive emphasis on the health of trees and would like greater attention paid to the value of dead and down trees. They stated that healthy ecosystems should have an abundance of large decaying live trees, large snags and coarse woody debris all of which are lacking in plantations. They are concerned that thinning captures future mortality, and that those potential dead trees are important for wildlife and as sources of down wood in streams.

The proposed action includes design criteria that would protect and enhance snags and down woody debris (s. 1.4.6.1, s. 1.4.9.J4). Down wood would not be removed and all snags would be retained where safety permits. New snags and down wood would be created after thinning. Skips and riparian protection buffers would provide abundant quantities of existing or future down wood (s. 3.8.2.3).

Stand data has been collected for this project and stand simulation modeling has shown sufficient quantities of dead and down wood would occur with the proposed action (s. 3.8.2.3). Forest Plan standards and guidelines would be met (s. 3.8.2.5) and the project would be consistent with the Aquatic Conservation Strategy (s. 3.4.8.1). Wood recruited into streams would occur over time at sufficient levels, primarily from the stream protection buffers (s. 3.4.4.1). The Biological Assessment found that impacts to streams and riparian reserves including the recruitment of wood to streams would not likely adversely affect listed fish species (s. 3.4.6).

Even though some commenters stated that decadence is important and that thinning creates unacceptable impacts, the analysis shows sufficient levels of decadence across the landscape (s. 3.8.2.4). This comment was considered during the development of the proposed action because it highlights the public concern about decadence. For example, some snags and down wood would be created and trees would be felled toward streams. And because of this concern, the level of analysis in section 3.8.2.4 was expanded to incorporate a detailed discussion of decadence.

1.6.1.3 LSR, Riparian Reserves, and Earthflow Areas

Bark submitted scoping comments raising a concern about thinning in areas that they consider inappropriate. Specifically, Bark suggested that thinning captures mortality that would be better left in LSRs and riparian reserves. They suggest that logging equipment would create unacceptable impacts to the land particularly in earthflows.

The project includes thinning in the listed land allocations to enhance the associated resource values (s. 1.3.2.1). The proposed action would meet the standards and guidelines for these land allocations (LSRs are discussed in sections 3.7.5.2, 3.7.5.4 & 3.7.6; Riparian reserves are discussed in section 3.4.4.2 & 3.4.8; Earthflows are discussed in s. 3.5.6. The Regional Interagency Ecosystem Office was consulted and the project was found to meet the standards and guidelines for Late-successional Reserves (s. 3.7.5.4). The Biological Assessment found that impacts to streams and riparian reserves would not likely adversely affect listed fish species (s. 3.4.6). The analysis shows that sufficient quantities of dead and down wood would occur with the proposed action (s. 1.6.1.2 & s. 3.8.2.3).

Even though comments stated that these land allocations should not be thinned because of unacceptable impacts, there is no basis to eliminate all thinning in these areas without regard for site-specific circumstances. The proposed action with project design criteria was developed considering site-specific factors.

1.6.1.4 Monitoring of Best Management Practices (BMPs)

Comments suggested that practices for minimizing effects to water quality are not monitored. They suggest that BMPs are not being followed and that they can't be relied on to assert that effects to water quality would be low.

The National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide (USDA 2012b) directs a nationally consistent strategy for considering suggested practices and refining them into project level Project Design Criteria (PDCs) based on local conditions and local experience. These BMPs are considered to be the best available science regarding protection of water quality and are an update to the 1988 BMPs that have been used by the Forest since their inception and that were used during Forest planning (RIEC 2013)(USDA 1988).

While PDCs are developed because they are thought to be appropriate practices to minimize effects, they do not eliminate all effects nor are they thresholds of significance. The ability to implement and effectiveness of the group of PDCs designed to minimize impact to water quality are addressed in the water quality specialist report which is incorporated by reference. It generally found that the practices as a whole would likely result in achieving water quality goals under the Clean Water Act (s. 3.3.1.5).

The Forest has professional resource specialists (including soil scientists, hydrologists, fisheries biologists and geologists), with a wide range of experience implementing and monitoring water quality on similar projects. These specialists participate in the planning of a project, its development into contract language, and eventual implementation. Section 1.4.10 describes this process and the monitoring that occurs to assure that projects are implemented as planned.

Forest-wide monitoring of water quality occurs as discussed in section 3.3.5.2. While this monitoring is often not specific to any given project, it does indicate whether BMPs are functioning as expected at the landscape scale. Recent monitoring has indicated a trend of improving riparian and aquatic conditions across the Forest (documented in the water quality specialist report).

Past monitoring of implementation and effectiveness of best management practices completed on the Clackamas River Ranger District indicated that PDCs were implemented as planned on 85% of the samples and were effective at avoiding impacts to water quality on 94% of the samples (s. 3.3.1.5).

When the national monitoring program is finalized, this project and all others on the Forest would be included in a pool of projects to randomly sample. Projects and BMPs would be randomly selected for implementation and effectiveness monitoring that involves standardized forms, techniques, and reporting so that with adaptive management, the Forest can continue the trend of improving riparian and aquatic conditions.

Because of this concern, the level of analysis in section 3.3 and elsewhere was expanded to incorporate a detailed discussion of BMPs and their effectiveness.

1.6.1.5 Diversity

Comments suggested that thinning could harm biodiversity and that the targeted stands should be allowed to recover without interference.

Specifically, a field trip sponsored by Bark generated many comments such as: “Today I hiked through unit 152 and I was impressed by the many species of plants, animals, fungi…” “Today I had the opportunity to explore the surprisingly diverse plantation at unit 152. I had expected a somewhat sterile location, given that it was previously planted. What I found instead were a wide variety of mushrooms, several newts and salamanders, trees big and small and generally a very healthy ecosystem. It concerns me that that this area could be negatively impacted by thinning.” “Please save unit 152, we found chanterelles….”

Unit 152 was thinned in 1995. The elements of diversity present indicate that the previous thinning, even though it did not incorporate variable density treatments with skips or gaps has grown and developed in a manner not expected by those that oppose thinning.

Additionally, a comment by Bark indicated that several stands such as Unit 226 display vigorous natural recovery from un-natural disturbance. This unit contains a multilayered structure with a western hemlock dominated understory coming up beneath the Douglas fir-dominated canopy.

Unit 226 was thinned once before in 1996. The multi-storied stand observed there today was created by thinning.

Even though some commenters stated that thinning should not occur because of unacceptable impacts to diversity, there is no basis to eliminate the thinning without considering all resource issues. In fact the commenters point out that the site-specific circumstances for units 152 and 226 show that there are some elements of diversity present in area that were thinned before. This comment was considered during the development of the proposed action because it highlights the public concern about diversity. In response to this concern, the proposed action includes enhancements such as skips and gaps.

1.6.1.6 Road Decommissioning

Several commenters were deeply disappointed that more extensive road decommissioning was not proposed.

The Forest is examining the watersheds incrementally, as funding allows, to assess travel and access management needs. While many decommissioning assessments have been completed across the Forest in the past 15 years, the Forest has made a recent effort to review the road decommissioning needs in high priority watersheds. The Oak Grove Fork was identified as increment 4 and the Middle Clackamas was identified as increment 6. (At this time two increments have been completed with substantial progress made to date on a third, with assessments in eight watersheds across the Forest, none of which overlap the project area). Originally it was thought that funding would be allocated so that increment 4 could be planned at the same time as the Grove Thin project but increment 4 has been deferred as funding went to higher priority projects nationwide.

At this time, the Forest is conducting a Travel Analysis Plan as outlined in 36 CFR 212.5(b). The majority of roads in the Oak Grove Fork and Middle Clackamas will be examined in a later planning effort. Because of this concern, the proposed action includes a few roads for closure, stormproofing and decommissioning that have already been examined as haul roads for the Grove project thereby achieving some desired road management conditions at no extra planning cost.

1.6.1.7 Invasive Species

One commenter suggested that the risk of spreading invasive plant species was too great.

The Forest is required to follow the standards and guidelines for invasive species. The Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants FEIS, was completed in 2005, and the “Site-Specific Invasive Plant Treatments for the Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, was completed in 2008. The management direction includes invasive plant prevention and treatment/restoration standards intended to help achieve stated desired future conditions, goals, and objectives, and is expected to result in decreased rates of spread of invasive plants. PDCs were developed tiering to the considerable knowledge base and experience that went into these Regional and Forest level plans. The impacts from this project on invasive species was fully analyzed and disclosed in section 3.14.

PDCs for invasive species at section 1.4.9H are not designed nor intended to reduce existing infestations. Existing populations may spread, even with no action. The Forest has an ‘early detection-rapid response’ process to identify and prioritize key populations for treatment. Certain species, particularly those that are not widespread and have potential to spread rapidly, are prioritized for herbicide or other treatment. This treatment is authorized by the Forest’s Site-Specific Invasive Plant Treatments FEIS and is outside the scope of this EA (s. 3.14).

PDCs for invasive species at section 1.4.9H have been found to be effective. They are designed to minimize the spread of invasive species from the road sides where they are more common into the forest stands where they are not common. Practices include washing off-road equipment and using certified seed and mulches.

2.0 ALTERNATIVES

This chapter describes and compares the alternatives considered for this project. It includes a description 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. The Proposed Action is described in s. 1.4 and is sometimes referred to as Alternative B.

2.1 Alternative A - 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. Stands would continue to remain uniformly dense and the overstocked condition would result in stands with reduced vigor, small trees, increased mortality, and increased susceptibility to stressors such as insects, diseases and weather (s. 3.1.3). Additionally, no wood products would be provided. The No-action Alternative would not repair or decommission any roads, would not improve the diversity of stands, would not provide additional forage for deer and elk, and would not provide any gains in wildfire protection around the wildland-urban interface.

2.2 Alternative B - Proposed Action

This alternative is described in section 1.4. To briefly summarize, the Forest proposes a thinning project in mid-aged stands ranging from 30 to 60 years old. The purpose is to increase the health and growth of trees; to enhance diversity within riparian reserves, late-successional reserves and matrix lands; and to provide forest products to the local economy. Approximately 1,756 acres of mid-aged stands are included. It is estimated that approximately ¾ of these acres would actually be thinned after accounting for stream protection buffers and other leave areas. Variable density thinning methods would be used that include the creation of skips, gaps, heavy thins and snags. The proposed action also includes approximately 85 miles of road repair and maintenance on system roads. Approximately 5.35 miles of existing road alignments would be reused as temporary roads and rehabilitated upon project completion. Approximately 0.2 mile of new temporary roads would be constructed and rehabilitated upon project completion.

2.3 Other Alternatives Considered

Section 1.6.1 discusses issues and concerns that were received from the public. These issues were used to refine the proposed action, including the project design criteria, and to frame the analysis for this project. The comments that suggested the consideration of other alternatives are discussed in this section. There is some overlap with the issues discussed in s. 1.6.1. The following sections provide further elaboration.

2.3.1 Bark submitted six suggestions during the 30-day comment period and requested that the agency review these suggestions as separate alternatives. While Bark's suggestions are considered separately below, all of Bark's suggestions when added together would delete approximately ¾ of the acres of the proposed thinning, leaving approximately 400 acres to be treated.

2.3.1.1 Re-assess the agency's ability to adequately remove "existing" roads from the map in a way that improves actual conditions on the ground. Reconsider the meaning of the word "decommission," to go back to the meaning intended in the Northwest Forest Plan. The commenter states that, "*We do not believe this was a word that was meant to be used to refer to roads that are temporarily put in storage for future use*."

This suggestion is not within the scope of this project. The definition of road decommissioning and on-the-ground application is established in the Forest Plan and Roads Analysis, rather than in project planning. Bark is asking that the Agency change its concept of system road decommissioning and temporary road rehabilitation to include a commitment to never reuse the alignments again.

The glossary of the Northwest Forest Plan Final Supplemental Environmental Impact Statement defines Decommission as "To remove those elements of a road that reroute hillslope drainage and present slope stability hazards." There is no implied prohibition on future use. This is also consistent with the 2003 Forestwide Roads Analysis, which defines road decommissioning as follows. "To remove those elements of a road that reroute hill slope drainage, and present slope stability hazards. The road is stabilized to reduce the potential for storm damage, and the need for maintenance. The road is no longer suitable for travel. Decommissioning includes putting a road in storage (storm proofing with dips, berms, waterbars, etc.) for later use. In some cases the road is obliterated, restoring the hydrologic function of the ground by decompacting the road surface, removing fills and culverts, revegetating, etc.)"

For this document, decommissioning is described in section 1.4.7.2:

- Decommission with entrance management - Installing one or more large earth berms or deep trenches, deeply decompacting approximately 1/8 mile. Culverts would be retained unless specified.
- Decommission with stabilization - removing culverts, reestablishing former drainage patterns or natural contours at stream channels, installing water bars, removing gravel surfacing, decompacting road surfaces, pulling back unstable fill slopes or road shoulders, scattering slash on the roadbed, applying erosion control mulch and seed on disturbed areas, and blocking and disguising the former road entrance to prevent motorized vehicle traffic.
- A decommissioned road is removed from the Forest's transportation system data base and is not maintained.

This application of road decommissioning is consistent with the Northwest Forest Plan.

Because temporary roads are used in the summer, they are not likely to have the same hydrologic issues as system roads that need to function in the wet season. The analysis showed that predicted sediment levels would change compared to the proposed action. Instead of a sediment reduction of 0.1% over existing conditions with the proposed action, this alternative would result in a reduction of approximately 0.2% over existing conditions. This small predicted difference would not be measurable at the subwatershed scale.

The assessment found that decommissioning system roads and rehabilitating temporary roads do result in improved conditions on the ground, even when the treatment is not permanent. Decommissioned roads and temporary roads are removed from the Forest's Motor Vehicle Use Map.

The suggested alternative of re-assessing the agency's ability to adequately remove "existing" roads from the map in a way that improves actual conditions on the ground, and that the agency reconsider the meaning of the word "decommission" was considered but not fully developed because:

- It is outside the scope of this project level analysis.

- It is addressed by the no action alternative and other alternatives considered that do not reuse roads.

2.3.1.2 Add additional miles of road decommissioning to the Grove project that do not include already passively decommissioned roads rebuilt for proposed unit access, and provide a clear implementation timeline. Change closed and stormproofed roads to decommissioning with entrance management, adding 13.33 miles of decommissioning to this project.

During project development, the timing of future management needs for these 13.33 miles of roads was considered along with the resource impact of the road and the cost of treatment. The criteria used included: public and administrative access; access to privately owned infrastructure; likelihood and timing of future stand management; level of aquatic risk; current road conditions; and, future road maintenance needs. Also considered was the aquatic risk rating from the 2003 Roads Analysis Report. Aquatic risk factors included: riparian areas/floodplains; fish passage; landslide hazard; surface erosion hazard; hydrologic hazard; high risk stream crossings; stream crossing density; and wetlands. These roads were determined to likely be needed in the near future for thinning or other Forest management. Some of the roads are needed by Portland General Electric to access their pipeline for maintenance.

Also, decommissioning with entrance management would provide a similar level of water quality protection when compared to closure and stormproofing, (s. 3.3.3.6). Based on these criteria, the proposed action would keep these roads on the Forest's transportation system, and would stormproof where appropriate and close them to public access until they are needed again.

The suggested alternative of changing closed and stormproofed roads to decommissioning with entrance management (13.33 miles) was considered but not fully developed because:

- The roads will likely be needed in the near future for thinning and other Forest management.
- Decommissioning with entrance management would provide a similar level of water quality protection when compared to closure and stormproofing and therefore is not substantially different from the proposed action.
- A separate analysis of the road system (the Travel Analysis Plan) is being conducted at the Forest level that may or may not recommend further road decommissioning in this area.

2.3.1.3 Remove units that require new road construction, rebuilding of actively decommissioned roads, or log haul over rebuilt/reused stream crossings. Oregon Wild also suggested a similar alternative to not build new roads and to delete the units that they access.

Approximately 16 acres would be removed from the project if 0.2 mile of new temporary roads were not constructed; approximately 129 acres would be removed if 1.52 miles of actively decommissioned road were not rebuilt; and approximately 79 acres would be removed if no roads were rebuilt or reused at stream crossings (totaling 224 acres).

In order to avoid any potentially undesirable impacts to aquatic resources, new temporary roads were strategically located on gentle slopes and would not cross any streams. The proposed action would rehabilitate the temporary road alignments after project completion. Road work included in the proposed action includes only those road segments that do not pose an adverse impact on aquatic resources and are needed to efficiently achieve the vegetation, health and diversity objectives discussed in section 1.3.

The reuse of existing alignments is consistent with Forest Service policy as described in Forest Service Manual 7703.22:

> "Motor vehicle use off designated roads, trails, and areas may be authorized by a contract, easement, special use permit, or other written authorization issued under federal law or regulation (36 CFR 212.51(a)(8); FSM 7716.2). This option may be particularly desirable when motor vehicle use off the designated system is associated with a single event or other authorized uses, such as grazing, vegetation management, and hazardous fuels reduction."

The 0.2 mile of new temporary road construction is estimated to impact less than one-half acre of ground, while the 1.53 miles of reconstruction would re-disturb about 3 acres of ground on actively decommissioned road alignments; all temporary roads would be rehabilitated and covered with slash or other effective ground cover after use. This suggestion would eliminate the repair of a washed out stream crossing on road 4630170; resulting in continued erosion. The environmental impact of new temporary road construction, reusing existing road alignments and repairing stream crossings have been fully analyzed and disclosed in Chapter 3; the effects were found to be minimal. Sections 1.4.7.3&4 discuss the details for these roads and section 3.3.3 discusses the impacts to aquatic resources. The analysis found the impacts to be sufficiently mitigated by project design criteria (s. 1.4.9). Forest Plan standards and guidelines would be met (s. 3.3.5 & s. 3.4.8) and the project would be consistent with the Aquatic Conservation Strategy (s. 3.4.8.1).

Predicted sediment levels would change with this alternative compared to the proposed action. Instead of a sediment reduction of 0.1% over existing conditions with the proposed action, this alternative would result in a reduction of approximately 0.15% over existing conditions. This small predicted difference would not be measurable at the subwatershed scale.

The suggested alternative of removing units that require new road construction, rebuilding of actively decommissioned roads, or log haul over rebuilt/reused stream crossings, was considered but not fully developed because:

- The suggested alternative would provide a similar level of water quality protection when compared to the proposed action and therefore is not substantially different from the proposed action in that respect.
- It would not provide the benefits described in the purpose and need for 224 acres.
  - 224 acres of stands would continue on a trajectory of declining health as overcrowded uniform conditions persist.
  - Approximately 2.5 million board feet of lumber would not be processed by local mills.
  - 224 acres of stands would continue to lack horizontal and vertical diversity.
  - Forage quality would continue to decline in these areas.
- There would be reduced value for the project as a whole and the remaining units may not be sufficient to pay for road decommissioning and other important work of the proposed action.

2.3.1.4 Modify project so no new skid trails, new landings or new temporary roads are constructed in high-risk Earthflow areas.

Approximately 292 acres of ground-based units are in high-risk earthflows. It is estimated that approximately 80% of each unit can be accessed by only using existing skid trails and existing landings. Therefore, approximately 58 acres of thinning (20%) would be eliminated. In addition, approximately 16 acres of thinning would be reduced if 0.2 mile of new temporary roads and new landings were not constructed on high-risk earthflows for a total reduction of 74 acres.

Forest experience with similar ground-based thinning is reflected in the soil analysis which shows an estimated 4% increase in detrimental soil conditions from new skid trails over what already exists. There are a few reasons for this:

- It is not always possible to replicate the logging patterns that were used many years ago where different equipment was used to clearcut old-growth timber.
- Different logging techniques are needed today to protect the residual leave trees.
- Old skid trails are sometimes obvious and easy to locate but in many circumstances, it is very difficult to find their exact location.
- Some old skid trails are in inappropriate locations because they cross a stream or seep or are located at the bottom of a swale.

While the objective of the project is to reuse existing skid trails, roads and landings in order to minimize the extent of detrimental soil conditions, the analysis recognizes that there are some areas where new impact may result.

Roads and units have been examined in the field by the Forest slope stability specialist and soil scientist. The fieldwork shows that the project is consistent with goals of maintaining earthflow stability. The detrimental soil condition standards are designed to protect site productivity and are not related to risks to earthflow stability.

While the existing skid trails are still considered to have detrimental soil conditions, there are some tree roots that have penetrated into the skid trails. Reusing the skid trails again may add some additional compaction around these roots but they would likely remain intact. Mechanical ripping or decompacting of skid trails would break the roots that have penetrated into the trails and lead to reduced growth, and increased root disease and tree mortality.

The Forest considered switching to other logging methods. One option considered was to switch to a skyline system, but that would overlay the impact of new skyline corridors over an existing network of skid trails and in many cases would result in the need to build new roads and landings to facilitate skyline logging. Another option considered was to switch to helicopter logging with its associated increase in cost. These options were not incorporated into the proposed action because the objectives of maintaining earthflow stability and site productivity would still be met by avoiding unstable areas, and minimizing impacts while thinning to create healthy, productive stands using ground-based methods.

The impacts to the Earthflow areas has been fully analyzed and disclosed in s. 3.5. The soil and geology sections analyzed the effects of thinning timber and the associated actions, including skid trails, landings and temporary roads to the Earthflow areas. This analysis showed minimal impact to these areas.

As described in section 3.6.6.4, there is no obvious symptom in the amount or quality of vegetation currently within these units even though many of the units have relatively high levels of detrimental soil condition. The factors that may explain this include the linear nature of skid trails, the local climate that is very conducive to high levels of vegetative production, and that gradual recovery may be underestimated.

The suggested alternative of modifying the project so no new skid trails, new landings or new temporary roads would be constructed in high-risk Earthflow areas was considered but not fully developed because:

- The effects of new skid trails, new landings and new temporary roads were found to be minimal. The objectives of maintaining long-term site productivity and earthflow stability would still be met even with some additional skid trails, landings and temporary roads. Given the minimal change in effects, this alternative is not substantially different than the proposed action.
- It would not provide the benefits described in the purpose and need for 74 acres.

- 74 acres of stands would continue on a trajectory of declining health as overcrowded uniform conditions persist.
- Approximately 800 thousand board feet of lumber would not be processed by local mills.

2.3.1.5 Remove the 150 acres of heavy thinning which would eliminate existing northern spotted-owl habitat from the project area.

The Forest consulted on a maximum of 150 acres of owl dispersal habitat removal due to heavy thinning and forage creation in its biological assessment. While units have been assessed for appropriateness of these treatments they have not yet been mapped. The proposed action of variable density thinning incorporating skips, gaps and heavy thins would result in acquiring late-successional characteristics sooner, and provide forage for deer and elk.

Plantations sometimes lack certain elements of diversity and complexity. They often do not contain the mix of tree species that were present in the original stand and they are relatively uniform in terms of size and spacing. When the original clearcut harvesting occurred within the project area, all of the large trees and snags were removed. The plantations have minimal variability of vertical and horizontal stand structure and little sunlight reaches the forest floor resulting in low levels of diversity of ground vegetation. Thinning that incorporates skips, gaps, heavy thins, and forage enhancement can change a uniform plantation into one with more variable vertical and horizontal structure and greater species diversity. These changes are beneficial to a wide range of plants and animals. As the stands continue to grow they would acquire the characteristics of old-growth forests sooner than if left untreated.

Deer and elk were selected as management indicator species because they are economically important game animals. With the reduction in timber harvest on the Forest in the past two decades and continued tree growth, openings for forage are becoming scarce. As the change in forest management has moved from widespread regeneration harvest to variable density thinning, past harvest units that once provided forage have grown a thick stand of young trees that shade out the grasses and forbs. There is a trend of declining forage quantity and quality as a large percentage of the landscape is managed for late-successional species.

The suggested alternative of removing 150 acres of heavy thinning which would eliminate existing northern spotted-owl dispersal habitat, was considered but not fully developed because:

- The US Fish and Wildlife Service found that the benefits from enhanced diversity outweighed the short-term effect to owl dispersal habitat from heavy thinning. There is abundant dispersal habitat in the project area (s. 3.7.5.2).
- It would not provide the benefits described in the purpose and need for 150 acres.

    - 150 acres of stands would continue on a trajectory of declining health as overcrowded uniform conditions persist.
    - Approximately 3 million board feet of lumber would not be processed by local mills.
    - 150 acres of stands would continue to lack horizontal and vertical diversity.
    - Forage quality would continue to decline in these areas.

2.3.1.6 Remove units that require helicopter access, in order to save agency time and resources spent on preparing units with minimal likelihood of profitable bids; resources that could be spent on assuring high quality road work.

Approximately 71 acres of helicopter units would be eliminated with this alternative. Helicopter logging on these 71 acres was carefully examined and the Forest found that other options for logging which would have included additional road construction was not warranted.

Helicopter logging is proposed for areas that do not have road access or are too steep for ground-based operations. Logging systems were carefully designed to meet resource protection needs while providing a mix of logging systems that would result in an economically viable project. The Forest has found that the project is likely to be viable and has sufficient value to cover the cost of road work and helicopter operations. Recent similar projects with helicopter units and road work received bids and have been awarded (Bass, Drum & Sax).

This suggested alternative was considered but not fully developed because:

- It would not provide the benefits described in the purpose and need for 71 acres.
    - 71 acres of stands would continue on a trajectory of declining health as overcrowded uniform conditions persist.
    - Approximately 800 thousand board feet of lumber would not be processed by local mills.
    - 71 acres of stands would continue to lack horizontal and vertical diversity.
    - Forage quality would continue to decline in these areas.

2.3.2 One suggestion from Bark, submitted during scoping, was to delete thinning in LSRs, riparian reserves and earthflows to avoid impacts to the associated resources (s. 1.6.1.3).

The project would thin approximately 32 acres of plantations in Late-Successional Reserves; 412 acres in riparian reserves; and 744 acres in earthflows. After accounting for overlaps in these land allocations, this alternative would eliminate 996 acres which is more than 1/2 of the project.

LSRs - These plantations are 49-56 years of age and are relatively uniform with Douglas-fir trees that average 13 inches diameter. They lack certain elements of diversity and complexity and they do not contain the mix of tree species that were present in the original stand and they are relatively uniform in terms of size and spacing. When the original clearcut harvesting occurred within the project area, all of the large trees and snags were removed. The plantations have minimal variability of vertical and horizontal stand structure and little sunlight reaches the forest floor resulting in low levels of diversity of ground vegetation. Thinning that incorporates skips and gaps can change a uniform plantation into one with more variable vertical and horizontal structure and greater species diversity. As the stands continue to grow they would acquire the characteristics of old-growth forests sooner than if left untreated (s. 1.3.1.5). There is a trade-off in several aspects of thinning to promote spotted owl habitat: the reduction in snags and down wood and the increased spacing of trees can reduce the productivity of the site for the northern flying squirrel for 20-40 years but the long-term benefits of variable-density thinning for squirrels are likely to be positive (s. 3.7.5.2).

Riparian Reserves – These plantations are 30-60 years of age and are relatively uniform with Douglas-fir trees that average 13 inches diameter. They lack certain elements of diversity and complexity and they do not contain the mix of tree species that were present in the original stand and they are relatively uniform in terms of size and spacing. When the original clearcut harvesting occurred within the project area, all of the large trees and snags were removed. These stands do not exhibit mature or late-successional characteristics; they are not able to fully meet the needs of riparian dependent species. The trees do provide some shade to streams and provide some small size woody debris. Thinning with appropriate buffers can move riparian reserves toward the desired condition by accelerating the development of mature and late-successional conditions. As the stands continue to grow they would acquire the characteristics of old-growth forests sooner than if left untreated (s. 1.3.1.5).

Thinning in the upland portion of the riparian reserves would result in fewer trees dying, and live trees would grow larger compared to no action. The stream protection buffers would continue to supply nearly the same level of small wood recruitment to streams. Recent research has shown that 90% of large woody debris in streams originated at ground distances between 33 and 66 feet from streams. The stands proposed for thinning are not the only sources of wood recruitment along stream reaches. There are mature forest stands along the affected stream reaches that also contribute wood to streams and the wood from these stands would be much larger than what is contributed from plantations. As trees respond to thinning there would be large sized trees that would become available for recruitment to tributary channels and riparian reserves. Modeling has shown that sufficient levels of dead trees would occur with the proposed thinning in the upland portion of the riparian reserve. Greater levels of dead trees would occur in the stream protection buffers.

The proposed action would fall some trees into streams to provide woody debris which would add structure.

Earthflows - Thinning units have been examined in the field by the Forest stability specialist and the project is consistent with goals of maintaining earthflow stability. Appropriate levels of thinning can move earthflows toward the desired condition by enhancing the health of stands. Density management allows individual trees to maintain healthy live crowns and increased root growth. Earthflows are relatively stable, are appropriate places for thinning, and should not be confused with landslides. See more detail in section 3.5.

This suggested alternative was considered but not fully developed because:

- This alternative would not provide the benefits described in the purpose and need (s. 1.3, s. 3.1.4 & s. 3.2.4) on 996 acres.
  - 996 acres of stands would continue on a trajectory of declining health as overcrowded uniform conditions persist.
  - 996 acres of stands would continue to lack horizontal and vertical diversity and there would be a delay in the transition to late-successional conditions.
  - Forage quality would continue to decline in these areas.
- There would be reduced value for the project as a whole and the remaining units may not be sufficient to pay for road decommissioning and other important work of the proposed action.
- The Regional Ecosystem Office reviewed the proposed action and found that it met standards and guidelines for LSRs.
- The Biological Assessment found that the proposed action would not likely adversely affect listed fish or their critical habitat.
- The proposed action is fully consistent with the Aquatic Conservation Strategy.

2.3.3 Another suggestion from Bark, is that trees in the LSR could be felled and left on site to accomplish thinning objectives instead of logging. *"This alternative would reduce the need to build any roads, landings or skid trails to and in the LSRs, and the money saved could balance out the lost income."*

The project would thin 32 acres of plantations in Late-Successional Reserves. These plantations are 48 years of age and are relatively uniform with Douglas-fir trees that average 13 inches diameter. To achieve the restoration objective in LSRs, the proposed thinning would remove approximately 150 trees per acre.

If this quantity of trees were felled and left on site there would likely be a dramatic increase in the population of Douglas-fir bark beetles (s. 3.7.5.4). This insect can build its population quickly in the presence of down trees and then spread to standing live trees causing mortality. They would spread and kill trees in the plantation as well as mature trees in adjacent stands. Because of the threat of resulting mortality caused by the bark beetles, leaving approximately 150 felled trees per acre onsite in LSRs would not achieve the purpose and need for an increase in health and growth of stands. The analysis shows that sufficient quantities of dead and down wood would occur with the proposed action (s. 1.6.1.2 & s. 3.8.2.3).

The comment raises concerns about the impacts of building roads, landings and skid trails in LSRs and proposes this alternative to avoid those impacts. No new road construction is proposed in LSRs (s. 3.7.5.4). The project would reuse existing road alignments, existing landings and existing skid trails (s. 1.4.7.3 & s. 1.4.9,C8).

The project was found to be consistent with LSR standards and guidelines (s. 3.7.6). The Regional Ecosystem Office reviewed the project and found it to be consistent with the objectives for LSRs (REO 2012) (s. 3.7.5.4).

The proposed practice also has no funding source. The commenter suggested that the savings associated with not building roads, landings or skid trails could potentially be used to cover the cost of felling the trees. The Forest does not have funding to pay for road reconstruction or tree felling; this work is accomplished by logging contractors in exchange for the value of the trees they remove. If the trees are not removed, there would not be sufficient value in the rest of the project to cover the cost of felling. At this time there is no known source of funding for this type of work and as such, it is not feasible to implement.

This suggested alternative was considered but not fully developed because:

- Impacts to late-successional dependent species would be minimal with the proposed action.
- This alternative would not provide the benefits of improved health and growth described in the purpose and need (s. 1.3, s. 3.1.4). Approximately 32 acres of stands would experience levels insect mortality that is not desired in LSRs.
    - The Regional Ecosystem Office reviewed the proposed action and found that it met standards and guidelines for LSRs.
    - There is no funding for this type of treatment.

2.3.4 One suggestion from Oregon Wild was to defer harvest of stands older than 50 years of age.

Most of the stands are 45 to 53 years of age. Approximately half the units are close to or just over 50 years of age. There are a number of conditions that affect the growth of trees such as elevation, soil type, hot fires, genetic variations, competition with brush and planting density. The District Silviculturist has evaluated the stands and found them to be at an appropriate age for variable density thinning. The analysis found similar environmental effects and benefits for stands above and below age 50 (s. 3.1). While the EA does not incorporate the suggested 50-year threshold, the oldest stands are close to age 50 and are not considered 'old' or 'too old' to benefit from thinning. The cited research points out the benefits of thinning stands before they get too old, but does not support the assertion of a 50-year threshold or that thinning stands over 50 years of age have negative consequences. After considering the cited research and site-specific stand exam information and the analysis of growth potential, the proposed action meets the purpose and need of enhancing health and growth and providing forest products.

The suggested alternative of removing units that are over age 50 was considered but not fully developed because:

- It would not provide the benefits described in the purpose and need for 800 acres.
  - 800 acres of stands would continue on a trajectory of declining health as overcrowded uniform conditions persist.
  - Approximately 9 million board feet of lumber would not be processed by local mills.
  - 800 acres of stands would continue to lack horizontal and vertical diversity.
  - Forage quality would continue to decline in these areas.
- There would be reduced value for the project as a whole and the remaining units may not be sufficient to pay for road decommissioning and other important work of the proposed action.

2.4 Comparison of Alternatives

This section presents a comparative summary of principal activities and the environmental effects for the alternatives being considered in detail. The summary is limited to the effects on the project's purpose and need, Forest Plan standards and guidelines, and other resources measurably affected and considered important for an informed decision.

	Alternative A - No Action	**Alternative B - Proposed Action**
Purpose and Need Indicators		
Increase health and growth (s. 3.1)	Stands would begin to stagnate and become more susceptible to insects and diseases.	Trees in thinned stands would have the space they need to grow and increase diameter and expand their crowns.

	Alternative A - No Action	Alternative B - Proposed Action
Tree diameter in 40 years	18.3 inches. Not meeting late-successional character.	23 inches. Achieves the minimum size where stands begin to function as late successional.
Tree growth rate in 40 years	1 cubic foot per tree per year	1.6 cubic feet per tree per year
Sustainably provide wood products (s. 3.17)	No wood products provided. Future productivity reduced as mid-aged stands stagnate.	Provides approximately 19 MMBF of wood products and creates healthy stands for future productivity.
Diversity of vertical and horizontal structure (s. 3.2)	Plantations would remain relatively uniformly dense and overcrowded.	Variable density thinning with skips, gaps, heavy thinning and forage openings would create greater structural diversity compared to no action.
Change in tree species	Douglas-fir would remain the dominant species.	Retention of minor species and removal of some Douglas-fir – results in greater representation of western hemlock, noble fir, Pacific silver fir, western redcedar and alder. More representative of historic species mix.
Change in other plants	Ground vegetation would remain unchanged.	More sunlight to forest floor would increase abundance of plants such as forage species.
Change in vertical canopy layers	Would primarily remain single story stands with small gaps created by natural disturbances.	Gaps and heavy thins would naturally regenerate and begin to grow young trees resulting in a two storied stand. Up to 10% gaps and up to 10% heavy thins.
Change in horizontal structure	Trees would remain uniformly dense.	A mix of gaps, skips, heavy thins, and variable density thinning would result in diverse structure. Up to 10% gaps, up to 10% heavy thins, skips would be 5 to 10% plus riparian buffers.
Change to snags and down wood (s. 3.8.2)	High levels of small snags and down wood in next few decades.	Lower levels of small snags and down wood compared to no action. Levels for larger sized snags and down wood are slightly less compared to no action. Snags and down wood would be created.
Forage (s. 3.8.3.4)	Forage for deer and elk would continue to decline across the landscape.	Forage for deer and elk would improve slightly across the landscape.
Road maintenance, repair and decommissioning (s. 3.12, s. 3.3.3.6)	Roads would continue to impact hydrologic function and water quality.	Active road decommissioning and the repair maintenance and stormproofing of roads would reduce chronic sediment delivery, restore hillslope hydrology and reduces sediment impacts associated with the potential catastrophic failure of stream crossings during storm events.
Fuel Break (s. 1.4.6.6, s. 1.3.1.8)	Fire Hazard would remain around facilities and residences in the wildland-urban interface.	Fire Hazard would be reduced around facilities and residences in the wildland-urban interface. A defensible space would allow greater safety for suppression forces and evacuating residents.
Summary of Actions (s. 1.4)		

	Alternative A - No Action	Alternative B - Proposed Action
Acres of mid-aged stands treated to meet purpose and need	0	1,756. This represents the entire acreage of stands before subtractions for stream buffers and skips.
Acres of Riparian Reserve Enhanced	0	412
Acres of LSR Enhanced	0	32
Miles of temporary roads constructed and then rehabilitated	0	0.2
Miles of old road alignments reconstructed and then rehabilitated	0	5.35
Miles of system roads maintained	0	85
Miles of open system roads closed	0	8.45
Issues and Concerns		
Roads (s. 1.6.1.1) (s. 1.4.7.3)	No road construction or reconstruction. Approximately 1.8 miles of existing temporary roads were never fully decommissioned or rehabilitated and would remain unrestored.	Reconstruct 5.35 miles of existing road alignments and rehabilitation. Temporary stream crossings minimized. Approximately 1.8 miles that were never decommissioned or rehabilitated before would be rehabilitated.
Decadence (s. 1.6.1.2) (s. 3.8.2.3)	Results in an abundance of small snags – as many as 16 per acre greater than 10 inches diameter in 20 years. In 100 years -12 snags per acre between 20 and 30 inches diameter and 2 snags per acre greater than 30 inches diameter.	Fewer small snags because small suppressed trees would be removed during thinning –7 to 9 small snags per acre greater than 10 inches diameter in 20 years. In 100 years -5 to 7 snags per acre between 20 and 30 inches diameter and 2 snags per acre greater than 30 inches diameter.
LSR, Riparian & Earthflow (s. 1.6.1.3) (s. 3.7.5.2) (s. 3.4.4.2) (s. 3.5.6)	No treatment in LSRs, Riparian Reserves or earthflows.	412 acres of riparian reserve thinned, 32 acres of LSR thinned and 744 acres of earthflow thinned. (996 acres after accounting for overlaps.) All would meet Forest Plan Standards and Guidelines (S&Gs).
Monitoring of BMPs (s. 1.4.10) (s. 1.6.1.4) (s. 3.3.5.2&3)	No project monitoring. Landscape scale trend monitoring continues.	Projects would be included in sample for national monitoring protocol for BMP implementation and effectiveness.
Diversity (s. 1.6.1.5) (s. 3.2)	Natural processes would continue as stands grow.	Variable density thinning with skips, gaps, heavy thinning and forage openings would create structural diversity.
Road Decommissioning (s. 1.6.1.6) (s. 1.4.7.2)	No roads would be decommissioned.	4.64 miles of system roads would be decommissioned.

	Alternative A - No Action	Alternative B - Proposed Action
Effects Summary		
Water Quantity (s. 3.3.2.4)	Gradual continued recovery, water routed by road problems not restored.	Little change, gradual continued recovery meets S&Gs, roads rehabilitated and decommissioned reducing water routing problems.
Water Temperature (s. 3.3.3.3)	No change	Not measurable. Uses stream protection buffers.
Sediment (s. 3.3.3.6)	Continued sediment delivery from system roads.	Some short-term sediment production from road decommissioning, temporary road reconstruction and use and some long-term sediment reduction from road repair, road decommissioning and stormproofing. Project design criteria (PDCs) minimize erosion and sedimentation.
Fisheries ESA Listed Fish Habitat (s. 3.4.6)	No Effect	May Affect, Not Likely to Adversely Affect
Fisheries MSA Essential Fish Habitat (s. 3.4.6)	No Adverse Affect	No Adverse Affect
Aquatic Sensitive and Survey&Manage (s. 3.4.6)	No Impact	May impact individuals or habitat, but would not likely contribute to a trend towards Federal listing or loss of viability to the population or species
Management Indicator Species – Fish (s. 3.4.7)	Would not contribute to a negative trend in viability on the Forest	Would not contribute to a negative trend in viability on the Forest
Aquatic Conservation Strategy (s. 3.4.8.1)	Would not enhance late-successional characteristics of riparian reserves.	Meets ACS Objectives. Would enhance late-successional characteristics of riparian reserves.
Geologic Stability (s. 3.5)	Gradual continued recovery of earthflows, water routed by road problems not restored.	Gradual continued recovery of earthflows. Roads rehabilitated and decommissioned reducing water routing problems on earthflows. Landslide prone areas are avoided. Earthflows are hydrologically recovered. Meets S&Gs.
Soil Erosion (s. 3.6.5)	Gradual continued recovery of existing soil conditions. Roads continue to be unrestored.	Very small risk for a very short period of time with PDCs. Reduced erosion as roads are rehabilitated and decommissioned and stormproofed.
Detrimental Soil Disturbance (s. 3.6.6)	Gradual recovery. Many stands currently exceed S&Gs.	Uses existing skid trails & landings. Temporary roads and landings would be restored. Exceptions to S&Gs
Organic Matter (s. 3.6.7)	Gradual recovery as trees die and fall.	PDCs minimize alteration of duff and down wood. Slash would be retained and would quickly decay.

	Alternative A - No Action	Alternative B - Proposed Action
Northern Spotted Owl (s. 3.7.5)	No noise, no reduction in dispersal habitat. No Effect	Retention of dispersal habitat in LSR, quicker progression towards old-growth character in LSRs, reduction of dispersal habitat in matrix. Seasonal restriction minimizes noise effect. Would not cause jeopardy.
Sensitive Species (s. 3.4.3, s. 3.8.1.1, s. 3.13)	No Impact	May Impact Individuals, but not likely to Cause a Trend to Federal Listing or Loss of Viability to the Species. No Impact for others.
Survey and Manage (s. 3.8.1)	No Effect	Does not apply to stands less than 80 years of age.
Snags (s. 3.8.2.3)	Results in an abundance of small snags – as many as 16 per acre greater than 10 inches diameter in 20 years. In 100 years -12 snags per acre between 20 and 30 inches diameter and 2 snags per acre greater than 30 inches diameter.	Fewer small snags because small suppressed trees would be removed during thinning –7 to 9 small snags per acre greater than 10 inches diameter in 20 years. In 100 years -5 to 7 snags per acre between 20 and 30 inches diameter and 2 snags per acre greater than 30 inches diameter.
Deer and Elk (s. 3.8.3.4)	Forage is declining across the landscape. Projected decline in population.	Project would enhance forage. Population may still decline.
American Marten (s. 3.8.3.5)	No habitat	No habitat
Pileated Woodpecker (s. 3.8.3.6)	Abundant small snag habitat	Fewer small snags. Would not contribute to a negative trend in viability on the Forest for pileated woodpecker.
Scenery (s. 3.9)	No change	Little change. Would diversify uniform patterns.
Scenic and Recreational Rivers (s. 3.11)	No change	Outstandingly remarkable values (Botany/Ecology, Fish, Wildlife, Recreation and Cultural Resources) would be protected.
Transportation (s. 3.12)	No road maintenance	Would maintain and repair 85 miles of system roads that are needed for public access including wilderness trail heads. Approximately $360,000 would be generated to maintain and repair roads, and approximately $90,000 would be generated to decommission roads.
Botany (s. 3.13)	No change	For many species that may be present - May Impact Individuals or habitat but not likely to lead to a trend toward federal listing.
Invasive Species (s. 3.14)	No change. Several invasive plants are present	PDCs would minimize spread of existing invasives and would minimize the introduction of new species.

	Alternative A - No Action	Alternative B - Proposed Action
Fuels (s. 3.15)	No change. Fire hazard remains for administrative sites, employees and residents.	Provides increased protection from fire for facilities, employees and residents. Provides a safer environment for suppression forces in the event of a fire.
Summary of Other Resources		
Wilderness (s. 3.10)	No change. Roads to wilderness trail heads would not be repaired.	Roads to wilderness trail heads would be repaired. Several units are close to the wilderness boundary (86, 88, 122, 124, 126, 128, 130 & 132). In each case, a road is between the unit and the Wilderness.
Inventoried Roadless Areas (IRAs) (s. 3.10)	There are no units in IRAs. The nearby Roaring River IRA has been added to the Wilderness system.	
Private Land (s. 3.3.2.1)	52 acres of private land owned by Portland General Electric are in the planning area.	
Fire Hazard (s. 1.3.1.1) (s. 1.4.6.6) (3.15)	Fire suppression in the past 100 years has not dramatically altered the structure of stands or increased fire hazard in this group. A fuel break is proposed to increase protection of administrative facilities. No fuels treatments are proposed outside the fuel break other than landing slash disposal. Slash would be left in the units. It would be crushed under equipment where mechanical harvesters are used.	
Mature/Late-Successional/Old-Growth Forest (s. 3.1)	The project occurs in mid-aged stands, 30 to 60 years of age. Some units are bounded by stands with older forest. There would be little or no effect to these adjacent stands.	
Recreation (s. 3.10)	There are several developed recreation areas near the project. Some roads that lead to recreation areas would be repaired and maintained.	

3.0 ENVIRONMENTAL CONSEQUENCES

This section summarizes the physical, biological, social and economic environments of the affected 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.

Cumulative Effects

3.0.1 A discussion of cumulative effects is included for each resource where appropriate. Cumulative effects are impacts on the environment that result from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions. If the proposed action would have little or no effect on a given resource, a more detailed cumulative effects analysis is not necessary to make an informed decision.

The land area and the time scale used for cumulative effects analysis varies by resource. The analysis considers the impact of activities on other ownerships where appropriate. In the planning area, the only other non-National Forest lands are 52 acres owned by Portland General Electric.

In order to understand the contribution of past actions to the cumulative effects of the proposed action and alternatives, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

The cumulative effects analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach:

- A catalog and analysis of all past actions would be impractical to compile and unduly costly to obtain. Current conditions have been impacted by innumerable actions over the last century (and beyond), as well as by natural processes of growth and recovery since. Trying to isolate the individual actions that continue to have residual impacts would be nearly impossible.
- Providing the details of past actions on an individual basis would not be useful to predict the cumulative effects of the proposed action or alternatives. In fact, focusing on individual actions would be less accurate than looking at existing conditions, because there is limited information on the environmental impacts of individual past actions, and one cannot reasonably identify each and every action over the last century that has contributed to current conditions.
- Focusing on the impacts of past human actions risks ignoring the important residual effects of past natural events, which may contribute to cumulative effects just as much as human actions. By looking at current conditions, we are sure to capture all the residual effects of past human actions and natural events, regardless of which particular action or event contributed to those effects.
- The Council on Environmental Quality issued an interpretive memorandum on June 24, 2005 regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions.
- The cumulative effects analysis in this document is also consistent with Forest Service National Environmental Policy Act (NEPA) Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

    > "CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives would add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable

> foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)"

Each resource includes a discussion of how information on past projects was considered. For the reasons discussed above, the analysis of past actions is primarily based on current environmental conditions. Some resources utilize the current GIS vegetation layer which includes information on current condition of forest stands as they have been affected by events such as forest fires, past regeneration harvest and road construction as well as the growth that has occurred since.

3.0.2 Other Factors

Where appropriate, the PGE hydropower system of dams, pipes and power lines would be considered in the assessment of cumulative effects.

Other types of projects or activities are also considered where appropriate including road maintenance, road decommissioning, danger tree removal, gathering of special forest products, and recreational uses. There are several recent and ongoing thinning projects in the vicinity that may be included, depending on the cumulative effects analysis area which is unique for each resource.

3.1 STAND GROWTH AND PRODUCTIVITY

(This section elaborates on Purpose and Need section 1.3 and s. 1.3.1.3)

Growth and productivity are primarily concerns in the matrix land allocation but the stand dynamics of mid-aged stands are also relevant to achieving objectives for other land allocations. This section contains a discussion about stand dynamics and growth and summarizes the silvicultural specialist report and the stand data in the analysis file which are incorporated by reference and summarized below. Soil productivity is discussed in section 3.6.

When trees are too closely spaced they experience a slowing of growth due to competition for sunlight, moisture and nutrients. Denser stands are more susceptible to stem breakage or tipping in winds. Trees that grow at tight spacing in the interior of stands are protected from the wind and often do not develop strong stems or roots.

Trees that grow at wide spacing and in windy areas can develop resistance to wind by growing strong stems and strong, spreading root systems.

The project area lies within the Western Hemlock Zone (WHZ). The WHZ is an area where specific complexes of plant communities or associations occur. Plant associations describe the assemblages or complexes of vegetation and plant communities found in the forest. They reflect differences in temperature, moisture, and plant debris inputs and tend to correlate well with timber productivity and provide a useful tool for making inferences about growth and yield. The Western Hemlock Zone encompasses forests where western hemlock would dominate the overstory (assuming no disturbance) but Douglas-fir is currently the dominant overstory species. Most of the area is located on productive, well-drained soils, typical of the plant associations they occupy.

The stands in the project area display moderate species diversity with common overstory species consisting predominantly of Douglas-fir (*Pseudotsuga menziesii*), with minor inclusions of western hemlock (*Tsuga heterophylla*), noble fir (*Abies procera*), grand fir (*Abies grandis*), Pacific silver fir (*Abies amabilis*), and western redcedar (*Thuja plicata*). Ground cover includes, dwarf Oregon grape (*Mahonia nervosa*), vine maple (*Acer circinatum*), salal (*Gaultheria shallon*), snowberry (*Symphoricarpos albus*), swordfern (*Polystichum munitum*), and bracken fern (*Pteridium aquilinum*). There are inclusions of red alder (*Alnus rubra*), primarily in wet areas.

The western hemlock zone supplies most of the timber produced on the Forest, however there is great variability in timber productivity. In the western hemlock zone, on average, the most productive conditions occur where effective rooting depth is greatest, the input of plant residues is high and the organic matter is decomposed and leached into the soil quickly. The plant associations with the highest amounts of large fallen trees are those with a warm, moist environment and relatively high productivity.

3.1.1 For this proposal, the following actions have the potential to affect stand growth, productivity and health, both positively and negatively and are included in the analysis of effects. Thinning would generally have a positive effect on growth and productivity. Potential negative effects may include soil compaction from the use of heavy equipment, damaging leave trees, and attracting insects by leaving slash and down logs on the ground. With the proposed action certain elements designed to enhance diversity such as skips and gaps have the potential to reduce the acreage where thinning benefits for tree growth and productivity would occur. The effects of thinning on stand growth and productivity are generally felt only inside the thinned stands; therefore the analysis area for direct, indirect and cumulative effects for stand growth and productivity would be the unit boundaries.

3.1.2 Existing Condition

Mid-aged stands in the project are capable of rapid growth but growing space has become limited due to overcrowding and stands are experiencing growth suppression and some mortality. The major causes of growth suppression are competition from surrounding trees, concentrations of ground and understory vegetation, and limited resources such as light, water, and nutrients.

The species mix is similar in each of the stands but most exhibit various concentrations and distributions. Douglas-fir generally dominates the overstory with lesser quantities of western hemlock, noble fir, grand fir, and areas scattered with western redcedar. Relative densities (RDs) range from 55 to 85 with an average diameter of approximately 13 inches. The net growth rate (which includes growth and mortality) is 0.8 cubic foot per tree per year. Heights in the project area are approximately 100 feet. Productivity is relatively high when compared to Region 6 averages; site indices range from site II to III.

Both laminated root rot and armillaria root disease have caused moderate to severe infection and mortality throughout the project area. Openings ranging in size from ½ to 3 acres have been created by laminated root rot while smaller patches of armillaria are more common.

Direct and Indirect Effects

Random plots were measured within the proposed thinning units and the data was incorporated into the Forest Vegetation Simulator (FVS) (Crookston 1999) to project future growth. Stand exam data and FVS outputs were interpreted by a certified silviculturist.

In the following analysis, projections are sumarized for 40 years from now. This allows sufficient time for trees that have been thinned to improve root development and to fully realize the site's potential. For the purpose of this analysis, a tree size threshold of 20 inches in diameter is displayed because it is thought to be the minimum size at which stands begin to exhibit late-successional conditions or characteristics.

3.1.3 No Action - Trees that have been uniformly spaced during planting have less of a chance to express dominance when they have been planted from genetically similar seed sources and maintained at relatively even spacing. Therefore, when these stands reach density levels in which individual trees are competing with each other for growing space it may take longer for individuals to express dominance. As tree competition increases, stems would continue to grow in height, but diameter growth would drastically slow. These trees would become more dependent on neighboring trees for support. When trees develop in this manner they are more likely to blow down in large groups or if drought conditions persist, be more susceptible to insects and disease.

Failure to maintain tree spacing while they are young can have consequences lasting the life of the stand (Oliver 1996). If no action is taken, the overstocked condition of current stands would result in stands with reduced vigor, small trees, increased mortality, and increased susceptibility to stressors such as insects, diseases and weather.

In terms of wind stability, with no action stands would remain crowded and would gradually decrease in vigor. Stands would reach density levels in which individual trees are competing with each other for growing space. As tree competition increases, stems would continue to grow in height, but diameter growth would drastically slow. These trees would become more dependent on neighboring trees for support. When trees develop in this manner they are more likely to blow down in large groups or if drought conditions persist, be more susceptible to insects and disease. Overcrowded stands cannot defend themselves very well against damaging agents such as insects because their sap production is limited. Trees have less of a chance to express dominance when they have been planted from genetically similar seed sources and maintained at relatively even spacing.

Overcrowded stands cannot defend themselves very well against damaging agents such as insects and disease. The loss of vigor is a direct result of increased stress and overall poor health related to overcrowding. Factors such as limited sap production can promote conditions for insect entry and colonization and the lack of diseases resistance decreases the ability to fight against infection.

With no action, the average stand diameter in 40 years would be approximately 18.3 inches and the net growth rate (which includes growth and mortality) would be 1 cubic foot per tree per year. Stocking would be at levels where growth suppression and mortality continues to occur (RD would exceed 95 in some stands). The understory vegetation would also continue to be suppressed.

3.1.4 Proposed Action – In general, thinning tends to improve the overall vigor, growth, health and architecture of trees. Thinning can directly affect productivity and forest health by maintaining growth rates of young stands. Thinning would redistribute growth potential to fewer trees, while maximizing the site's potential, leaving a stand with a desired structure and composition (Oliver 1996).

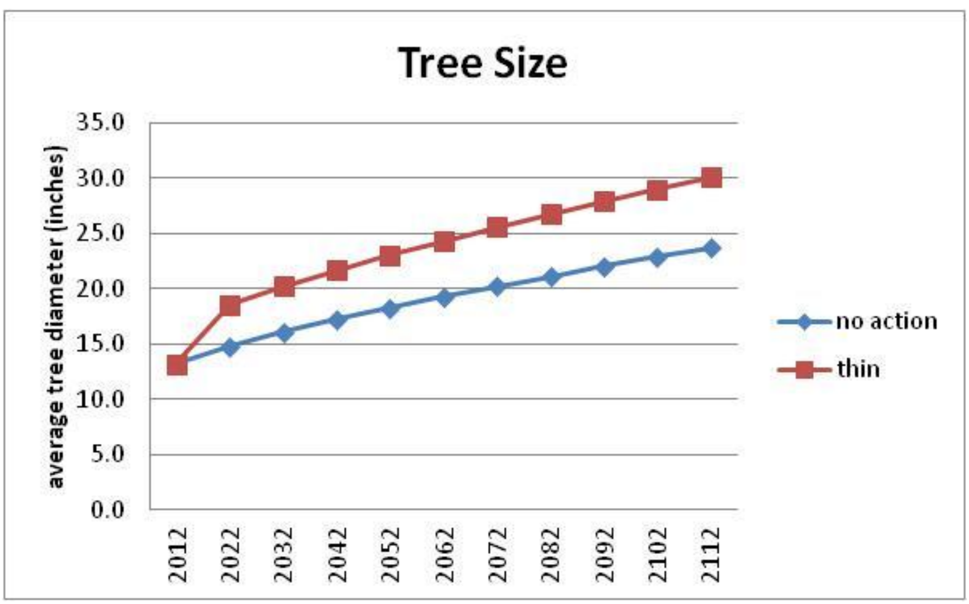
Thinning provides growing space, which gives the trees with the best competitive advantage the opportunity to take advantage of this growing space for the longest practical time, fully utilizing the ability of the trees to expand their crowns into the growing room provided by the removal of neighboring trees (Oliver 1996). Trees with larger crowns have greater stem taper, that is, the base of the tree is relatively large compared with trees that have small short crowns. Thinning increases a tree's resistance to the wind (windfirmness) by maintaining a larger crown and increasing stem taper. Trees with more taper are less likely to suffer stem breakage or windthrow. In general, thinning increases both stem and root strength. Thinning can also improve the resistance of some trees to some pathogens by manipulating the structure and species composition of a stand.

Stands in the matrix would be thinned to improve stand growth, individual tree growth and to provide variability. The thinning prescription would employ a range of relative densities from 20 to 25. (This range corresponds to approximately 80 and 100 square feet of basal area.) These prescriptions would achieve the matrix objectives of stand growth, productivity and health goals while providing forest products. These objectives would be met with the proposed action but would not be achieved with no action.

Average stand diameter in 40 years would be approximately 23 inches and the net growth rate (which includes growth and mortality) would be 1.6 cubic feet per tree per year. Thinning would provide forest products consistent with the Northwest Forest Plan goal of maintaining the stability of local and regional economies. It would supply approximately 19 million board feet of wood products now but it would also keep forests healthy and productive to sustainably provide forest products in the matrix in the future. Not only are forest products needed by society, but also the employment created is important to local and regional economies (Northwest Forest Plan ROD p. 26, Mt. Hood Forest Plan p. Four-3&26).

Comparison of Alternatives

The following chart shows a comparison of the alternatives for live trees. The proposed action would achieve an average 20 inch diameter 40 year sooner than with no action. Stands sometimes begin to exhibit late-successional conditions when they reach approximately 20 inches in diameter.



3.1.5 Cumulative Effects – Health and Growth

The effects of thinning on stand growth and productivity are generally experienced or expressed within the thinned stands; therefore the analysis area for cumulative effects would be the unit boundaries. The time scale for cumulative effects analysis is quite long: some impacts from 30 to 60 years ago when stands were clearcut remain today, and alterations made during thinning have the potential to benefit health and growth 100 or more years into the future. The existing condition and the changes projected above include past actions as they have affected growth including previous logging, site preparation, planting (including the selection of genetically appropriate seed), and precommercial thinning. There are no other owners or entities performing actions inside the units to consider. There are also no foreseeable future projects occurring inside the units to consider. While there may be future logging or other management within the units, there are no current proposals with sufficient site specificity to conduct an analysis. Because the impact of the proposed action on growth and productivity is a beneficial one, and there are no other additive impacts to consider, there would be no cumulative effects.

3.1.6 Forest Plan standards and guidelines

Forest Plan References
Forestwide Timber Management Standards and Guidelines - FW-306 to FW-385, page Four-86
Mt. Hood FEIS pages IV-50 to IV-76
Northwest Forest Plan - Matrix Standards - page C-39

FW-372 Thinning has been designed to maintain the desired stocking level to achieve a vigorously growing stand throughout the rotation, while considering wildlife cover needs.

The proposed action is consistent with this standard and guideline.

3.1.7 Other Findings

The proposed action is consistent with the National Forest Management Act regulations for vegetative management. There would be no regulated timber harvest on lands classified as unsuitable for timber production (36 CFR 219.14) and vegetation manipulation is in compliance with 36 CFR 219.27(b). There would be no created openings large enough to require reforestation or planting and therefore standards and guidelines FW-358 to 363 would be met.

3.2 DIVERSITY

(This section elaborates on Purpose and Need section 1.3 and s. 1.3.1.5)

3.2.1 Introduction - This section focuses on diversity at the stand scale. Other sections of this document contain discussions of stand and landscape-scale effects to wildlife (s. 3.7 & s. 3.8) and botany (s. 3.13). This section summarizes the silvicultural specialist report and the stand data in the analysis file which is incorporated by reference.

Diversity is the distribution and abundance of different native plant and animal communities and species within an area. There are many types of diversity including but not limited to genetic, structural, horizontal, and vertical. At the landscape scale, a mix of forest types and ages can provide habitat for a wide range of plants and animals. At the stand scale other elements become more relevant such as species composition, snag abundance or the number of canopy layers.

In Douglas-fir forests, standing and down dead wood is as important a component of ecosystem function as the live plants, soils or animals (Maser 1984). Plantations generally lack certain elements of diversity and complexity. They often do not contain the mix of tree species that were present in the original stand and they are relatively uniform in terms of tree species, size and spacing. When the original clearcut harvesting occurred, all of the large trees and snags were removed. The plantations tend to display minimal variability of vertical and horizontal stand structure and little sunlight reaches the forest floor resulting in low levels of diversity of ground vegetation.

The age and density of stands, and management strategies affect a variety of ecosystem functions including: wildlife species use and migration, nutrient cycling, hydrologic function, production of snags and coarse woody debris, and disturbance processes (fire, insects, disease, and windthrow). Many species evolved to use the large snags and logs that were historically abundant in the landscape. The loss of snag and log density from managed stands affects biodiversity and critical function such as control of forest insects and initiation of microbial activity.

The distribution of snags and fallen trees is partly a function of elevation, aspect, slope and other site factors that contribute to overall site productivity; but the history of stand disturbance and inter-tree competition have perhaps even greater influence. Under natural conditions, disease, fire, insect infestation and the proximity of the trees to each other as the stand develops are factors that contribute to tree mortality, and create snags and/or down wood.

The proposed action has the potential to affect diversity, both beneficially and adversely. Thinning would feature variable density with skips and gaps. Leave trees would include minor species, trees with the elements of wood decay and non-hazardous snags while some snags and down logs would be created. Some hazardous snags may be lost. The effects of thinning on the elements of stand diversity are generally felt only inside the thinned stands; therefore the analysis area for direct, indirect and cumulative effects for stand diversity would be the unit boundaries. Other elements of diversity at the larger landscape scale are discussed in section 3.8.

One of the opportunities described in section 1.3 is to create greater variability in the targeted stands. To evaluate the accomplishment of this objective, the alternatives are compared in terms of the following measures: acres treated, the change in tree species composition, the change in the abundance of other desired plants, the change in vertical canopy layers, the change in horizontal structure with skips and gaps, and the changes to snags and down logs. Additional discussions of snags and down logs at the stand and landscape scale are in section 3.8.2.

3.2.2 Existing Condition

Stands in the project area are relatively dense with one canopy layer (see s. 3.1). The clearcuts were planted primarily with Douglas-fir in the lower elevations; in some areas other species such as noble fir were planted. Other tree species such as western hemlock, grand fir, Pacific silver fir and western redcedar are present because they seeded in from stand edges. Snags present in the stands are the result of planted trees that have died from inter-tree competition or disease over time. Some horizontal variability exists in some stands from the down wood remaining following regeneration harvest and small gaps that are being created by root disease.

Direct and Indirect Effects

3.2.3 No Action

The uniformity of stands would continue in terms of species composition, vertical or horizontal structure. Recent studies have indicated that dense, closed-canopy second-growth stands without legacy trees can result in a period of low structural diversity that can last more than 100 years and can have profound effects on the capacity of the forest to develop biocomplexity in the future (Courtney 2004, appendix 5, p. 3-24). The stands contain some small and medium size snags (planted trees that died) and these would remain with this alternative. Over time as trees become suppressed, more small and medium size trees would die. At the landscape scale, there is not a shortage of small or medium sized snags. Where root rots occur, there would be a continued slow expansion of gaps as trees die and fall. Species that rely on diverse mature forests would have to wait many years for appropriate habitat conditions to develop without intervention. It would take 40 years longer to get trees averaging larger than 20 inches diameter compared to the proposed action (s. 3.1.4). However, it would take much longer for stands to acquire multi-storied canopy and the vertical and horizontal heterogeneity compared to the proposed action.

3.2.4 Proposed Action

The proposed thinning as described in s. 1.4.1 would introduce some elements of diversity that are lacking. The concepts of variable-density thinning are discussed in research by Dodson, Carey, Chan and Tappeiner (Dodson 2012) (Carey 2003) (Chan 2006) (Tappeiner 1999) (Bauhus 2009). Thinning would be conducted to introduce structural diversity through variable-spaced thinning. Minor species, non hazardous snags and down wood and would be retained and skips and gaps would be created. The quantity and sizes of skips and gaps are varied based on land allocation and site-specific situations.

These additions would result in improvements in diversity that would benefit plants and animals in the project area and across the landscape. Thinning units would have a more complex mix of tree species and varied spatial arrangement. There would be greater variability of vertical and horizontal stand structure and more sunlight would reach the forest floor to create greater diversity of ground vegetation. There would be a greater diversity of live trees and sufficient quantities of dead trees, down wood, and live trees with the elements of wood decay to meet the needs of dependent species.

There are several elements of diversity considered here with both short and long-term implications; it is possible to affect one element beneficially while affecting others adversely. With the proposed action, variable density thinning would be implemented to achieve vertical and horizontal structure. The result would be a reduction in levels of small snags and down logs in the short term compared to no action. The proposed action would create some snags and down logs now and would result in large trees in the future (s. 3.1.4). Some of these larger trees would eventually die and become snags, although it is recognized that thinning improves tree health and it may take longer for the trees to die. In comparison, the No-Action Alternative is projected to have a large number of small snags and down wood as a result of overcrowding in both the short and long term. Large snag and down log levels are slightly higher with no action because thinning provides growing space which increases tree health. The proposed action would not affect the viability of species that depend on snags and down logs because sufficient levels would be provided at the local and landscape scales (s. 3.8).

3.2.5 Comparison of Alternatives

Measure	No Action	Proposed Action
Acres Affected	0	Variable density thinning would occur on approximately 1,756 acres.
Change in tree species composition	Tree species mix would not change. Stands are currently predominantly Douglas-fir (approximately 5 % minor species in most stands).	Retention of minor species and removal of some Douglas-fir – resulting in greater representation of western hemlock, noble fir, Pacific silver fir, western redcedar and alder (as much as 20% minor species in some stands). Minor species are likely to seed into stands more readily than Douglas-fir. More representative of historic species mix.
Change in abundance of ground vegetation and	Plants on the forest floor would remain unchanged.	More sunlight to forest floor would increase abundance of plants such as forage species.

species richness		
Change in presence of vertical canopy layers	Stands would primarily remain single story stands with small gaps created by natural disturbances.	Gaps and heavy thins would naturally regenerate primarily with shade-tolerant trees resulting in a two storied stand. (Up to 10% gaps and up to 10% heavy thins). Some ingrowth would also occur throughout stands except in skips and riparian buffers.
Change in horizontal structure	Trees would remain uniformly dense. Root rot pockets would create small gaps in stands where it is present.	A mix of gaps, skips, heavy thins, and variable density thinning would result in more diverse structure. (Up to 10% gaps, up to 10% heavy thins, skips would be 5 to 10% plus riparian buffers). The quantities of these features would vary between units.
Change in abundance and size of snags and down wood (s. 3.8.2)	High levels of small snags and down wood in next few decades.	The project would create some small snags and down logs now (s. 1.4.6.1). In terms of natural mortality, there would be lower levels of small snags and down wood in the next few decades compared to no action. In the long term, levels of larger sized snags and down wood are slightly less compared to no action, although future snags are likely to be larger than what would occur under no action due to increased growth rates (s 3.1.4).

3.2.6 Cumulative Effects

The effects of thinning on stand diversity are generally felt only inside the thinned stands; therefore the analysis area for cumulative effects is the unit boundary. Other sections of this document contain discussions of landscape scale diversity such as effects to wildlife habitat in sections 3.7 and 3.8. The time scale for cumulative effects analysis is quite long: impacts from 30 to 60 years ago when stands were clearcut are still felt today, and changes made during thinning have the potential to benefit and impact elements of diversity 100 or more years into the future. The existing condition and the changes projected above include past actions as they have affected stand diversity including road construction, previous logging, site preparation, planting (including the selection of tree species), and precommercial thinning. There are no other owners or entities performing actions inside the units to consider. There are also no foreseeable future projects occurring inside the units or directly adjacent to them to consider. While there may be future logging or other management within the units, there are no current proposals with sufficient site specificity to conduct an analysis. For these reasons, cumulative effects for stand-level diversity would not occur, as the effects of this action are limited to direct and indirect effects and no other project overlaps in time or space to contribute to a cumulative effect. Variable density thinning with skips and gaps is intended to enhance stand-level diversity. While there would be some change to certain decadence elements, cumulative impacts are not likely to occur.

3.2.7 Forest Plan standards and guidelines - Landscape and Stand Diversity

Forest Plan References
Forest Management Goals - #11 and 12, page Four-2
Forestwide Forest Diversity Standards and Guidelines – FW-148 to 169, page Four-67

The proposed action is consistent with these standards and guidelines. The no-action alternative would not enhance diversity.

FW-148 to 150	The thinning prescriptions retain a diversity of species.
FW-152 to 153	Not applicable
FW-154 &155	The thinning prescriptions retain a diversity of tree species based on site potential and encourage the continued presence of minor forest tree species.
FW-156	No native species would be lost.
FW-157	Some areas contain an abundance of alder. It would be retained where feasible.
FW-158 to 160	Not applicable
FW-163 to 169	See Wildlife section

3.3 WATER QUANTITY and QUALITY

This section summarizes the water quality specialist's report and data in the analysis file. After this section presents some background information, it discusses water quantity (s. 3.3.2), temperature (s. 3.3.3.1), and sediment (s. 3.3.3.4). There is additional discussion on related topics in the Fisheries (s. 3.4), Geologic Stability (s. 3.5) and Soil Productivity (s. 3.6) sections.

The elements of the proposed action that could affect hydrologic recovery or water quality include variable density thinning and cutting or killing trees for down logs and snags as well as fuels treatments, road maintenance, log haul, and road, landing, skyline corridor and skid trail construction or reconstruction. Other actions such as road decommissioning and road stormproofing are specifically designed to benefit water quality. All of these actions are included in the discussions below.

3.3.1 Background

The project is within two watersheds: the Middle Clackamas River (Hydrologic Unit Code (HUC) 1709001104) and the Oak Grove Fork of the Clackamas River (HUC 1709001103).

> Note: In other documents the term 'field' is used to describe the size of a watershed, such as 5th field, 6th field or 7th field. Since that terminology may be confusing and is used differently by different agencies, this document uses the

term ‘watershed’ to describe the 5th field size, ‘subwatershed’ to describe 6th field size, and ‘drainage’ to describe the 7th field size.

Approximately 60% of the Grove Thinning Units are in the Oak Grove Fork Watershed and 40% of the units are in the Middle Clackamas River Watershed. The project area varies in elevation from 1,400 to 4,200 feet with average annual precipitation varying from 60 to 75 inches per year. The average peak snow water equivalent in the snowpack is 13 inches indicating at this site approximately 20% of the average annual precipitation is in the form of snow.

3.3.1.1 Oak Grove Fork

The Oak Grove Fork of the Clackamas River originates on the western slopes of the high cascades. Slopes are gentle, often less than 30%.

In contrast to the eastern portion of the Oak Grove watershed which has been only slightly modified by erosion, erosional processes dominate the landscape in the western portion of the watershed. This is due to weaker and older geological units which have resulted in deeply incised drainages and steep slopes often over 70%. The weak materials and steep slopes contribute to many landslides in the western portion. The Lower Oak Grove channel is constricted by large ancient landslide deposits known as earthflows. The geology section (s. 3.5) has a detailed discussion of earthflows and landslides.

Landslides, roads, and recent harvest units were considered the major sediment delivery processes in the watershed (USDA 1996a).

An assumption can be made that steep slopes of the weak geologic units have always delivered sediment to streams. Sediment from landslides initiated or influenced by management activities can be considered an addition to the sediment load of the system (USDA 1996a).

Many stream bank failures or inner-gorge failures yet to be inventoried are believed to be continuously delivering sediment to streams and probably account for a majority of the sediment delivered to streams by landslides (USDA 1996a).

The Oak Grove enters the Clackamas River at 1,340 feet elevation. Most of the watershed falls within the rain-on-snow zone where rain-on-snow events produce peak flows, debris torrents and sudden rapid land sliding (USDA 1996a).

3.3.1.2 Middle Clackamas River

The Middle Clackamas watershed is a ‘collector’ watershed: it is comprised of a series of small watersheds feeding into the mainstem of the Clackamas River between the Collawash confluence down to the Forest Boundary (including Trout Creek, Tar

Creek, Mag Creek, Tag Creek, Big Creek, Sandstone Creek, Bull Creek, Whale Creek, Cripple Creek, Roaring River, Fish Creek, South Fork Clackamas, and North Fork Clackamas). Water quality and sediment delivery are directly influenced by upstream events. This process is best displayed at the confluence of the Clackamas River and Collawash River. During winter storm events turbidity levels are much greater in the Collawash. The Clackamas River runs much clearer and the water quality of the Middle Clackamas River is defined by those two systems (USDA 1996b).

The dominant human imposed feature of the Middle Clackamas watershed is Highway 224, which parallels the river often only a few feet from the river's bank (USDA 1996b).

At least 50% of the lengths of Tar, Tag, Mag, Bull, Big and Dugan Creeks flow through earthflow zones. The lowermost part of Sandstone, Cripple, and South Fork Cripple Creeks are, to a lesser extent (15-20%), in earth flow zones. Streams flowing through earthflows have a large floodplain relative to the channel's width, the substrate is high in silt, stream banks are not well defined, pools are poorly formed, readily filling in after scouring, and there are more alders and underlying vegetation, such as grasses and skunk cabbage near the banks. Streams in earthflow zones have different characteristics than streams in a steep, rock landform, such as lower gradient and velocity, thus less scouring potential, the water has less flushing potential and tends to deposit more sediment in the channel, and pool formation is the result of woody debris rather than substrate (USDA 1996b).

Peakflow events occur during the rainy season, following a rapid and substantial depletion of the snowpack during a prolonged rain-on-snow period in the "transient snow zone". The Clackamas River transient snow zone is estimated to occur between 1,500 feet and 4,000 feet elevation (Christner 1982).

3.3.1.3 Oak Grove Hydroelectric Development

A complex series of hydroelectric facilities operated by Portland General Electric (PGE) and Eugene Water and Electric Board (EWEB) divert water into pipelines that cross through both the Oak Grove and Middle Clackamas Watersheds.

Operations associated with Oak Grove hydroelectric development have an impact on water quantity and quality criteria within the project area.

PGE operates three dammed reservoirs near the project area: Timothy Lake, Lake Harriet, and Frog Lake (an off-stream reservoir). Other facilities include a powerhouse, pipelines, and power transmission facilities. In addition, PGE operates other dams lower in the Clackamas basin including North Fork, Cazadero, Faraday, and River Mill Reservoirs. A new 45-year hydropower license was granted in 2011 for the Clackamas River Hydro Project (including the facilities in the Oak Grove watershed). The agreement includes new minimum flow releases below impoundments, a plan for improved fish habitat and passage, and other agreed upon elements. A component of the agreement is improved river flows and enhanced side channels below Lake Harriet in the Oak Grove Fork of the Clackamas.

Timothy Lake serves as the storage reservoir for the Oak Grove Fork Development. Water released from Timothy Lake Dam flows down the upper Oak Grove Fork. Approximately one mile downstream from Timothy Lake Dam, a portion of the river's flow is diverted into a pipeline at EWEB's Stone Creek Project. The Stone Creek Powerhouse discharges back to the Oak Grove Fork approximately 3.5 miles upstream of Lake Harriet. At Lake Harriet, water is again diverted into a pipeline which delivers water to the powerhouse at Three Lynx which discharges to the Clackamas River. The Oak Grove Powerhouse, pipeline, and Lake Harriet were completed in 1924. Frog Lake was built to allow peaking generation at the Oak Grove Powerhouse and was completed in 1953. Timothy Lake was completed in 1956 to improve power generation during low flow periods between September and April (PGE 2009).

The settlement agreement results in minimum releases of between 70 and 100 cubic feet per second (cfs) year-round at Lake Harriet. The effects on flows would be most significant at low flow periods (summer, early fall) when the channel was previously dewatered. This extra flow helps to lower temperature and increase dissolved oxygen levels over previous operations (PGE 2009).

3.3.1.4 Watershed Condition Framework

The Watershed Condition Framework (WCF) is a comprehensive approach for proactively implementing integrated restoration on priority watersheds on national forests and grasslands (USDA 2011a).

The WCF approaches watershed restoration by targeting the implementation of restoration activities in those watersheds that have been identified as priorities for restoration. The WCF also establishes a nationally consistent reconnaissance-level approach for classifying watershed condition, using a comprehensive set of 12 indicators that are surrogate variables representing the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition. Primary emphasis is on aquatic and terrestrial processes and conditions that Forest management activities can influence. The WCF provides an outcome-based performance measure for documenting improvement to watershed condition at forest, regional, and national scales.

Watershed condition classification is the process of describing watershed condition in terms of discrete categories (or classes) that reflect the level of watershed health or integrity.

Class 1 watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. These are considered to be functioning properly.

Class 2 watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. These are considered to be functioning at risk.

Class 3 watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. These are considered to have impaired function.

The watershed condition classification uses the 12 core national indicators, shown in the following table.

Aquatic Physical (Weight = 30%)	**Aquatic Biological** (Weight = 30%)	**Terrestrial Physical** (Weight = 30%)	**Terrestrial Biological** (Weight = 10%)
Water Quality Water Quantity Aquatic Habitat	Aquatic Biota Riparian/Wetland Vegetation	Roads & Trails Soils	Fire Regime or Wildfire Forest Cover Rangeland Vegetation Terrestrial Invasive Species Forest Health

Watershed condition classification maps and other information can be downloaded at

http://www.fs.fed.us/publications/watershed/

Summary of Watershed Condition Ratings for Subwatersheds in Grove Thinning Project in 2010

HUC	**Water Quality**	**Flow**	**AQ Habitat**	**AQ Total**	**Aquatic Biota Total**	**Aquatic Biological Total**	**Roads**	**Soils**	**Terr Phy. Total**	**Terr. Bio. Total**	**Overall Rating**
Cot Creek-Oak Grove Fork Clackamas River	1	2	2.33	1.8	1	1	3	1.7	2.3	1.3	Functioning at Risk*
Shellrock Creek - Oak Grove Fork Clackamas River	1	1	2.17	1.4	1	1	2.6	1.3	2	1	Functioning Properly
Anvil Creek-Oak Grove Fork Clackamas River	1	2	2	1.7	1	1	2.7	1.7	2.2	1	Functioning Properly
Three Lynx Creek-Middle Clackamas River	1	1	2.17	1.4	1	1	2.8	1.7	2.2	1	Functioning Properly

*It is assumed that operations associated with Oak Grove Hydropower Project have impacted a number of factors used to assess watershed condition and are partially responsible for the Functioning at Risk rating for the Cot Creek-Oak Grove Fork Clackamas River watershed. The Watershed Condition Assessment for the Cot Creek-Oak Grove Fork Clackamas River watershed was completed prior to the new 45-year hydropower license that was granted in 2011 for the Clackamas River Hydro Project (including the Oak Grove developments). The agreement includes new minimum flow releases below impoundments, a plan for improved fish habitat and passage, and other agreed upon elements. A component of the agreement is improved river flows and enhanced side channels below Lake Harriet in the Oak Grove Fork of the Clackamas River. With implementation of the agreement it is assumed that the Watershed Condition rating of the Cot Creek-Oak Grove Fork Clackamas River watershed would change from Functioning at Risk to Functioning Properly.

Watershed condition associated with the individual indicator of Roads is classified as poor for all the associated subwatersheds and Aquatic Habitat condition is classified as poor for Cot Creek Oak Grove Fork Clackamas River. The road indicator addresses changes to the hydrologic and sediment regimes due to the density, location, distribution, and maintenance of the road and trail network. The aquatic habitat indicator addresses habitat fragmentation, large woody debris, and channel shape and function.

3.3.1.5 The Clean Water Act and Best Management Practices

The Federal Clean Water Act (CWA) (33 U.S.C. § 1251 et seq.) is the foundation for surface water quality protection in the United States. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.

The Forest Service, as an agency of the Federal Government, is required to comply with all Federal, State, and local requirements for water pollution control in the same manner and to the same extent as any nongovernmental entity (CWA section 313) (USDA 2012b).

Section 303(d) of the CWA requires that water bodies violating State or tribal water quality standards be identified and placed on a 303(d) list. By direction of the CWA, where water quality is limited, DEQ develops Total Maximum Daily Load (TMDL) plans to improve water quality to support the beneficial uses of water. For water quality limited streams on National Forest System lands, the USDA Forest Service provides information, analysis, and site-specific planning efforts to support state processes to protect and restore water quality. The Clackamas Subbasin TMDL was approved by the Environmental Protection Agency on September 29, 2006. This TMDL among other issues addresses stream temperature in the project area.

The Forest Service strategy for control of nonpoint source pollution is to apply appropriate BMPs using adaptive management principles. This strategy involves applying approved BMPs, monitoring the implementation and effectiveness of the BMPs, and using the monitoring results to inform and improve management activities (USDA 2012b).

It is the responsibility of the Forest Service as a Federal land management agency through implementation of the Clean Water Act (CWA), to protect and restore the quality of public waters under their jurisdiction. Protecting water quality is addressed in several sections of the CWA including sections 303, 313, and 319. Best Management Practices (BMPs) are used to meet water quality standards (or water quality goals and objectives) under Section 319.

A Memorandum of Understanding (MOU) between the Regional Forester (Region 6) and the State of Oregon Department of Environmental Quality (DEQ) Director, was finalized in January 2014. It identified procedures for agencies to cooperatively implement Federal and State water quality regulations on National Forest System (NFS lands), meet State water quality standards and support beneficial uses of water (USDA 2014).

DEQ recognizes the Forest Service as the Designated Management Agency for water quality management on National Forest System lands. The agreement relies on the National Best Management Practices (BMP) program, Watershed Condition Framework, Land and Resource Management Plans, and Water Quality Restoration Plans (for impaired waters) as the primary mechanisms for compliance.

The DEQ:

- Sets water quality standards,
- Assesses water quality against those standards,
- Coordinates with the Forest Service on collection and interpretation of water quality data and list/de-listing decisions,
- Coordinates with the Forest Service on Total Maximum Daily Loads (maximum amount of pollution that water can receive and still meet standards) and Water Quality Restoration Plans for impaired waters,
- Provides technical assistance,
- Reviews and comments on Land and Resource Management Plans and projects,
- Requests Forest Service review of new rules,
- Issues permits, and
- Takes enforcement actions.

The Forest Service:

- Protects and restores water quality to meet federal and state water quality standards,
- Implements National BMPs (including associated monitoring and adaptation of BMPs),
- Implements the Watershed Condition Framework,
- Reviews national BMPs to determine the need for a Regional supplement,
- Provides technical assistance interpreting data, and
- For impaired waters, participates in TMDL development and implementation.

Site-specific Water Quality Best Management Practices, with the express purpose of limiting non-point source water pollution, are incorporated into the proposed action and associated project design criteria for this project.

BMPs were originally compiled from Forest Service manuals, handbooks, contract and permit provisions, and policy statements. BMPs were further refined to address recommendations in General Water Quality Best Management Practices, Pacific Northwest Region (USDA 1988). An analysis of ability to implement and effectiveness was conducted on the Forest in 2004 (USDA 2004). Finally BMPs were refined to meet National Best Management Practices for Water Quality Management on National Forest System Lands - Volume 1: National Core BMP Technical Guide (USDA 2012b).

The following is an excerpt from the National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide (USDA 2012b):

The National Core BMPs are deliberately general and nonprescriptive. Although some impacts may be thought of as characteristic of a management activity, the actual potential for a land use or management activity to impact water quality depends on:

1. The physical, biologic, meteorological, and hydrologic environment where the activity takes place (e.g., topography, physiography, precipitation, stream type, channel density, soil type, and vegetative cover).
2. The type of activity imposed on a given environment and the proximity of the activity area to surface waters.
3. The magnitude, intensity, duration, and timing of the activity.
4. The State designated beneficial uses of the water in proximity to the management activity and their relative sensitivity to the potential impacts associated with the activity.

These four factors vary throughout the lands administered by the Forest Service. It follows then, that the extent and kind of potential water quality impacts from activities on NFS lands are variable, as are the most appropriate mitigation and pollution control measures. No solution, prescription, method, or technique is best for all circumstances.

The National Core BMPs cannot include all possible practices or techniques to address the range of conditions and situations on all NFS lands. Each BMP has a list of recommended practices that should be used, as appropriate or when required, to meet the objective of the BMP. Not all recommended practices would be applicable in all settings, and there may be other practices not listed in the BMP that would work as well, or better, to meet the BMP objective in a given situation. The specific practices or methods to be applied to a particular project should be determined based on site evaluation, past experience, monitoring results, new techniques based on new research literature, and other requirements. State BMPs, Forest Service regional guidance, land management plans, BMP monitoring information, and professional judgment should be used to develop site-specific BMP prescriptions.

The Interdisciplinary Team has examined the applicable general National Core BMPs and developed more specific and prescriptive Project Design Criteria (PDCs) to implement the intent of the BMPs.

Some of the PDCs are standard practices and others were tailored specifically for this project based on site-specific conditions. They were developed based on many years of experience and an understanding of recent research. The team evaluated the PDCs and rated their "ability to implement" and "effectiveness." This analysis is in the water quality specialist report and is incorporated by reference. The analysis found that the PDCs had a moderate to high ability to implement and a moderate to high level of expected effectiveness, meaning that all practices would be implemented and effective at least 75% of the time. Past monitoring on the Clackamas River Ranger District indicated that PDCs were implemented as planned on 85% of the samples and were effective at avoiding impacts to water quality on 94% of the samples (See the water quality specialist report which summarizes data found in the Forest's annual monitoring reports available on the Forest's web site.)

3.3.1.6 Drinking Water

Approximately 400,000 people get water from the Clackamas River of which the Oak Grove Fork and Middle Clackamas watersheds are tributary, (Clackamas River Water Providers). The Grove Action Area only provides a fraction of this water since it is mixed into the water of several other rivers and streams before it reaches the water providers. The Collawash River joins the much larger Clackamas River just upstream of the Action Area. Downstream of this junction, the Clackamas River continues and is joined by many small streams plus the Oak Grove Fork, Fish Creek, Roaring River, South Fork Clackamas River and North Fork Clackamas River before reaching Estacada.

The project area contains the entire groundwater drinking water source areas for Lake Harriet Campground, Riverside Campground and Timberlake Job Corps Center. The project area also contains portions of the surface water drinking water source areas for The City of Estacada.

3.3.2 Water Quantity

The Oak Grove hydropower project affects peak and base flows in the Oak Grove Fork and Clackamas River. The area of greatest effect is the four mile reach of the Oak Grove Fork below Lake Harriet down to the confluence with the Clackamas

River, from there downstream about five-miles where diverted flows are returned to the river. With implementation of the new flow requirements below both Timothy and Harriet Lakes, the base flow regime more closely reflects the natural conditions of this system. The dams on this river system help to ameliorate peak flows that would normally be caused by flood events.

Changes in hydrologic processes associated with management activities can be grouped into two classes according to causal mechanisms. One class consists of change resulting from removing forest vegetation through harvest as measured by the Aggregate Recovery Percentage (ARP) methodology. A second class consists of changes in hydrologic processes consists of those that control infiltration and the flow of surface and subsurface water. This class is dominated by the effects of forest roads and is assessed using the Stream Drainage Network Extension Methodology.

3.3.2.1 Aggregate Recovery Percentage Methodology

The Aggregate Recovery Percentage (ARP) has been used to represent the proportion of a watershed in a 'hydrologically mature' condition. The model was originally developed to model hydrologic recovery for timber harvest operations where most of the forest canopy was removed, but has been adapted for partial forest canopy removal that occurs during forest thinning projects. By measuring the percent of an area in a hydrologically recovered condition, the ARP model evaluates the risk of increased peak flows from rain-on-snow events. In stands with little or no forest canopy within the transient snow zone, more snow accumulates than beneath a partially or fully hydrologically recovered forest.

The ARP model ranks recovery from 0 to 100, with 100 being fully recovered. Stands that have trees greater than 8 inches in diameter and over 70% canopy cover are considered hydrologically recovered. In the ARP model, stand age is used to determine whether stands meet these criteria. Recovery curves have been developed to model forest stand growth after either complete or partial removal of forest canopy, to determine when a forest stand has hydrologically recovered. A regeneration harvest would result in a stand that would be modeled at 0 % recovery, while a thinned stand would be modeled as having partial hydrologic recovery depending on the amount of forest canopy removed. As time goes by the stands would grow and recovery would gradually occur. Depending on the quality of site conditions, full hydrologic recovery may take approximately 35 years after regeneration harvest. Note: Hydrologic recovery is not the same a soil recovery; with no intervention, detrimentally disturbed soils may take longer to recover.

The 4,200-foot elevation line is generally considered the threshold for the transient snow zone in this area. The project area is below the 4,200-foot level. The transient snow zone is an area in the basin where precipitation frequently falls as snow but then may melt a few days or weeks later, a cycle that may be repeated several times each winter. Flooding can occur if heavy rain and warm temperatures occur simultaneously when snow has accumulated.

As timber harvest occurs either by complete or partial canopy removal, a portion of the watershed is no longer considered hydrologically mature if enough forest canopy is removed, thus the ARP for that drainage is reduced from 100% depending on the extent and intensity of timber harvest. 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. With higher levels of snow accumulation and increased rates of snowmelt in stands where sufficient canopy has been removed, there is the potential to 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 partially hydrologically immature condition, the potential for peak flows to be increased becomes greater. Over time, vegetation grows and a stand would return to a hydrologically recovered condition. Growth rates vary from very productive in earthflow areas (25 years to recovery) to slower growth in high elevation stands (40 years to recovery). An average of 35 years is used for the ARP analysis.

The ARP analysis also addresses many other factors including:

- All past timber harvest, road construction, rock quarries, and other openings such as power lines;
- Projects that are under contract but not yet completed;
- Recent wildfires;
- Roads that have been recently been decommissioned and others that are planned for the near future; (As these road beds begin to grow trees and close in, they would become hydrologically recovered but this process would take approximately 35 years for full recovery.)
- Other ownership; (In the Project area there is one private parcel of 52 acres owned by PGE. Past vegetation management is included but there are no foreseeable future timber harvest projects on this parcel.)
- Other foreseeable actions. (While it is likely that there would be thinning or other stand management in the future, there are no other current proposed actions to include in the ARP calculation at this time. Future actions cannot be known site specifically at this time. The appropriate consideration of cumulative effects for unspecified future project would be at the time an environmental analysis is conducted for those future projects.)

To calculate an estimated ARP, the acres of all of the forest stands by stand origination date were tallied in the subwatersheds. Subwatersheds are the same areas used for the Watershed Condition Framework Assessment. A spreadsheet was used to estimate hydrologic recovery for these stands assuming a 35 year period for a stand to reach full hydrologic recovery; when a stand has reached an average diameter of 8 inches and 70% canopy cover. All past harvests are included but recent timber sales (since 2000) and those not yet completed are tracked by project name.

3.3.2.2 Stream Drainage Network Extension Methodology

Changes in hydrologic processes that control infiltration and the flow of surface and subsurface water are dominated by the effects of forest roads. A hydrologically connected road is any road segment that, during a runoff event has a continuous surface flow path between any part of the road prism and a natural stream channel. In other words, a hydrologically-connected road becomes part of the stream network. Wherever a hydrologic connection exists, accelerated runoff sediments, and road-associated chemicals such as spills or oils generated on the road surface and cutslope have a direct route to the natural channel network and surface waters. The relatively impermeable surfaces of roads cause surface runoff that bypasses longer, slower subsurface flow routes. Where roads are insloped to a ditch, the ditch extends the drainage network, collects surface water from the road surface and subsurface water intercepted by roadcuts, and transports this water quickly to streams. These changes in hydrologic processes are assessed by estimating the extension of the stream drainage network associated with roads.

Based on research on two basins in the Western Cascades of Oregon, 57% of the road length is connected to the stream network by surface flowpaths including roadside ditches and gullies below road drainage culverts (Wemple 1996).

Water generated on the road prism can enter the natural stream channel network in a variety of ways (http://www.stream.fs.fed.us/news/streamnt/jul00/jul00_2.htm):

- Inboard ditches delivering runoff to a stream at a road-stream crossing
- Inboard ditches delivering runoff to a cross drain (culvert, dip, waterbar, etc.) where sufficient discharge is available to create a gully or sediment plume that extends to a stream channel
- Other cross-drainage features, such as waterbars or dips, that discharge sufficient water to create a gully and/or sediment plume that extends to a stream channel
- Roads sufficiently close to streams so that the fillslope encroaches on the stream, such as at road-stream crossings
- Landslide scars on the road-fill that expose bedrock and create a surface flow path to an adjacent channel.

For this analysis the key process of concern is associated with inboard ditches delivering runoff to a stream where a road intercepts the stream.

The increase in channel length due to the inboard ditch was calculated as the length of the ditch directly connected to the stream up to the next ditch relief structure.

In a study on the effects of forest roads on peak streamflows (LaMarche 2001) in the western slope of the Cascade Range in southwestern Washington, forest roads alone were predicted to have increased the mean annual flood in the subwatersheds from 2.2 to 9.5 percent, and from 2.9 to 12.2 percent for the ten year event. The largest increases associated with forest roads (without harvest) were roughly equivalent to those predicted for harvest, without roads. The predicted increases in floods due to roads generally increase with flood return period, while vegetation effects decrease. The effects of roads and harvest on peak flows at the drainage and subwatershed levels are essentially independent, and the combined effects on peak flows are therefore roughly additive.

The longevity of changes in hydrologic processes resulting from forest roads is as permanent as the road. Until a road is removed and natural drainage patterns are restored, the road would likely continue to affect the routing of water through watersheds (USDA 1993).

Modeling studies for Washington watersheds suggest an approximate doubling of the percentage change in peak flows attributed to harvest alone when road construction is included in the model (Grant 2008).

Since the effects of vegetation removal through harvest and roads are considered independent from each other and they are roughly additive they can be integrated when assessing management effects on peak streamflows within a watershed.

3.3.2.3 Water Quantity Existing Condition

Current level of hydrologic recovery in Grove Planning Area Subwatersheds

Name	ARP Percentage
Three Lynx Creek - Clackamas River	95.5
Cot Creek – Oak Grove	93.8
Shellrock Creek – Oak Grove	93.6
Anvil Creek – Oak Grove	91.9

The stands proposed for thinning are currently hydrologically recovered according to Forest Plan standards and guidelines because they are greater than 8 inches diameter and greater than 70% canopy cover. Because there has been relatively little regeneration harvest in the past two decades, the ARP levels in all the subwatersheds are continuing to increase by approximately 1% per year as young stands grow.

For the Northwest Forest Plan—the First 15 Years (1994–2008): Watershed Condition Status and Trend assessment (Lanigan, 2012) models were developed to assess the effect of vegetation change on hydrologic response, especially peak flows and their effects on channel morphology. All of the subwatersheds in the project area were found to be closer to the excellent condition for this parameter than the poor condition for the rain-on-snow transitions zone. Based on the model results the subwatersheds are in a condition where there are not any impacts expected based on the effect of vegetation change on hydrologic response, especially peak flows and their effects on channel morphology

Stream Drainage Network Extension Approximately 48 miles of roads have already been decommissioned in these subwatersheds. As these roads are decommissioned, natural drainage patterns would be re-established, reducing amount of the road drainage network increase in the watersheds where the road decommissioning occurs. It would take approximately 35 years for a decommissioned road to become hydrologically recovered.

Roads within the analysis area were examined to determine if the drainage network would be expanded from 1 or 2 directions. If the road grade dips into and rises out of the crossing the channel network would be expanded in two directions. If the road grades away from the stream crossing in one direction the channel network would be expanded in one direction. Most of the roads in the analysis meet the second criterion and expand the stream network in one direction. Based on experience with road decommissioning across the forest it was assumed that the average ditch relief culverts are spaced approximately 350 feet apart.

Stream Drainage Network Extension – Grove Project Area Subwatersheds

Subwatersheds	Stream Drainage Network Extension
Anvil Creek – Oak Grove	17%
Cot Creek – Oak Grove	15%
Shellrock Creek – Oak Grove	11%
Three Lynx Creek - Clackamas River (Only the portion overlapping the Action Area)*	12%
TOTAL	13%

*In order to focus on effects associated with the Grove Project, only the portion that overlaps the Action Area is included. This includes 13,669 acres of the 31,546 acre subwatershed. This partial subwatershed is used for all subsequent tables below.

It is generally accepted that based on considerations of gage and measurement error at high-flow events, a minimum detectable change in peak flow (detection limit) of ±10 percent for site-scale analysis. Percentage changes in peak flow that fall in this range are within the experimental and analytical error of flow measurement and cannot be ascribed as a treatment effect (Grant 2008). Since this process increases flow routing efficiency and may result in increased magnitude of peak stream flows, the 10% threshold is used to set a level of concern associated with this process. The table above shows the subwatersheds are at or above the 10% threshold of concern.

3.3.2.4 Water Quantity - Direct and Indirect Effects

No Action

The current ARP values indicate that all subwatersheds in the project area are approximately 92-95 percent hydrologically recovered. With the no action alternative, hydrologic recovery would gradually continue as young stands grow.

With no action, there would be no thinning but there would also be no road decommissioning or stormproofing. Since those roads would remain on the landscape they would continue to contribute to accelerated water movement and the stream drainage network extension would remain unchanged.

Compared to the proposed action, no action would not maintain or repair 85 miles of system roads including one stream crossing failure; it would not close and stormproof 11.61 miles of system roads; it would not decommission 4.64 miles of system roads; and it would not rehabilitate 1.82 miles of existing road alignments that were never actively decommissioned or rehabilitated including one culvert that was never removed. Therefore, the road related effects including the routing of water and sediment to streams associated with these areas would continue.

Proposed Action

The proposed action is dispersed over a wide landscape overlapping parts of four subwatersheds. The following table shows the reduction in ARP values associated with project implementation. The percent change figure includes the treatments that reduce canopy cover including variable density thinning as well landing, skid trail and temporary road construction.

ARP Values Associated with Implementation of the Proposed Action

Subwatershed	Acres Thinned	ARP Percentage - Current Condition	ARP Percentage - Proposed Action	Percent Reduction in ARP Associated With Implementing Proposed Action
Three Lynx Creek - Clackamas River	688	95.5	95.1	0.4
Cot Creek – Oak Grove	477	93.8	93.2	0.6
Shellrock Creek – Oak Grove	311	93.6	93.1	0.5
Anvil Creek – Oak Grove	280	91.9	91.6	0.3

With the relatively high existing levels of hydrologic recovery for these subwatersheds, the slight changes in ARP associated with the project would not likely cause stream channel instability or increases in peak flows during rain-on-snow events. With implementation of the proposed action all the subwatersheds would be below the 20% of an area harvested threshold where increases in peak streamflows are likely to be detectable (Grant 2008).

There would be slight reductions in stream channel network extension associated with the active road decommissioning that is part of this project. The slight change would not be enough to bring any of the subwatersheds below the 10% increase in the stream drainage network associated with the threshold of concern for this process. Since no temporary roads with road ditches are being constructed, there would be no stream channel network extension as a result of implementing this project.

Cumulative effects for water quantity are addressed in section 3.3.4.2.

3.3.3 Water Quality

Rivers, streams, and lakes within and downstream of the treatment areas are used for boating, fishing, swimming, and other water sports. Additionally, the Forest streams provide habitat and clean water for fish and other aquatic biota, each with specific water quality requirements. The Clean Water Act (CWA) protects water quality for all of these uses (s. 3.3.1.5).

The Forest developed a Water Quality Restoration Plan (WQRP) to serve as the TMDL Implementation Plan for the Willamette Basin TMDL. Under the WQRP the protection and recovery of water quality depends on implementation of the Forest Plan as amended. Key to this strategy are the standards and guidelines and the Aquatic Conservation Strategy (ACS) objectives for the protection, restoration, and active management of riparian areas.

The table below details the water quality status of streams in the project area with respect to sediment, temperature and biological criteria associated Oregon's 2010 Integrated Report Assessment Database and 303(d) List. There are no Section 303(d) listed streams in or adjacent to the project area.

Water Quality Status -Oregon's 2010 Integrated Report Assessment Database

Water Body (Stream/Lake)	**River Miles**	**Parameter**	**Status**
Bull Creek	0 to 2.5	Sedimentation	Insufficient data
Clackamas River	0 to 83.2	Biological Criteria	Impairing pollutant unknown
Clackamas River	55.7 to 83.1	Temperature	Attaining
Dinger Creek	0 to 4.4	Sedimentation	Insufficient data
John Creek	0 to 2	Sedimentation	Insufficient data
Kink Creek	0 to 2.6	Sedimentation	Insufficient data
Oak Grove Fork Clackamas River	0 to 24.7	Biological Criteria	Potential concern
Oak Grove Fork Clackamas River	0 to 15.7	Temperature	Attaining

Water Body (Stream/Lake)	River Miles	Parameter	Status
Oak Grove Fork Clackamas River / Unnamed Lake	15.7 to 17.9	Sedimentation	Insufficient data
Shellrock Creek	0 to 6.9	Sedimentation	Insufficient data

3.3.3.1 Stream Temperature Methodology

Vegetation removal near water bodies has the potential of increasing solar radiation to surface water which in turn may increase water temperature. The following analysis utilizes tools contained within the *Northwest Forest Plan Temperature TMDL Implementation Strategies: Evaluation of the Northwest Forest Plan Aquatic Conservation Strategy and Associated Tools* (2012) document to identify necessary shade so that stream temperatures within treatment areas would not increase as a result of the proposed vegetation treatments. This document is the result of work between the USFS and the BLM and identifies how to maintain sufficient stream shading to meet the Clean Water Act while providing the opportunity to treat Riparian Reserve vegetation to improve riparian conditions. The State of Oregon DEQ conditionally approved the Strategy in September 2005 as the temperature TMDL implementation mechanism under the Clean Water Act.

The concept of the sufficiency analysis is to maintain a primary shade zone of vegetation next to the stream and identify a secondary shade zone and other areas within the Riparian Reserves further away from the stream that can be treated to reach Riparian Reserve Objectives while maintaining stream temperatures. The size of this zone is dependent on the current height of the trees and the hill slope. This relationship is shown in the table below.

TREE HEIGHT	Hill Slope <30 %	Hill Slope 30 to 60 %	Hillslope >60 %
Trees < 20 feet	12 feet	14 feet	15 feet
Trees 20 to 60 feet	28 feet	33 feet	55 feet
Trees >60 to 100 feet	50 feet	55 feet	60 feet
Trees >100 to 140 feet	70 feet	75 feet	85 feet

As an example, in stands where the hill slopes are between 30% and 60% and existing tree heights are over 100 feet, the strategy would suggest a primary shade zone of 75 feet.

Stream temperature data from the summer of 2013 indicate that the minimum flow releases in the Oak Grove Fork resulted in stream temperatures that meet the Oregon DEQ standards.

RAPID Stream Shade Assessment Model

Vegetation removal near water bodies has the potential of increasing solar radiation to surface water which in turn may increase water temperature so the RAPID Stream Shade Assessment Model was used to compare average existing shade to average potential shade in the project area.

RAPID is a shade model that runs in ArcGIS that was developed to complete a shade assessment at the watershed level and identify potential restoration sites. The model uses vegetation databases developed by the Landscape Ecology, Modeling, Mapping and Analysis (LEMMA) group at the USFS Pacific Northwest Research Station and Oregon State University, the vegetation dataset is based on 2006 imagery. The utility of the model is to automate and streamline a shade assessment at the watershed scale for the preparation of Water Quality Restoration Plans (RAPID Tool Documentation).

The RAPID Stream Shade Assessment Model is based on the Shadow Model that was developed to predict temperature increases from management activity. Five inputs are needed for Shadow including: tree height, stream width, stream orientation, side slope, and canopy closure (Stockdale 2013).

Some of the model assumptions indicate the stream buffer providing shade is 150 feet from stream. This better represents the vegetation height, and averages out errors associated with satellite imagery. Side slope with an aspect azimuth between 270 and 90 degrees (north) provides shade to the stream (Stockdale 2013).

3.3.3.2 Stream Temperature – Existing Condition

Within the project area the following standards apply associated with stream temperature (Oregon Administrative Rule (OAR) 340-041-0028 Temperature)

13.0°C during times and at locations of salmon and steelhead spawning.
16.0°C during times and at locations of core cold water habitat identification.
18.0°C during times and at locations of salmon and trout rearing and migration

In the past, before flows below the Lake Harriet diversion were restored, stream temperature standards were exceeded in the dewatered sections. In the Oak Grove Fork downstream of Lake Harriet to the confluence with the Clackamas River monitoring completed by PGE indicated violations of the stream temperature numeric criteria during both rearing and spawning periods (16 and 13 degrees Celsius, respectively). In the Clackamas River from the Oak Grove Fork to the Oak Grove Powerhouse PGE monitoring indicated that water temperatures exceed the numeric criterion often during summer, and occasionally during the spawning season.

Stream temperature was modeled for these river reaches to predict future temperatures based on increased minimum flows associated with the settlement agreement for the Clackamas Hydropower Project. This modeling shows that the new minimum flows reduce water temperatures to the point where there are no longer concerns for water temperature in either the Oak Grove Fork or the Clackamas River between the confluence of the Oak Grove Fork and the Oak Grove powerhouse. Since the flow has been restored, anadromous fish have been observed spawning in the Oak Grove Fork.

After running the RAPID Stream Shade Assessment Model, the following existing conditions were identified:

Subwatershed	Average Existing Shade %	Average Potential Shade %
Three Lynx Creek-Clackamas River	73	75
Cot Creek-Oak Grove Fork	72	74
Anvil Creek-Oak Grove Fork	67	70
Shellrock Creek - Oak Grove Fork	74	77

As detailed in the table all the subwatersheds associated with the Grove thin project are within 3% of the average potential shade for the area.

3.3.3.3 Stream Temperature – Direct and Indirect Effects

No Action Alternative

Stream temperatures would remain unchanged from predicted levels in the watershed because there would be adequate streamside shade.

Proposed Action

This alternative proposes to thin trees within the dry upland portion of Riparian Reserves. The canopy closure at the prescribed rate of thinning would range from 63 to 76% based on stand exam data and FVS modeling (USDA 2009a and Fiala 2006). This represents an average for the portion of the unit outside the protection buffer. The canopy closure within the stream protection buffer would be similar to the current condition which ranges from 84 to 88%. While canopy closure is not equivalent to shade, they are closely correlated. Other factors that affect shade include the stream orientation, stream width and the stand’s aspect and slope. Some shade is also provided by streamside shrubs which are not modeled by FVS.

Within the stream protection buffer zone of certain thinning units, some second-growth trees would be felled into streams to provide in stream structure.

Treatment is proposed for units 8, 94, 186, 190, 203 and 204. Live trees would be felled or pushed/pulled over to meet the desired frequency of 20 trees per 1,000 lineal feet of stream. Approximately 41 live trees would be added. A fisheries biologist would select the trees to fell from areas that are fully stocked with trees and would avoid unstable areas or areas with a high water table. Since the trees to be felled into the stream are from areas that are fully stocked at rates that replicate natural mortality rates, no impacts to stream shade is anticipated associated with this activity.

The TMDL strategy was used to develop the stream protection buffers listed in the PDC section at section 1.4.9.A1. Sufficient shade would be provided in the primary and secondary shade zones adjacent to streams so that there would be no increase in stream temperature resulting from implementation of this project. The project would meet the Clean Water Act standards for water temperature.

Some areas were also assessed using Oregon Department of Environmental Qualities Shade-a-lator model which uses site-specific measurements to predict shade. The model results confirmed that buffer widths associated with the TMDL strategy would protect existing effective shade.

The Fisheries Biological Assessment found that the buffer widths would not likely affect listed fish (see section 3.4).

3.3.3.4 Sediment Methodology

Sediment yield associated with the existing road system was estimated using methodologies described in the Washington Road Surface Erosion Model (WARSEM) (Dubé, 2004).

This model was selected because

- It allows for standardized calculations of road surface erosion
- Geology, climate, and management practices from Washington are similar to those in the project area
- It has the ability to determine reduction in sediment delivery resulting from applying Best Management Practices (BMPs) to road segments
- In a study in the Oregon Coast Range near Corvallis, Amann (2004) measured runoff and sediment yield from nine road segments in the Oak Creek watershed, Oregon. Measured values were compared to the WEPP:Road Model and SEDMODL2 predictions of annual sediment yield. He concluded that WEPP:Road was easy to use but overestimated sediment production, and SEDMODL2 was more difficult to use but provided closer estimates of sediment yield. SEDMODL2 calculations were used as the basis of Washington Department of Natural Resource's WARSEM model that lets users calculate road surface erosion with or without the GIS interface.

Presentation of the WARSEM model results are intended to provide a means of comparing existing conditions with the proposed project in which both existing and proposed actions utilize the same assumptions and to give a comparison in broad terms of natural to management related sediment yields within the Grove Thin Project area. The WARSEM manual states: It is appropriate to look at the relative differences in erosion estimates when comparing watershed areas or road segments, but the sediment values in tons/year should always be regarded as estimates not absolute values. Any predicted runoff or erosion value--by any model--would be, at best, within plus or minus 50 percent of the true value. Erosion rates are highly variable, and the models predict only a single value. Replicated research has shown that observed erosion values vary widely for identical plots and for the same plot from year to year (Elliot 2000).

3.3.3.5 Sediment– Existing Condition

Turbidity is rarely a problem in the Clackamas River or Oak Grove Fork because high gradient and high energy streams effectively route sediment out of the system. There are, however, areas of concern: management on earthflow areas, mid-slope roads built with side cast methods, flood damage, roads paralleling streams, the design and spacing of ditch relief culverts, and past intensive riparian harvest have been identified in both Watershed Analyses as sources of suspended sediment. Erosion is the primary cause of high levels of suspended sediment, turbidity and embeddedness.

Available data for turbidity and sedimentation are relatively low values, corroborating that there are no ongoing problems with turbidity (PGE 2009) or sedimentation in the Oak Grove Fork.

The streams in the project area appear clear except during storms when turbidity levels increase as expected due to natural processes of sediment movement during high flow events. Timothy Lake is relatively clear. The settling process which occurs within Timothy Lake and to a lesser extent in Lake Harriet would tend to decrease turbidity levels during high flow events in this system.

Water quality and sediment delivery are directly influenced by upstream events. This process is best displayed at the confluence of the Clackamas River and Collawash River. During winter storm events turbidity levels are much greater in the Collawash. The Clackamas River runs much clearer (USDA 1996b).

Several streams in the project area flow through earthflow zones. Earthflow landforms consist of weathered pyroclastic material. There is more detail on earthflows in the Geology section 3.5. This material tends to weather quickly, its composition is high in clay, the soil holds large quantities of water, and stream banks can be unstable. Streams flowing through earthflows typically have a large floodplain relative to the channel's width, the substrate is high in silt, stream banks are not well defined, pools are poorly formed, readily filling in after scouring, and there are more alders and vegetation, such as grasses and skunk cabbage near the banks. Streams in earthflow zones typically have different characteristics than streams in other landforms, such as lower gradient and lower velocity. They have less scouring potential, less flushing potential and streams tend to deposit more sediment in the channel (USDA 1996a).

In channel fine sediment was evaluated based on stream surveys that have been completed in the project area (on streams that were surveyed after 1995). Portions of Kelley, John and Chief Creeks were identified with excessive levels of fine sediment. Out of the 84 miles of streams that were surveyed 1.9 miles were identified with excessive sediment.

Unstable stream banks have the potential to directly deliver sediment to the stream system. Stream surveys conducted in the project area indicate limited areas of unstable stream banks. Many of the stream surveys indicated no area of unstable stream banks. Areas with greater than 5% unstable stream banks include portions of Butte, Mag and Shellrock Creeks. Approximately 7 miles of the 84 total miles surveyed (8%) were identified as unstable.

Using sediment delivery rates from undisturbed forested areas in an area classified as an unstable zone in the H.J. Andrews Experimental Forest (Swanson 1975). The following table shows estimated sediment delivery from similar unstable zones (areas classified as high landslide risk).

Natural Background Levels of Sediment Yield

Subwatersheds	Estimated Natural Background from Slides (tons per year)
Anvil – Oak Grove	602
Cot – Oak Grove	941
Shellrock – Oak Grove	657
Three Lynx - Clackamas River	3,756
Total	5,956

Another potential source of coarse and fine sediment to surface water in the area is roads. Road networks in many upland areas of the Pacific Northwest are the most important source of management-accelerated delivery of sediment to streams. The sediment contribution to streams from roads is often much greater than that from all other land management activities combined, including log skidding and yarding. Road related landsliding, surface erosion and stream channel diversions frequently deliver large quantities of sediment to steams, both chronically and catastrophically during large storms. Roads may have unavoidable effects on streams, no matter how well they are located, designed or maintained. Many older roads with poor locations and inadequate drainage control and maintenance pose high risks of erosion and sedimentation of stream habitats (USDA 1993).

The following table estimates sediment delivery using the WARSEM model.

Estimated Sediment Yield from the Existing Road System

Subwatersheds	Estimated tons of Sediment Delivery per year from Roads
Anvil – Oak Grove	759
Cot – Oak Grove	406
Shellrock – Oak Grove	243
Three Lynx - Clackamas River	264
TOTAL	1,671

3.3.3.6 Sediment – Direct and Indirect Effects

No Action Alternative

Sediment delivery to streams in the project area would remain at current level or may increase associated with the deteriorating road network. The current road network would see minimal levels of maintenance associated with reduced funding levels and may pose a risk of failure and may contribute sediment to streams. With no action, there would be no road decommissioning or stormproofing. Since those roads would remain on the landscape they could potentially contribute to sedimentation. Ground vegetation that impedes erosion and sediment delivery would continue to grow.

Compared to the proposed action, no action would not maintain or repair 85 miles of system roads including one stream crossing failure; it would not close and stormproof 11.61 miles of system roads; it would not decommission 4.64 miles of system roads; and it would not rehabilitate 1.82 miles of existing road alignments that were never actively decommissioned or rehabilitated including one culvert that was never removed. Therefore, the road related effects including the routing of sediment to streams associated with these areas would continue.

Proposed Action

Some ground disturbing activities in this alternative have the potential to dislodge soil particles which in turn may increase erosion. These activities include new temporary roads, landings, skid trails, yarding corridors, in-stream large wood enhancement, burn piles, and areas of road maintenance and repair. A detailed discussion of soil erosion is contained in the soils section (3.6). Levels of erosion or sediment delivery would be small due to implementation of Best Management Practices (BMP) and Project Design Criteria (PDC) which include reusing existing skid trails and landings, maintaining protective groundcover, restricting ground-based equipment to appropriate slopes, and application of seed and mulch on disturbed soils. Stream protection buffers and the additional equipment restriction provide an effective filtration zone that keeps most erosion from reaching streams.

Changes in hydrologic processes that affect erosion and sedimentation are dominated by the effects of forest roads. The potential for landscape-scale road decommissioning is discussed in section 1.6.1.6. While many areas have roads that could be analyzed for decommissioning at a future date, this project only includes a relatively small amount of decommissioning, involving only those roads that access thinning units. Even though the area has relatively high road density, the landscape-scale road decommissioning effort was deferred because the watershed has relatively low aquatic risk compared to other watersheds that were funded.

Lengths of temporary road construction and reconstruction, system road maintenance, repair and decommissioning and system road conversion to maintenance level 1 are summarized in section 1.4.7.

Road maintenance prior to log haul would help maintain the designed drainage of the road surface, ditches and culverts which reduce the potential for sediment inputs. This includes the placement of new aggregate surfacing where necessary, blading, removing debris, brushing out encroaching vegetation, removing berms, and ditch and culvert inlet cleanout where needed. Aggregate road surfacing can minimize the amount of fine sediment from road surfaces entering streams following log haul, especially during and following rainfall events. Ground disturbing road maintenance activities would be limited to the dry season (generally June 1 to October 31 dependent upon soil moisture and weather conditions).

Some road maintenance activities have the potential to increase road related erosion and sediment during rainfall events. This increase is associated primarily with blading, ditch cleaning and culvert cleaning on aggregate and native surface roads although ditch cleaning associated with paved roads is a potential sediment source. Implementation of PDCs that include installation of erosion control measures to minimize or eliminate sediment introduction into streams would further reduce the risk of sediment introduction. Any sediment delivered to streams during these activities would be minimal, short-term duration, and undetectable at a subwatershed or watershed scale. The probability of any degradation to water quality or fisheries resources caused by sedimentation due to road construction, reconstruction and maintenance is extremely low.

Log hauling would not measurably increase the amount of fine sediment in streams. The roads along the haul route have for the most part well vegetated road ditchlines that allow any eroded soil to be stored adjacent to the roads. The potential for sediment input into streams along the haul routes would further be minimized by permitting haul only when conditions would prevent sediment delivery to streams. PDCs restrict log hauling when necessary to minimize water quality degradation. Haul would be stopped if there is rutting of the road surface or a noticeable increase in the turbidity of water draining to the road ditches or at stream crossings. The majority of these crossings are at intermittent or small perennial streams that would have very little flow during the normal season of operation. These channels also have numerous natural roughness elements such as woody material and boulders that would store sediment near the point of origin.

Temporary road work includes construction of 0.2 miles of temporary roads and re-opening 5.35 miles of existing road alignments as temporary roads. None of the proposed new roads are in Riparian Reserves. Some of the temporary road alignments reopened, cross through Riparian Reserves but none of these have associated stream crossings (there is one seep associated with a temporary road in unit 196). With the implementation of PDCs associated with the location of temporary roads and erosion control measures to prevent movement of disturbed or exposed soil, there would be a very low probability of any sediment from temporary road surfaces reaching streams. The new temporary roads and re-opened alignments would be rehabilitated and revegetated immediately following completion of harvest operations to help reduce compaction, increase infiltration rates, minimize surface erosion, and re-establish natural drainage patterns.

Active road decommissioning and stormproofing would reduce chronic sediment delivery, restore hillslope hydrology and reduce sediment impacts associated with the potential catastrophic failure of stream crossings during storm events.

Sediment yield associated with the temporary roads was estimated using methodologies from the Washington Road Surface Erosion Model (WARSEM).

Sediment Yield Associated with Temporary Roads

Subwatershed	Estimated Increased Sediment Yield (tons per year)
Anvil – Oak Grove	0.5
Cot – Oak Grove	0.0
Shellrock – Oak Grove	0.5
Three Lynx - Clackamas River	6.6
TOTAL	7.6

The increased sediment yield was modeled for the year of activity. It was modeled as if all roads would be constructed in the same year when in actuality the construction activities associated with the temporary roads would most likely be spread out over several years as different harvest units are accessed. Sediment from these roads would continue to accrue in subsequent years but the level of sediment predicted for the year of activity would gradually taper off as a result of ground cover placed on road surfaces and as vegetation regrows.

Changes in the road network in the project area associated with closing and decommissioning roads results in reductions in sediment yield based on estimates using WARSEM. These changes would be realized as road work is completed and erosion control groundcover is installed.

Research from the Rocky Mountain Research Station indicates an initial reduction of 64% in fine sediment delivery and a post-large-storm-event reduction of 80% in fine sediment delivery associated with road decommissioning (Nelson 2012).

Reduction in Sediment Yield associated with Road Closures and Decommissioning

Subwatershed	Estimated Decreased Sediment Yield (tons per year)
Anvil – Oak Grove	0.0
Cot – Oak Grove	9.0
Shellrock – Oak Grove	0.4
Three Lynx - Clackamas River	4.9
TOTAL	14.2

When the net change in sediment yield (tons per year) associated with increases from temporary road construction and decreases associated with road decommissioning and road closures is calculated there is an estimated net reduction of 6.6 tons per year in the subwatersheds associated with the Grove Thin Project.

Net Changes in Sediment Yield Associated with Temporary Roads and Road Closure and Decommissioning

Subwatershed	Estimated Net Change in Sediment Yield (tons per year)
Anvil – Oak Grove	+0.5
Cot – Oak Grove	-9.0
Shellrock – Oak Grove	+0.1
Three Lynx - Clackamas River	+1.7
TOTAL	-6.6

The table below compares all quantified sources of sediment that were estimated (these comparisons should only be used a broad sense to understand the differences in scale between the different sources). Over the whole project area there is an estimated net reduction in sediment yield associated with project implementation, however there are slight increases predicted in Anvil, Shellrock, and Three Lynx subwatersheds. These increases are very small when compared to estimated natural background levels (all subwatersheds are less than 0.1% of the natural background from slides). Under natural conditions the stream channels in this area have developed to process large amounts of sediment associated with the natural background level from slides.

Estimated Levels of Sediment Yield from Modeled Sources

Subwatershed	Estimated Natural Background from Slides (tons per year)	Estimated Delivery from the existing road system (tons per year)	Estimated Increased Delivery from Temporary Roads (tons per year in the year of activity)	Estimated Decreased Delivery from Decommissioning and Closing Roads (tons per year)	Estimated Net Change in Sediment Yield (tons per year)
Anvil – Oak Grove	602	759	0.5	0.0	+0.5
Cot – Oak Grove	941	406	0.0	9.0	-9.0
Shellrock – Oak Grove	657	243	0.5	0.4	+0.1
Three Lynx - Clackamas River	3,756	264	6.6	4.9	+1.7
TOTAL	5,956	1,671	7.6	14.2	-6.6

The levels of sediment associated with temporary road construction and use represent an increase of 0.1% over the existing condition for the watershed. This would be more than compensated with reduced sediment from road decommissioning and stormproofing; the project as a whole would have a net reduction of 0.1% over existing conditions. This level would not likely be detectable at the subwatershed or watershed scale.

The temporary roads would be decommissioned and revegetated immediately following completion of harvest operations to help reduce compaction, increase infiltration rates, minimize surface erosion, and re-establish natural drainage patterns. Decompacting the road surface during decommissioning or rehabilitation activities loosens the soil, thus making it more likely to be mobilized during the first significant run-off period unless the road is on relatively flat terrain, not near streams, or sufficient ground cover (mulch, woody debris, etc.) is provided. Since there is culvert removal associated with the proposed decommissioning activities there is the potential to deliver sediment into stream channels during project implementation. Road rehabilitation near streams would have short-term, construction-related effects. These projects may cause a short-term degradation of water quality due to sediment input and turbidity. Streambank condition and habitat substrate may also be adversely affected. This would be a short-term effect since turbid conditions would dissipate soon after the in-stream work phase was completed, generally in a few hours. However with careful project design and PDCs such as erosion control, these effects are expected to be of a limited extent and duration.

Project design criteria and associated BMPs for road rehabilitation and decommissioning would reduce the risk of sediment entering any stream course. The impacts to water quality caused by sedimentation due to road construction, reconstruction, maintenance, or road decommissioning, if any, would be short-term and undetectable at the watershed scale.

Timber harvest alone rarely initiated large amounts of runoff and surface erosion, particularly when newer harvest practices were utilized (Litschert 2009). Sediment delivery from timber harvest may be further reduced by locating skid trails away from streams, maintaining high surface roughness downslope of water bars, and promptly decommissioning skid trails following harvest. PDCs would require skid trails to be located away from streams, they would have erosion control measures such as water bar placement, hillslope contouring, creating small ditches or diversions to redirect surface water movement, scattering slash on disturbed soils, placement of mulch, and application of approved seed. Effective ground cover would be installed prior to October 1 of each year. The coverage of effective ground cover would be sufficient to prevent off-site movement of soils as guided by Forest Plan standard and guideline FW-025 and by Forest Service Handbook 2509 (R6 supplement); and maintain high surface roughness downslope of water bars.

The ability of PDCs to reduce erosion and sediment delivery is documented in Effectiveness Of Timber Harvest Practices For Controlling Sediment Related Water Quality Impacts (Rashin 2006). In this study, the authors looked at 21 harvest sites that had a variety of treatments ranging from no buffers to buffers up to 66 meters wide. They found that, “Of 157 individual erosion features determined to deliver sediment to streams during either the first or second year following timber harvest, 94 percent were located within 10 meters of the stream. Conversely, 74 percent of the 248 erosion features with no evidence of sediment delivery were greater than 10 meters from streams.” Other studies also support the effectiveness of mitigating sediment delivery by maintaining a buffered area adjacent to surface water. Lakel (2010) looked at the effectiveness of a variety of treated and untreated buffers in trapping sediment adjacent to timber harvest units. This study concluded that streamside management zones (buffers) between 25’ and 100’ were effective in trapping sediment before it could enter streams. These streamside management zones consisted of both treated and untreated areas. The study also found that thinning within buffers was an appropriate forest management tool, “because the practice did not significantly increase erosion.”

Other studies also support the effectiveness of mitigating sediment delivery by maintaining a buffered area adjacent to surface water. Burroughs (1989) found that 80% of sediment reaching streams from roads in the first year after construction came from the fill slope of the road. This study also found that transport distances and obstructions between the fill slopes and streams influenced the amount and likelihood of eroded material reaching these streams. Burroughs found that windrowed fill slopes, which would act very similar to unharvested stream buffers in that there would be obstructions to flow, had an average travel distance of 3.8 feet for eroded material, and a maximum travel distance of 33 feet. Similar results were documented by Packer (1967). He found that “the most important factors that affect the distance that sediment moves are the spacing between down slope obstructions and an interaction between this spacing and the kind of obstruction.” He found that logs, rocks, and trees or stumps were the second, third, and fourth most effective materials in reducing sediment movement distances below roads. Travel distances were similar to those reported by Burroughs.

Design criteria that include undisturbed vegetative buffers of at least 70 feet along perennial streams and 30 feet along intermittent streams, with an additional buffer where only low impact harvesting equipment would be allowed, use of erosion control where necessary, and lower impact road maintenance techniques (leaving vegetated buffer strips in ditchlines near streams) would substantially reduce the amount of sediment reaching the streams from this work. Burroughs (1989) reported that measures such as erosion control blankets alone could reduce sediment production by 80 to 90 percent. This in conjunction with other measures such as minimizing the amount of ground disturbance and seeding these areas would further decrease the chance of short-term direct and indirect sediment production. With PDCs, new temporary roads, landings, skid trails, yarding corridors, road maintenance, road repair work, and road decommissioning and rehabilitation are expected to have minimal effect on sedimentation.

The Biological Assessment found that the project with PDCs for erosion and sedimentation prevention were effective and would not likely adversely affect listed fish (s. 3.4.6).

3.3.4 Cumulative Effects for Water Quantity and Quality

Four subwatersheds are used as the analysis area for cumulative effects: Three Lynx Creek - Clackamas River, Cot Creek – Oak Grove Fork, Shellrock Creek – Oak Grove Fork, and Anvil Creek – Oak Grove Fork. This area encompasses 77,222 acres. It incorporates the Clackamas River over five miles downstream of the Grove units which is far enough that direct effects from the Grove project would not likely be measurable.

The time frame used to include or exclude actions varies by the type of action. Some impacts are considered permanent with no modeled recovery including permanent roads, quarries and the power line and pipeline rights-of-way. Some impacts such as regeneration harvest would recover gradually over approximately 35 years.

Because several actions have the potential to impact water quantity, the ARP model was used to describe cumulative effects. Past disturbances within the affected subwatersheds are the most substantial contribution to reductions in hydrologic recovery associated with the ARP model, and include fires, timber harvest, quarries, power line and pipeline right-of-way clearing and road construction. There are several ongoing thinning projects within the analysis area that are included in the analysis of cumulative effects. The projects are Beluga-Orca (374 ac.), Jelly (48 ac.), Pink (141 ac.), Quarry (252 ac.), Reel (226 ac.), Rod (275 ac.), Rotor (281 ac.), Swag (228 ac.) and Tuba (88 ac.) for a total of 1,913 acres. The analysis also tracks projects by name that were implemented between 2000 and the present. The analysis includes harvest before 2000 even though it is not tracked by name. Harvest that has occurred on the 52 acres of private land is also included. There are no other foreseeable future projects on the Forest to consider other than those already discussed. While there may be future logging or other management within the watershed, there are no current proposals with sufficient site specificity to conduct an analysis.

In terms of water quality, the following restorations have cumulatively contributed to a trend of stable or improving aquatic conditions in the project area:

- In-stream restoration projects including the reconnection of side channels, and the addition of wood and boulders.
- Replacing undersized culverts with larger ones that allow improved fish passage and the ability to withstand larger flood events.
- Decommissioning of roads.
- Managing riparian reserves for shade, large wood recruitment, and the development of late-successional conditions.
- Managing Off-Highway Vehicle use to avoid erosion near sensitive streams.
- Changing the management of the Oak Grove Hydro project to ameliorate impacts.

There are foreseeable restoration actions in the action area that are in the planning phase including the 2014 Clackamas Restoration EA which includes approximately 2 miles of system road decommissioning. Also included are the potential cumulative effects and benefits of the Oak Grove Hydroelectric operations and restoration projects associated with the hydroelectric relicensing. These include:

- Gravel deposition to increase spawning habitat, and generally initiate restoration of geomorphic and ecological processes. This project would add approximately 2,200-3,000 tons of gravel during the first three years of the license in the Oak Grove Fork downstream of the barrier falls.
- Side channel construction. This project would provide permanent connections to 40,000 ft^2 of side channels in the Lower Oak Grove Fork.

Other projects that are assessed for potential contribution to cumulative effects for water quality include: danger tree removal, ongoing road maintenance, recreation uses, and maintenance of the BPA power line right-of-way.

3.3.4.1 Past, Present and Foreseeable Projects

The table below provides a qualitative summary of potential cumulative watershed effects. It shows ongoing and potential projects, and whether these projects overlap in time or space with Grove Thinning.

Project	Topic	Overlap in Time	Overlap in Space	Comments
Existing Old Regeneration Timber Harvest Units	Sediment	No	Yes	Most regeneration harvests in the project area happened 20 to 60 years ago with one as recent as 10 years ago. Due to the regrowth of vegetation and ground cover, there are few remaining effects to sediment or water temperature. Stands less than 35 years old have an effect on hydrologic recovery and are included in the analysis.
	Stream Temperature	No	Yes	
	Water Quantity	Yes	Yes	
Ongoing Thinning	Sediment	Yes	Yes	There may be an overlap in timing of these projects with the Grove Thin Project. Any suspended sediment would be minor in scope for each project and would not likely be measurable due to implementation of PDCs in each project that are designed to minimize erosion, and conformance with existing standards and guidelines on both the ongoing projects and the Grove Thin Project. Of the recent and ongoing projects listed below, only Swag uses the same haul roads as Grove.
	Stream Temperature	Yes	Yes	Each thinning has PDCs that provide stream protection buffers to provide shade.
	Water Quantity	Yes	Yes	Because each thinning project has an effect on hydrologic recovery, they are included in the analysis.
Ongoing Hazard Tree Removal	Sediment	Yes	Yes	Felling danger trees rarely results in ground disturbance or erosion. Any widely scattered small increases in fine sediment would not likely be detectable at the watershed or subwatershed scales.
	Stream Temperature	Yes	Yes	Some danger trees would likely be felled near streams. Minor reductions of stream shade are reasonably certain to occur in a small number of areas scattered throughout the action area. Any widely scattered small increases in stream temperature would not likely be detectable at the watershed or subwatershed scales.
	Water Quantity	Yes	Yes	Hazard trees are typically widely scattered along roads. Their removal would not impact ARP values because canopy cover of stands would likely remain above the 70% threshold.
Oak Grove Hydroelectric Project, Ongoing Operations	Sediment	Yes	Yes	Most operations do not contribute to increased turbidity levels. There is a potential for the construction activities proposed under the new license to result in short-term turbidity increases as the facility is reconfigured for increased minimum flows. This construction would be completed before Grove Thin units are harvested. PDCs are in place so any turbidity and associated sediment deposition should be minimal and not result in detectable levels of sediment.
	Stream Temperature	Yes	Yes	PDCs are in place so the project would comply with temperature standards. New minimum flow levels have been established.
	Water Quantity	Yes	Yes	With implementation of the new flow requirements below both Timothy Lake and Lake Harriet the base flow and peak flow regimes would more closely reflect the natural conditions of this system.
Oak Grove Fork Project Restoration – Gravel Deposition	Sediment	Yes	Yes	The restoration project is designed to increase spawning habitat, and generally initiate restoration of geomorphic and ecological processes. This project has PDCs in place to avoid detrimental impacts associated with fine sediment deposition.
	Stream Temperature	Yes	Yes	No impacts to stream temperature associated with implementation of this project.

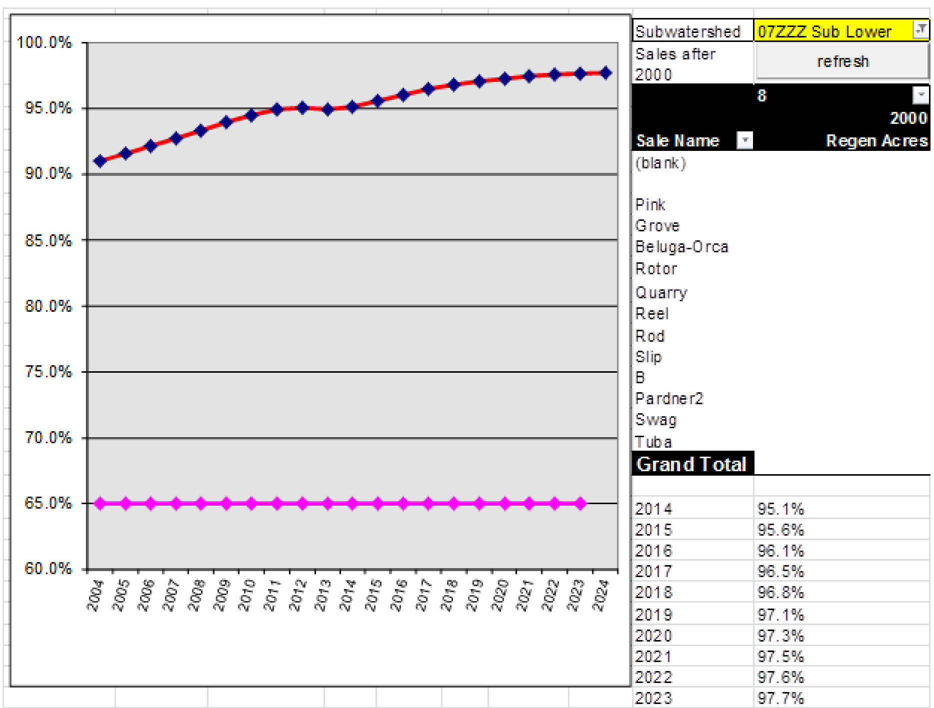
	Water Quantity	Yes	Yes	This project would not impact water quantity.
Oak Grove Fork Project Restoration – Side Channel Construction	Sediment	Yes	Yes	This project has the potential to create short-term turbidity or move sediment around in the riparian zone, however due to PDCs in place for both this project and Grove Thin no adverse impacts are likely.
	Stream Temperature	Yes	Yes	This project has the potential to temporarily impact stream temperature by altering stream shade and exposing water in the reactivated side channels to solar radiation. Shade would be restored as vegetation grows back alongside channels. The increased minimum flows associated with the new license would likely compensate for any temporary temperature increase associated with the side channel project.
	Water Quantity	Yes	Yes	This project is designed to restore the Lower Oak Grove Fork to more closely reflect the natural streamflow conditions. It would not likely result in increases in water quantity.
Ongoing Road Maintenance Activities	Sediment	Yes	Yes	Localized, short-lived increases in fine sediment in stream substrates or along channel margins may occur. Any widely scattered small increases in fine sediment would not likely be detectable at the watershed or subwatershed scales. Proper road maintenance is likely to reduce chronic sediment inputs from roads over the long term.
	Stream Temperature	Yes	Yes	Road brushing may increase stream temperature widely scattered over time and space where ditches are wet during the dry season or at stream crossings. Any widely scattered small increases in stream temperature would not likely be detectable at the watershed or subwatershed scales.
	Water Quantity	Yes	Yes	Road maintenance would not likely increase water quantity.
BPA Power Line Corridor Maintenance	Sediment	Yes	Yes	There is the potential for widely scattered and small amounts of sediment to be delivered to the stream system associated with the use of secondary roads for power line and right-of-way maintenance. Any widely scattered small increases in fine sediment would not likely be detectable at the watershed or subwatershed scales.
	Stream Temperature	Yes	Yes	Where streams cross the power line right-of-way, stream temperature is affected. The power line crosses the upper reaches of Peavine Creek, Snive Creek and Chief Creek where they have low levels of flow. Stream temperatures have been elevated for short reaches. Any increases in stream temperature would be moderated by the influx of cooler water down stream and would not likely be detectable at the watershed or subwatershed scales.
	Water Quantity	Yes	Yes	The power line corridor is maintained in an early-seral condition so the right-of-way is included in ARP calculation. Approximately 90 acres is in the analysis area.
Recreation Site, Trail, and Administrative Structure Maintenance and Associated Public Use	Sediment	Yes	Yes	The heavy use of certain recreation sites along streambanks is likely to result in bank erosion, delivery of sediment, and increased channel width. Any widely scattered small increases in fine sediment would not likely be detectable at the watershed or subwatershed scales.
	Stream Temperature	Yes	Yes	Depending on site specific conditions, the combination of suppressed vegetation and increased width/depth ratios for heavily used streamside recreation sites are likely to increase stream water temperatures for heavily used streamside at the scale of the stream reach. Any widely scattered small increases in stream temperature would not likely be detectable at the watershed or subwatershed scales.
	Water Quantity	Yes	Yes	This action would not likely increase water quantity.
Past, Ongoing and Foreseeable	Sediment	Yes	Yes	Projects have the potential to create short-term turbidity during project implementation.

Restoration Projects	Stream Temperature	Yes	Yes	Riparian restoration and road decommissioning would not likely affect stream temperature.
	Water Quantity	Yes	Yes	Riparian restoration and road decommissioning would not likely affect water quantity.

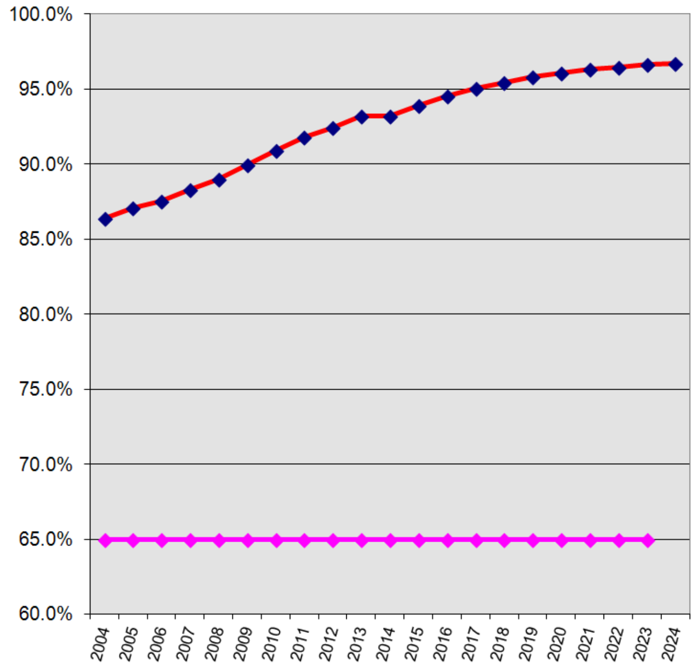
3.3.4.2 Cumulative Effects - Water Quantity

The following charts detail the cumulative recovery of all stands in the watershed combined with the cumulative impact of all actions that have affected hydrologic recovery. It is a weighted average of the modeled recovery status of thousands of stands. While the thinning and road construction of the proposed action would likely be spread out over several years, it is modeled here as occurring in 2014 which is the earliest potential harvest date. The graph does not show a downward dip in the line in 2014 because of the many young stands in the watershed are growing at a rate faster than the impact caused by proposed action.

ARP in Three Lynx Creek - Clackamas River Subwatershed

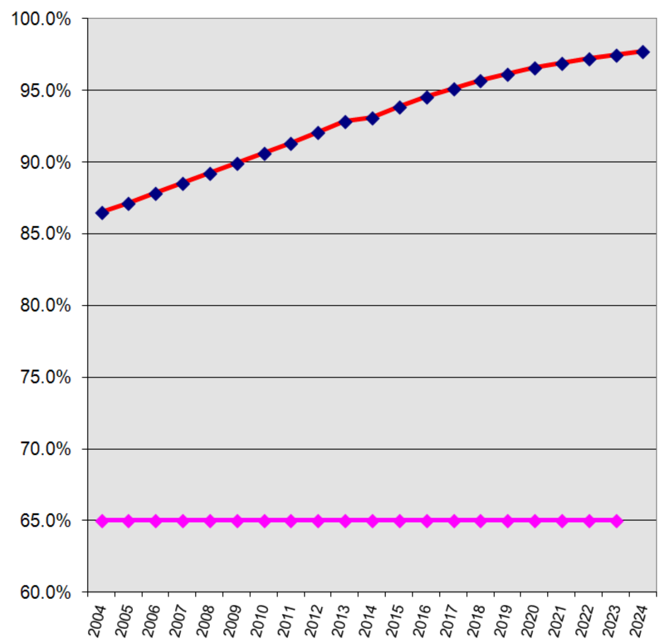


ARP in Cot Creek – Oak Grove Fork Subwatershed



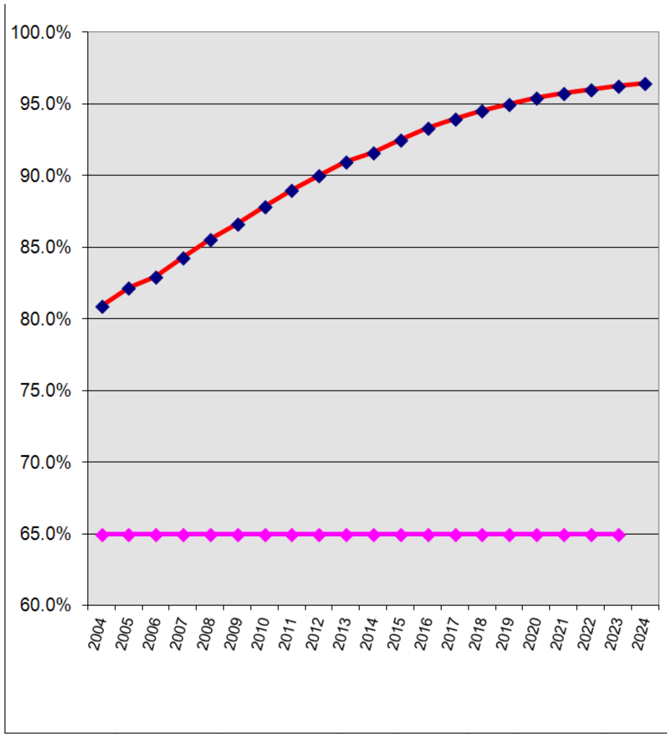
Subwatershed	09Q Cot-Oak Sum
Sales after 2000	refresh
8	2
Sale Name	Regen A
(blank)	
Batwings	
Grove	
B	
Pardner2	
Swag	
V	
G	
Cowpoke2	
W	
Grand Total	
2014	93.2%
2015	93.9%
2016	94.5%
2017	95.0%
2018	95.4%
2019	95.8%
2020	96.1%
2021	96.3%
2022	96.5%

ARP in Shellrock Creek –Subwatershed



Subwatershed	09R Shell Sum
Sales after 2000	refresh
8	2
Sale Name	Regen Ac
(blank)	
Lightning Flats	
Grove	
Swag	
G	
Grand Total	
2014	93.1%
2015	93.9%
2016	94.5%
2017	95.2%
2018	95.7%
2019	96.2%
2020	96.6%
2021	96.9%
2022	97.3%

ARP in Anvil Creek – Oak Grove Fork Subwatershed



Subwatershed	09S Anvil-Oak Sur
Sales after 2000	refresh
	8
Sale Name	Regen A
(blank)	
Lightning Flats	
Batwings	
Barstool	
Borg	
Bars	
Grove	
Swag	
G	
Bay	
Jelly	
P	
Peavine	
Grand Total	
2014	91.6%
2015	92.5%
2016	93.3%
2017	94.0%
2018	94.5%
2019	95.0%
2020	95.4%
2021	95.7%
2022	96.0%

Cumulative effects pertaining to peak flow increases are not expected because changes to hydrologic recovery as projected by the ARP model are very small in watersheds that are steadily moving toward full recovery.

In addition, stream drainage network extension that identifies roads that are hydrologically connected to the stream network is either static or is going down associated with road decommissioning activities that are part of the proposed action. This would indicate little potential for additional peak flow increases associated with the infiltration and the flow of surface and subsurface water associated with roads.

Since the cumulative impact of vegetation removal associated with all activities is minimal, there are no substantive cumulative effects anticipated for water quantity.

3.3.4.3 Cumulative Effects - Stream Temperature

Activities associated with Grove Thin are not expected to increase water temperature due design criteria designed to maintain existing primary shade vegetation adjacent to streams. As described in the direct and indirect effects section, this project would maintain existing water temperatures. Operations associated with the Clackamas River Hydroelectric Project are designed to insure that the project would comply with the temperature standards resulting in cooler water temperatures in the Oak Grove Fork below Lake Harriet and in the Clackamas River downstream of the confluence of the Oak Grove Fork. Hazard tree removal, restoration activities associated with the settlement agreement for the Clackamas River Hydroelectric project, road maintenance, BPA power line corridor maintenance, recreational site use and maintenance, and fish habitat restoration projects all have to potential to impact stream shade and associated stream temperature, however these activities would be dispersed in time and space (and all these activities would have water quality protection Best Management Practices in place to control impacts to stream temperature). No detrimental cumulative effects to stream temperature are expected as a result of activities within the cumulative effects analysis area. Project design features associated with all activities are aimed at controlling impacts to stream temperature.

There would be some cumulative benefits to stream temperature with increased flows below hydro power diversions and as riparian reserves are moved toward desired conditions and restoration projects achieve their objectives. Because the stream buffers for Grove Thinning were found to be sufficient to prevent any increase in water temperature, there would not likely be any substantial or measurable cumulative effect.

3.3.4.4 **Cumulative Effects - Sediment**

Past management actions including logging and road construction are incorporated in the discussion of existing conditions (s. 3.3.3.5). Management-related sediment production and delivery comes primarily from the road system (s. 3.3.3.5).

Since the initiation of the Northwest Forest Plan, many factors have contributed to a trend of stable or improving stream habitat conditions on the Forest (s. 3.4.7). Harvest levels since the Northwest Forest Plan have been well below the level projected. Recent projects have been designed using the standards and guidelines of the Northwest Forest Plan and its emphasis on restoration of riparian reserves. As a result, ongoing thinning projects, road decommissioning, danger tree felling, road maintenance, dispersed recreation are not creating measureable impacts to streams or aquatic resources at the subwatershed or watershed scale.

In recent years, road decommissioning has occurred and more is planned. Approximately 48 miles of the highest risk roads were decommissioned in the last decade. The 2014 Clackamas Restoration EA includes approximately 2 miles of system road decommissioning in the action area including culvert removal. Decommissioning a stream crossing can create a short-term pulse of sediment during in-stream work but there would be a long-term restoration with reduced overall sedimentation. In fact, the sediment reduction modeled for road decommissioning and stormproofing for this project would be 14.2 tons per year; more than compensating for the minor amount of sediment contributed by the use of temporary roads. The reconstruction, use and rehabilitation of the temporary roads for this project would result in a maximum increase of 7.6 tons of sediment per year. This level would occur in the year of the activity but would taper off in subsequent years as vegetation regrows. This level is one tenth of one percent of the background level of sediment (s. 3.3.3.5).

The proposed action and other thinning projects would improve stream and riparian conditions by moving the stands toward late-successional conditions. Other ongoing thinning projects use a similar set of PDCs to protect water quality.

The recent or ongoing projects (Beluga-Orca, Jelly, Pink, Quarry, Reel, Rod, Rotor, Swag and Tuba) combined have approximately 3.65 miles of temporary road reconstruction, use and rehabilitation. Because the direct effect of the proposed action's 5.35 miles of temporary roads would result in a 0.1% change in sediment over base-line conditions, it is unlikely that an additional 3.65 miles of reconstruction and rehabilitation spread out over several years and spread out over the subwatersheds would cumulatively result in measurable quantities of sediment. This quantity of sediment is more than compensated for by the reduction in sediment modeled for the proposed 4.64 miles of system road decommissioning and 11.61 miles of system road stormproofing. In addition to the system road decommissioning associated with this proposed action, there are 1.9 miles of system road decommissioning authorized by the 2007 Plantation Thinning Decision Notice in the vicinity of the Beluga-Orca, Pink, Quarry, Reel and Rod thinning projects and 2 miles of system road decommissioning planned as part of the 2014 Clackamas Restoration EA; all of which are in the same subwatersheds as Grove.

Ongoing Clackamas River Hydroelectric Project operations, restoration activities associated with the settlement agreement for the Clackamas River Hydroelectric project, road maintenance, BPA power line corridor maintenance, recreational site use and maintenance, and fish habitat restoration projects all have to potential to introduce small amounts of sediment that would be dispersed in time and space.

Project design features that implement Best Management Practices are included with all ongoing projects and operations and are aimed at controlling erosion and sedimentation, reducing the potential of erosion and delivery of material to adjacent surface water.

Temporary road reconstruction, logging and log haul associated with this project (with project design criteria implemented) have the potential to introduce a very limited amount of sediment to the stream system. The system road decommissioning and stormproofing have the potential to reduce chronic sources of sediment. The cumulative effects of this project when added to other past actions as well as foreseeable and ongoing actions would not likely be substantial or contribute to a downward trend for water quality in local streams or downstream rivers because the quantities of sediment introduced from this project and the quantities of sediment removed would be small compared to the overall sediment load for the drainage. No detrimental cumulative effects are expected.

3.3.5 Forest Plan Consistency

Forestwide Water Standards and Guidelines - FW-54 to FW-79, FW-109 to FW-114, FW-127 to FW-136, page Four-53
Mt. Hood FEIS pages IV-22, IV-47, IV-155 to IV-167

The project is consistent with Forest Plan standards and guidelines that relate to water quality and quantity. There are several Forest Plan standards and guidelines that address hydrologic recovery. The project is fully consistent with all of the standards and guidelines addressed below. The ARP model ranks recovery from 0 to 100 with 100 being fully recovered. The Forest Plan refers to a maximum watershed impact area or threshold of concern which are the inverse of ARP with 0 being fully recovered. The ARP numbers are subtracted from 100 to get watershed impact area or threshold of concern.

FW-63

This standard and guideline indicates a maximum watershed impact area of 35% for major drainages for lands available for vegetative manipulation. After project implementation the major drainages are projected to be between 10 and 15% which would clearly meet the standard and guideline. These areas are steadily recovering due to the very low levels of regeneration harvest in the recent past and the rapid growth of young stands.

FW-64

This standard and guideline indicates a maximum watershed impact area of 35% at the drainage scale for lands available for vegetative manipulation. All of the drainages are well below 35%.

Drainage Name	Proposed Action 2014 - Watershed Impact Area %
Cot	7
Cripple	4.9
High Rock	7.6
Kink	10.9
Lake Harriet	7
Lower Oak Grove	8
Middle Oak Grove	9.2
Peavine	9.2
Shellrock	9.2
Tag	7.4
Timber Lake	9.2
Wards Reach	6.9

3.3.5.1 Key Watersheds

The Key Watershed delineation for the project area does not include entire watersheds but a narrow band ¼ mile wide on either side of the Clackamas and Oak Grove Fork Rivers. The standard and guideline for Key Watersheds requires no net increase of system and nonsystem roads.

Within the project area, in the Key Watershed delineation:

- 2.7 miles of system roads have been decommissioned already.
- No new system roads would be constructed.
- 0.04 mile of temporary road would be constructed and rehabilitated (unit 100).
- 0.02 mile of temporary road would be reconstructed and rehabilitated on an old system road alignment that was never actively decommissioned (unit 178).
- 0.42 mile of temporary road would be reconstructed and rehabilitated on old temporary road alignments that were never actively rehabilitated (units 2 & 112).
- 0.12 mile of system road would be decommissioned (4630.023).

  There would be no net increase of roads because of there would be fewer roads than when the Northwest Forest Plan took effect, therefore this standard and guideline would be met. The No-action Alternative would not decommission 0.12 mile of system roads resulting in a slightly larger road network.

Other standards and guidelines for Key Watersheds are met: Watershed Analysis has been completed prior to harvest operations, and there are no actions in inventoried roadless areas.

3.3.5.2 Forest-Wide Monitoring

In an effort to support the Clean Water Act, the Forest conducts a variety of monitoring and inventory programs to determine status of meeting state water quality standards as well as other regulatory and agency requirements. In an average year, approximately 75 sites are monitored for water temperature throughout the Forest. In addition, other water quality monitoring occurs at various locations throughout the Forest. This could be turbidity monitoring, in-stream sediment sampling, water chemical sampling, or surveys of physical stream conditions. Currently, approximately 25 miles of physical stream habitat is surveyed every year and to date approximately 1,200 miles of stream have been surveyed. Some of the information collected during these surveys includes the number of pools and riffles, amount of large wood, riparian area condition and types, and numbers of fish and other aquatic organisms.

Chapter 5 of the Forest Plan contains BMP monitoring requirements. The over-arching question answered through monitoring is whether water quality-related standards and guidelines and BMPs are effective at maintaining or enhancing water quality and ensuring compliance with state water quality requirements.

The Forest Service is in the midst of a transition from using the Best Management Practices Evaluation Process that was used up until 2004, to the new National BMP monitoring protocol. During the transition period, effectiveness monitoring was accomplished through the Aquatic and Riparian Effectiveness Monitoring Program; an interagency effort that evaluates the parameters of the Aquatic Conservation Strategy in maintaining and restoring watershed conditions.

Forest-wide monitoring of water quality has affirmed that the watersheds on the Forest are experiencing a trend of improving water quality, riparian and aquatic conditions, even with the implementation of thinning projects similar to Grove. Monitoring shows that BMPs are functioning as expected on a landscape scale.

Also during the transition to the new National BMP monitoring protocol, the Forest participated in extensive testing of the draft National BMP monitoring protocol in 2011, 2012 and 2013, and as a result, the final protocol has been adjusted and clarified.

The effectiveness of the techniques included as PDCs in this project and on the projects that have been implemented in recent years has been validated because Forest-wide monitoring has shown an ongoing trend of improving conditions for water quality. The PDCs in this project have been refined where appropriate based on past monitoring to make them more implementable and more effective.

3.3.5.3 Project-Level Monitoring

Past monitoring of implementation and effectiveness of BMPs on the Clackamas River Ranger District indicated that PDCs were implemented as planned on 85% of the samples and were effective at avoiding impacts to water quality on 94% of the samples. The water quality specialist report contains this analysis in compliance with Appendix H of the Forest Plan. It found that similar levels would likely be experienced for this project. This level of effectiveness was considered in the analysis of effects described above.

This project will go into a pool of similar projects to be selected for project level BMP implementation and effectiveness monitoring as per the National BMP Monitoring Protocol. An interdisciplinary team would evaluate whether the site-specific BMPs were implemented and the effectiveness of the BMPs at minimizing impacts to water quality.

Monitoring is used in an adaptive management process to inform and improve management activities so that lessons learned can be used to make future projects better and to share with other appropriate Federal, State and local agencies.

3.4 FISHERIES

This section summarizes the Fisheries Biological Assessment and Biological Evaluation and the fisheries report which are incorporated by reference. Fisheries issues such as sediment and water temperature are already discussed in the water quality section (s. 3.3) and are only repeated here where needed to add clarification.

The project "Action Area" consists of portions of the Middle Clackamas River and the Oak Grove Fork of the Clackamas River watersheds (see maps in Appendix A). The action area is defined for ESA purposes as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402).

A small portion of the action area is classified as Tier I, Key Watershed in the Northwest Forest Plan. Instead of entire watersheds, in this area only narrow bands along the major rivers are included as Tier I. Tier I watersheds have been identified as crucial refugia for at-risk fish species.

The lower reaches of the action area watershed support populations of at-risk anadromous fish, including spring Chinook salmon, winter steelhead and coho salmon. Streams with these fish are referred to as listed-fish habitat (LFH). A waterfall on the Oak Grove Fork blocks these fish. Despite this, the upper reaches support native resident cutthroat and rainbow trout.

Past actions that have shaped the action area and its fisheries include timber harvest, road building, hatchery introductions, and hydroelectric development. Timber harvest has created a fragmented pattern that has contributed to a loss of riparian habitat, increased stream temperatures and increased sedimentation. Regeneration and clearcut harvest occurred on approximately 36% of the forested lands within the action area, converting mature forest habitat to plantations. The riparian reserves have also been altered by road building.

Past clearcut timber harvest often occurred within riparian areas and to the edges of adjacent streams. The harvest impacted stream shade, and water temperatures, but shading has recovered to near historic conditions with deciduous and early-seral vegetation, and large second-growth trees.

3.4.1 Management Indicator Species

See section 3.4.7 for discussion of effects.

Because of their relative sensitivity to change, the family of fishes, known as salmonids, was selected as "an indicator species group" for aquatic habitats. This group of species is especially important for their commercial and game values and because they occupy the spectrum of aquatic habitats on the Forest. It is assumed that if the needs of salmonids are met, the needs of other fish and aquatic species would also be met. Management Indicator Species for the Forest include Chinook salmon, coho salmon, steelhead, coastal cutthroat trout and rainbow trout. A Forest-level analysis of the status of these species and their habitat was conducted in 2011. The state of Oregon, in concert with the regulatory agencies, manages fish populations while the Forest manages the habitat. For a population to be viable, attributes such as species abundance, productivity, spatial structure, and genetic diversity are needed for the species to maintain its capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. All of these attributes are affected by habitat and other environmental conditions that influence species behavior and survival. The Forest-wide analysis was conducted at a coarse scale using available GIS data. The project level interdisciplinary team took the Forest-wide data and refined it based on field examinations and local knowledge of habitat conditions. For example, some of the maps of resident fish presence show fish in portions of streams that are known to be intermittent with no fish.

3.4.2 Federally Listed Species

See section 3.4.6 for discussion of effects.

Columbia River Bull Trout (*Salvelinus confluentus*) Threatened
Bull trout were historically present in the Clackamas River system and the lower mainstem Collawash River. They were believed to be extirpated in the entire Clackamas watershed. Repeated recent fish sampling conducted in the Clackamas River drainages failed to uncover any bull trout presence. Bull trout were evaluated for reintroduction through a feasibility analysis and were reintroduced into the upper Clackamas River in 2011 as a nonessential experimental population. The nearest thinning unit is 180 feet from bull trout habitat.

Lower Columbia River Steelhead (*Oncorhynchus mykiss*) Threatened
Lower Columbia River (LCR) steelhead occur in the Clackamas River, Sandy River, and Hood River basins. They also occur in the West Columbia Gorge tributaries. Adult winter steelhead enter rivers and streams on the Forest primarily during April through June with peak migration occurring in May. Steelhead use the majority of the mainstem rivers and tributaries as spawning and rearing habitat. LCR steelhead occur within the action area. The nearest thinning unit is 180 feet from LCR steelhead habitat.

Upper Willamette River Chinook (*Oncorhynchus tshawytscha*) Threatened
Upper Willamette River (UWR) spring Chinook salmon that occur in the Clackamas River consists of both naturally spawning and hatchery produced fish. Only wild naturally produced Chinook are allowed to pass PGE's North Fork Dam and fish ladder onto National Forest lands in the Clackamas basin. These fish primarily spawn and rear in the mainstem Clackamas River and larger tributaries including the Oak

Grove Fork up to the waterfall. The nearest thinning unit is 180 feet from UWR Chinook habitat.

Lower Columbia River Coho Salmon (*Oncorhynchus kisutch*) Threatened
The Clackamas River contains the last remaining viable run of wild late-run winter coho in the Columbia Basin. There is also an early returning run that has naturalized from hatchery stocks within the Clackamas Basin. Coho salmon occur within the mainstem Clackamas River, and the lower reaches of streams in the Clackamas watershed including the Oak Grove Fork up to the waterfall. The nearest thinning unit is 180 feet from LCR coho habitat.

3.4.3 Sensitive Species and Survey and Manage Species

Because this project involves thinning stands less than 80 years of age, the standards and guidelines outlined in the 2001 Record of Decision for the Amendments to the **Survey and Manage**, Protection Buffer, and other Mitigation Measures are not applicable, as the Pechman exemption applies to these stands.

Sensitive species on the Regional Forester's list:

See section 3.4.6 for discussion of effects.

Dalles Juga *(Juga hemphilli dallesensis)* aquatic snail
This snail has been found in Mill Creek and the central and eastern Columbia River Gorge from Hood River to The Dalles, in Hood River and Wasco Counties, Oregon and Skamania County, Washington. They are found at low elevation large springs and small-medium streams with a stable gravel substrate and fast-flowing, unpolluted, highly-oxygenated cold water. Given that known locations are well north and east of the action area and its preference for low elevation habitat, this species is not believed to occupy habitat in the action area.

Barren Juga (*Juga hemphilli hemphilli*) aquatic snail
This snail is found in freshwater habitats in small to medium sized highly oxygenated cold water streams at low elevations. They prefer streams that have moderate velocity level bottoms with stable gravel substrates. Their known range is the Columbia River Gorge in Oregon and Washington. They have been found on the Forest and the Columbia River Gorge National Scenic Area. They are also suspected to occur in the Gifford Pinchot National Forest. While the planning area is outside of the known range of this species, the habitat description closely matches some locations in the action area, therefore, this species is presumed to be present.

Purple-lipped Juga (*Juga hemphilli maupinensis*) aquatic snail
This snail is endemic to Oregon. They are found in large streams at low elevations, and they prefer riffle habitat with stable gravel substrates, in cold well oxygenated water. Their known range is the Lower Deschutes River drainage, below Pelton

Dam, and the Warm Springs River in Wasco and Sherman counties, Oregon. There are few locations on the Forest that match the above preferred habitat description. These locations are in larger rivers likely near the Forest boundary. They were once widespread in the Deschutes River Basin and may have been present in Forest tributaries. Current samples have only been collected from the lower Deschutes River and they are not believed to occupy streams in the Action Area. Because of the distance of known sample sites to the action area, the project would not likely impact individuals or habitat of this species.

Scott's Apatanian Caddisfly (*Allomvia scotti*) aquatic insect
This caddisfly occurs in forested mountain streams below the sub-alpine zone. The larvae inhabit small, cold streams with moss. They are known to reside in several high elevation streams on Forest and they may occur in other similar streams on or near Mt. Hood. The highest elevation units with similar streams are at 3,200 feet elevation and the species is not believed to occur at the project area.

Namamyia plutonisi (a caddisfly with no common name) aquatic insect
This caddisfly has been found in small streams in densely forested old growth or mature forest. They are known to occur in the Coastal and Cascade Ranges of Oregon and California. They have never been documented on the Forest, but suitable habitat is present in the action area. This species is presumed present in small streams with mature-forest characteristics within the action area.

3.4.4 Existing Condition, Direct and Indirect Effects Summary

No Action

Plantations are overstocked with relatively uniform tree size and distribution, have low species diversity, and have low habitat value. These plantations do not meet the needs of riparian dependent aquatic and terrestrial species. The plantations provide some shade to streams but they do not produce the size and quantity of coarse woody debris sufficient to sustain physical complexity and stability of the riparian reserves and associated streams. They do not have mature and late-successional stand conditions.

With no action there would be no immediate change to fisheries resources. Since there would be no ground disturbance or loss of forest canopy there would be no potential for any increase in surface erosion, sedimentation, peak flows or temperature. Riparian reserves would retain their current level of shade and water temperatures within and downstream of the project area would gradually improve as riparian reserves across the action area grow denser.

If no action were taken in riparian reserves, riparian stands would maintain their mid-seral structure for many decades and not reach the desired late-successional characteristics as quickly as thinned stands. There could potentially be negative effects because stands would become or remain overcrowded, affecting stream bank stability, and overall health of the riparian reserves. Stands would be denser, less diverse (structurally), have smaller diameter trees, and have less understory development compared to the proposed action. Riparian tree size would be smaller with no action. Over time, there would be an abundance of trees dying and falling into streams.

Proposed Action

For this proposed project, the following actions have the potential to affect aquatic species or their habitats: tree felling, road maintenance, road construction, repair and reconstruction, log yarding, log and rock haul, road decommissioning, road rehabilitation, felling trees into streams and constructing a fuel break around administrative sites. These actions are of concern because they could affect stream temperature, levels of sediment in streams, peak flows, future in-channel large wood recruitment and riparian vegetation.

3.4.4.1 Wood Recruitment

Large woody debris (LWD) is important in streams because it creates pools, enhances deposition of spawning gravels, boosts trophic processes, and adds structural complexity. In the 1950s through 1970s, the Forest routinely removed large woody debris from streams and salvaged logged in the action area. Removal of LWD reduced fish habitat quality and resulted in stream incision that is still evident today. Large Woody Debris is delivered to stream channels naturally by landslides, and by trees falling from adjacent riparian areas. Road construction has created a barrier to the movement of wood from upstream locations to LFH; if pieces of wood are moved down stream they are likely to be caught in a culvert and removed during road maintenance. The dams at Lake Harriet and Timber Lake also block the movement of wood from reaching LFH.

Surveys have found wood quantities in most streams to be below current standards. Where riparian areas were logged as part of a clearcut in the past, there is reduced potential for large woody debris recruitment into associated streams. In these areas, small woody debris currently plays an important role.

With no action, there would be an abundance of small wood recruited into streams as trees in plantations die and fall (s. 3.1.3 & s. 3.8.2.3).

With the proposed action, stream protection buffers would provide high levels of small wood recruitment (s. 3.8.2.3).

Thinning in the upland portion of the riparian reserves would result in fewer trees dying, and live trees would grow larger compared to no action. The stream protection buffers would continue to supply nearly the same level of small wood recruitment to streams. Recent research (Johnston 2011) has shown that 90% of LWD in western Oregon and Washington streams originated at ground distances between 33 and 66 feet from streams. Streams with wider buffers would have greater than 90% of the predicted level of recruitment and streams with 50-foot buffers would have approximately 85% of the predicted level of recruitment. The stands proposed for thinning are not the only sources of wood recruitment along stream reaches. There are mature forest stands along the affected stream reaches that also contribute wood to streams and the wood from these stands would be much larger than what is contributed from plantations. As trees respond to thinning there would be large sized trees that would become available for recruitment to tributary channels and riparian reserves (RIEC 2013).

In thinned stands, the current average tree diameter is 13 inches.

The FVS model predicts that tree size would average 18.3 inches diameter with no action and 23 inches diameter in approximately 40 years after thinning (s. 3.1.3&4). The FVS summaries in section 3.8.2.3 show that in 40 years, the levels of dead trees over 20 inches diameter associated with the 120 basal area thinning prescription for riparian reserves would be approximately 12 per acre compared to 16 per acre with no action.

In the interim, smaller wood would be provided from the stream protection buffer. The thinned portion of the riparian reserve would have larger trees but they tend to be healthy and not as likely to die and fall toward the stream. There is the potential to manually fall trees toward the stream if necessary to meet objectives for in-stream wood instead of waiting for trees to die and relying on chance that the dead tree would fall toward the stream. The proposed action includes felling plantation size trees in certain units to enhance streams in need of woody debris (s. 1.4.6.2).

The probability of affecting in-stream wood abundance in LFH is low because of the protections provided by stream protection buffers and because riparian reserve acres treated amount to only 2% of the total riparian reserve acres contained within action area.

3.4.4.2 Changes to Riparian Reserve Vegetation

One of the aspects of the purpose and need is to accelerate the development of mature and late-successional stand conditions in riparian reserves. The current vegetation in plantations does not meet the needs of associated aquatic and riparian resources. Timber production is not the objective in riparian reserves; this section focuses on tree growth and when desired riparian conditions might develop.

The riparian reserve plantations are overstocked and have relatively uniform tree size and distribution, have low to moderate amounts of small diameter coarse woody debris, lack understory development and have low levels of snags. These plantations are not late-successional and do not meet the needs of riparian dependent species. The plantations provide shade to streams but they do not produce the size and quantity of coarse woody debris sufficient to sustain physical complexity and stability of the riparian reserves and associated streams. They do not have mature and late-successional stand conditions.

No Action

With no intervention, these stands would remain at maximum density for many decades until natural mortality opens the canopy enough to allow expansion of crowns and understory response from increased light. Development of desired late-successional characteristics would proceed very slowly under these conditions.

Proposed Action

Silvicultural prescriptions would incorporate variable-density thinning, retention of minor species, and the creation of skips and gaps to move the stands toward the eventual acquisition of late-successional characteristics (Bauhus 2009). Many of these same practices are also proposed on the matrix portion, but the riparian reserve portion would have protection buffers and an emphasis on stream shading.

As trees respond to thinning they would become larger, and there would be greater diversity compared to no treatment. With the proposed action, plantations would acquire late-successional characteristics sooner compared to no action (s. 3.1).

Riparian thinning with the prescribed stream protection buffers would maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of large-diameter coarse woody debris sufficient to sustain physical complexity and stability.

3.4.4.3 Water Temperature and Sediment

Water temperature is addressed in sections 3.3.3.3 and sediment is addressed in section 3.3.3.6.

It is unlikely that sediment would reach listed fish habitat. Most of the reconstructed temporary road alignments are not connected to LFH and most of the haul roads in the vicinity of LFH are paved. Any impacts from the minimal amount of sediment generated during these activities would be for a short-term duration, and undetectable at a subwatershed or watershed scale.

3.4.5 Cumulative Effects

See additional discussion of cumulative effects in section 3.3.4. The same analysis area and time frames are used for impacts to fish.

Since the initiation of the Northwest Forest Plan, many factors have contributed to a trend of stable or improving stream habitat conditions on the Forest (s. 3.4.7). Harvest levels since the Northwest Forest Plan have been well below the level projected. Recent projects have been designed using the standards and guidelines of the Northwest Forest Plan and its emphasis on restoration in key watersheds. As a result, hydroelectric projects, ongoing thinning projects, road decommissioning, hazard tree felling, road maintenance, and recreation are not creating measureable impacts to streams or aquatic resources at the subwatershed scale. The proposed action and other thinning projects would improve stream and riparian conditions by moving the stands toward late-successional conditions.

The Biological Assessment found that the proposed action along with other past and ongoing actions would not have a measurable or substantive effect on aquatic resources, including wood recruitment and riparian vegetation because of protections provided by project design criteria including stream protection buffers. While there are likely some short-term cumulative effects related to wood recruitment and riparian vegetation, there would also be some cumulative benefits as riparian reserves are restored to late-successional conditions and as roads are decommissioned. The ongoing projects meet Forest Plan aquatic standards and guidelines and are consistent with the Aquatic Conservation Strategy. Even with all of the past and ongoing projects, the individual drainages and the watersheds as a whole are recovered hydrologically (s. 3.3.2.4). This project and all of the other ongoing projects were found to not likely to adversely affect listed fish or their critical habitat (s. 3.4.6). For these reasons cumulative effects would not be substantial.

3.4.6 Effects to Listed Species

This section summarizes the Biological Assessment.

Determination of Effect to Federally Listed Species & Designated Critical Habitat

Critical habitat exists adjacent to the proposed project. Siltation of LFH is the most likely disturbance that could result from this project. The analysis found little impact, and that disturbance would be localized and of short duration. The PDCs were found to be sufficient to minimize effects to water quality. The effects determination for this project is **"May Affect, Not Likely to Adversely Affect"** for LCR steelhead, Upper Willamette River Chinook, and LCR coho salmon, their proposed or designated critical habitat, or LFH.

Determination of Effect to Bull Trout

Suitable habitat exists for Columbia basin bull trout in the action area. The species was believed locally extinct for 48 years, however, the U.S. Fish and Wildlife Service has established a nonessential experimental population in the Clackamas River and its tributaries. The small scale and short duration of operations in the action area make the extent of impacts minimal. For this reason the proposed project would have **no effect** on bull trout or its habitat.

Determination of Effect to Essential Fish Habitat

Essential Fish Habitat (EFH) consists of the waters and substrate necessary to listed fish for spawning, breeding, feeding, or growth to maturity (Magnuson-Stevens Act or MSA). Salmon fishery EFH includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to coho and Chinook salmon. Salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e. natural waterfalls in existence for several hundred years).

The Proposed Action would **Not Adversely Affect Essential Fish Habitat** for Chinook and coho salmon.

Determination of Effect to Regional Forester's Special Status Species

The project design criteria including stream protection buffers are sufficient to provide for the habitat needs of aquatic mollusks and insect larvae.

The Dalles juga, purple-lipped juga and Scott's apatanian caddisfly (s. 3.4.3) are not likely to occur in the streams or springs in the project area. Because of the protections provided to all streams and springs and the low likelihood of presence, the project would have **no impact** to these species.

The barren juga, and a species of caddisfly (s. 3.4.3) may occur in streams and springs in the project area. The discussion above for fish and water quality in terms of direct, indirect and cumulative effects, particularly the discussions about sediment (s. 3.3.3.6) serve to document effects to these species. The project design criteria including stream protection buffers are sufficient to provide for the habitat needs of this species. The project **may impact** individuals or habitat, but would not likely contribute to a trend towards Federal listing or loss of viability to the population or species.

The effects determinations for Federally Listed species and Special Status species are appropriate because the project with design criteria would not have a measurable effect on baseline conditions including stream flow, sediment erosion, or water quality. The primary potential impacts to listed-species and their critical habitat would be sedimentation from log haul and temporary road and landing reconstruction. However, the impact would be of short duration, the likelihood is low that sediment would be transported out of the action area, and there would be low probability that sediment would reach LFH or aquatic species.

3.4.7 Management Indicator Species (MIS)

Management Indicator Species (MIS) for the Forest include the threatened anadromous species (Chinook salmon, coho salmon and steelhead), and resident trout.

A Forest-level analysis of the status of these species and their habitat was conducted in March of 2011. The state of Oregon, in concert with the regulatory agencies, manages fish populations while the Forest manages the habitat. For a population to be viable, attributes such as species abundance, productivity, spatial structure, and genetic diversity are needed for the species to maintain its capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. All of these attributes are affected by habitat and other environmental conditions that influence species behavior and survival. Maps of the distribution of fish species for the Forest are located in the analysis file. The Forest-wide analysis was conducted at a coarse scale using available GIS data. The project level interdisciplinary team took the Forest-wide data and refined it based on field examinations and local knowledge of habitat conditions.

Resident trout, including coastal cutthroat trout and rainbow trout, are found in most west-side streams on the Forest and are among the most widely distributed salmonids encountered. Information on fish populations came from Level II stream surveys in the past decade from most of the larger fish bearing streams in the action area. Additional information was also gathered by specialists during project planning on-the-ground inspections. Many tributary streams within the action area contain populations of resident trout. The proposed action is designed to avoid impacts to these species and other MIS downstream by creating stream protection buffers.

Several MIS fish species were listed as threatened under the Endangered Species Act due to concerns for their population levels and the condition of habitat and other factors such as commercial fishing and hydroelectric dams. Since the creation of the Northwest Forest Plan, the following factors have contributed to a trend of stable or improving stream habitat on the Forest:

- In-stream restoration projects including the reconnection of side channels, and the addition of wood and boulders.
- Replacing undersized culverts with larger ones or bridges that allow improved fish passage and the ability to withstand larger flood events.
- Decommissioning several hundred miles of roads.
- Managing riparian reserves for shade, large wood recruitment, and the development of late-successional conditions.
- Managing Off-Highway Vehicle use to avoid erosion near sensitive streams.
- Managing stream diversions for irrigation to minimize effects to fish.

- Treating hazardous fuels to minimize the impact of wildfire on riparian areas and fish.
- A new FERC license agreement for PGEs hydropower facilities.

Viability

In summary, the PDCs would minimize negative effects of sediment or turbidity. Winter haul could potentially generate the greatest impact to streams occupied by MIS fish. By adhering to the PDCs that address wet season haul on roads, the effects would be slightly negative, but not substantial to MIS fish. All haul routes would be maintained and closely monitored by the sale administrator, district hydrologist and fish biologist. Monitoring of compliance with wet season haul restrictions would be conducted to minimize turbidity inputs.

For MIS fish, the direct, indirect and cumulative effects to water quality and the physical habitat for these species are low to immeasurable due to protections provided by PDCs, and the low potential for any sediment to reach streams where these species reside. As such, this project would not contribute to a negative trend in viability on the Forest for MIS fish.

3.4.8 Forest Plan Standards and Guidelines

The Forest Plan has guidelines for water (FW 54-79), riparian (FW 80-136), fisheries (FW 137-147), and other areas (B7-28 to B7-39). The Northwest Forest Plan has riparian reserve Standards and Guidelines (pages C-31 to 38). The proposed project meets all of these standards and guidelines. In the long term, the proposed action would enhance riparian areas, water quality, and aquatic species and habitat at both the project and action area scale.

The project is consistent with the standards and guidelines that address Best Management Practices FW-055 to 059.

Northwest Forest Plan Standard and Guideline TM1 (Pages C-31-32) suggests the application of silvicultural practices for riparian reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain the Aquatic Conservation Strategy. The project is consistent with this standard because riparian reserve treatments have only been designed to further the goals of the ACS objectives. While some short-term impacts have been disclosed, the following section explains in detail how the objectives would be met and why active management is proposed.

3.4.8.1 Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) of the Northwest Forest Plan (USDA and USDI 1994) was developed to restore the health of watersheds and aquatic ecosystems. The ACS objectives are detailed on page B-11 of the Northwest Forest Plan. At B-10, the Northwest Forest Plan indicates that, to meet the intent of the ACS, management activities should either maintain the existing condition or lead to improved conditions in the long term.

The no-action alternative would maintain the current conditions and would result in stands that are overstocked with relatively uniform trees with low levels of diversity. They do not have mature and late-successional stand conditions (s. 3.4.4).

Portions of the effects analysis in this document in sections 3.3 and 3.4 focus on key parameters or indicators that make up elements of the nine Aquatic Conservation Strategy objectives, and form the rationale of the project's ability to maintain the existing condition or lead to improved conditions in the long term, for these indicators. The proposed action was evaluated at various temporal and spatial scales. The following table identifies the relevant indicators for each objective. The suite of indicators for each objective was evaluated to determine if the action achieves the specific ACS objective. The Fisheries Biological Assessment which is incorporated by reference has a detailed discussion on these indicators.

Aquatic Conservation Strategy Objectives and Related Indicators

	Aquatic Conservation Strategy Objectives								
Indicators	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**
Temperature		X		X				X	X
Sediment				X	X	X		X	X
Chemical Contamination				X				X	X
Physical Barriers	X	X						X	X
Substrate			X		X	X			X
Large Woody Debris			X					X	X
Pool Frequency			X						X
Pool Quality			X						X
Off-Channel Habitat	X	X	X						X
Refugia	X	X						X	X
Width/Depth Ratio			X					X	X

	Aquatic Conservation Strategy Objectives								
Indicators	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**	**#9**
Streambank Condition			X			X		X	X
Floodplain Connectivity	X	X	X				X	X	X
Peak/base Flows					X	X	X		
Drainage Network Increase					X	X	X		
Riparian Reserves	X	X	X	X	X	X		X	X

ACS Objective 1 - Watershed and Landscape-Scale Features

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

The vegetation in the action area including riparian reserves has been changed from one predominated by mature forest to one fragmented by clear cuts and plantations with low levels of diversity. Past clearcutting and road construction have also reduced pool and margin habitat in streams, reduced aquatic cover habitat, and removed or delayed future recruitment of large down wood, large snags, and live trees. Large wood loss also resulted in loss of habitat connectivity for species like mollusks and salamanders that use logs that span from streams to uplands areas (s. 3.4.4.1).

The project would accelerate the restoration of late-successional conditions and reduce fragmentation. Riparian prescriptions would restore stands by creating diversity and complexity in largely homogenous stands. Stream protection buffers provide in-stream woody debris recruitment. The proposed action would also fall trees directly into streams and buck logs that span over the top of streams to provide some immediate benefit. The proposed action provides a balance between the maintenance of existing habitat for aquatic and terrestrial riparian species, populations, and communities, primarily through protection buffers, with opportunities to develop landscape scale restoration as multiple stands move toward late-successional conditions thereby improving the distribution, diversity and complexity typical of landscape features that developed under natural conditions. Over time, as late-successional conditions are restored in riparian reserves, missing elements such as large woody debris complexity both at the stream and landscape scales would be restored. (s. 1.3.1.3, s. 1.3.1.5, s. 3.2, s. 3.4.4.1, s. 3.4.4.2)

For these reasons, the objective of maintaining and restoring watershed and landscape-scale features would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 2 - Connectivity Within and Between Watersheds

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

Connectivity in the project area has been affected by the construction of roads and clearcutting in riparian areas. Connectivity has been disrupted by hydroelectric projects including dam construction and piping water from one area to another. This has been ameliorated somewhat in recent years as increased minimum flows have been required. Connectivity has also been disrupted by roads that cross streams with culverts impassable to aquatic organisms. Roads and clearcuts in riparian areas have also broken some connections for dispersal of terrestrial riparian dependent species such as salamanders. In recent years, road decommissioning and the replacement of certain culverts has removed some of these barriers. (s. 1.3.1.2, s. 3.3.1.3)

In the project area, a network of riparian reserves covers rivers, streams, springs, ponds and wetlands and the land adjacent to them. Due to climatic and geologic factors, the action area has a relatively dense network of streams, springs and wet areas all providing for spatial connectivity for aquatic and riparian dependent species. Maintenance of natural flow paths on the landscape and within the project area assure temporal connectivity. (s. 1.3.2.1)

New temporary road construction would not cross streams or follow streams closely. Roads that are constructed or reconstructed would be temporary and would be rehabilitated after use. Reconstructed temporary road alignments have minimal connectivity to streams and their rehabilitation after use would to restore spatial and temporal connectivity. Stream temperature, current wood recruitment and undisturbed terrestrial dispersal corridors would be maintained in the short term by protection buffers adjacent to streams and the falling of trees into streams. Riparian treatment prescriptions would restore stands in the long term by accelerating the creation of missing diversity and complexity elements including large diameter trees, skips, gaps and down wood. As these and other riparian reserve stands are enhanced across the action area, aquatic connectivity and late-successional connectivity would be restored more rapidly. The project would actively rehabilitate 1.82 miles of old road alignments that were never actively decommissioned or rehabilitated before. On system roads, the project would decommission 4.64 miles, stormproof 11.61 miles, close 1.84 miles and maintain 85 miles. It would repair road problems including adding one culvert where a stream shifted its path. As these enhancements are made, spatial and temporal connectivity at the site scale would be restored to more natural flowpaths. (s. 1.4.7, s. 1.4.7.2, s. 1.4.7.3, s. 3.3.2 to 3.3.3.6, s. 3.3.4.2, s. 3.4.4.2)

For these reasons, the objective of maintaining and restoring connectivity within and between watersheds would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 3 - Physical Integrity

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

The physical integrity of aquatic systems has been affected by the construction of roads, clearcutting in riparian areas and hydroelectric projects. (s. 1.3.1.2, s. 3.3)

Recent enhanced minimum flows below Lake Harriet would improve the physical integrity of the lower Oak Grove Fork. Stream protection buffers and road use restrictions during the wet season and other PDCs would minimize erosion and changes to stream shorelines, banks and bottom configurations and maintain the integrity of stream channels. New temporary road construction would not cross streams or follow streams closely. Roads that are constructed or reconstructed would be temporary and would be rehabilitated after use. Reconstructed temporary road alignments have minimal connectivity to streams; the two seeps crossed would be rehabilitated after use would to restore them to their original bank and bottom configurations. System road repairs and maintenance have PDCs to protect the physical integrity of the aquatic system. The project would actively rehabilitate 1.82 miles of old road alignments that were never actively decommissioned or rehabilitated before. On system roads, the project would decommission 4.64 miles including several intermittent stream culverts and the removal of several cross drain culverts. It would stormproof 11.61 miles, close 1.84 miles and maintain 85 miles of system roads. It would repair road problems including adding one culvert where a stream shifted its path. As these enhancements are made, seep and stream crossings would be restored to their original bank and bottom configurations, and the physical integrity of these features would be enhanced. Changes in peak streamflows associated with vegetation manipulation and roads were assessed and it was determined that peak flows would not likely cause stream channel destabilization or impacts to the physical integrity of the aquatic system. (s. 1.4.7.1, s. 1.4.7.2, s. 1.4.7.3, s. 3.3.3.2, s. 3.3.3.6, s. 3.3.2 to 3.3.2.4, s. 3.3.4.2)

For these reasons, the objective of maintaining and restoring physical integrity of aquatic systems would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 4 - Water Quality

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

Temperature and sediment in the project area have been affected by the construction of roads, clearcutting in riparian areas and hydroelectric projects. Temperature and sediment situations are gradually improving as roads are improved or decommissioned and as riparian vegetation grows and provides shade. Recent enhanced minimum flows below Lake Harriet would mitigate some temperature issues in the lower Oak Grove Fork. (s. 3.3.1.3, s. 3.3.5.2)

The quality of water would be maintained by following PDCs that include restrictions on wet season logging and haul, equipment slope restrictions and erosion control methods. The project would actively rehabilitate 1.82 miles of old road alignments that were never actively decommissioned or rehabilitated before. On system roads, the project would decommission 4.64 miles, stormproof 11.61 miles, close 1.84 miles and maintain 85 miles. It would repair road problems including adding one culvert where a stream shifted its path. As these enhancements are made, water quality would improve. Stream protection buffers would maintain stream temperatures and filter out sediment where timber harvest is taking place. (s. 1.4.7.1, s. 1.4.7.2, s. 1.4.7.3, s. 3.3.3.3, s. 3.3.3.6)

PDCs for logging and road construction and maintenance would insure that project activities minimize sediment delivery. There would be some short-term localized increases in sediment delivery associated with temporary roads, culvert removal and other actions; however the level of sediment is very low compared to the natural background sediment level in the action area. The short-term sediment impacts associated with the temporary roads would also be spread out in time and space. The analysis of aquatic species found that the biological, physical and chemical aspects of water quality were within the range needed to support survival, growth, reproduction and migration. (s. 3.3.3.4 to 3.3.3.6, s. 3.4.1 to 3.4.3, s. 3.4.6, s. 3.4.7)

For these reasons, the objective of maintaining and restoring water quality would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 5 - Sediment Regimes

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

Even though this action area has a history of natural erosion processes through landslides and debris flows, human activities such as road construction have changed the frequency and timing of erosion processes. Road decommissioning efforts have already restored the highest risk road segments. The hydroelectric dams and Timber Lake reservoir have trapped sediment behind them. (s. 3.3.4, s. 3.3.3.5)

Peak stream flows were examined by assessing the effect of vegetation manipulation and roads on peak stream flows individually and in combination and it was determined that implementation of the project would not impact the timing, volume, rate or character of sediment input, storage or transport. The action area has recovered hydrologically as trees in young stands grow. Implementation of project activities including thinning mid-aged stands, repairing roads, rehabilitating reused temporary roads and decommissioning system roads are not anticipated to have any impact on base stream flows. The project would actively rehabilitate 1.82 miles of old road alignments that were never actively decommissioned or rehabilitated before. On system roads, the project would decommission 4.64 miles, stormproof 11.61 miles, close 1.84 miles and maintain 85 miles. It would repair road problems including adding one culvert where a stream shifted its path. As these enhancements are made, a more natural sediment regime would result at those locations. (s. 1.4.7.1 to 1.4.7.3, s. 3.3.3.6, s. 3.3.2 to 3.3.2.4, s. 3.3.4.2)

The project would implement PDCs that include restrictions on wet season logging and haul, equipment slope restrictions and erosion control methods. Stream protection buffers would trap material away from streams. New roads would not cross streams. Road repairs, maintenance, stormproofing and decommissioning would result in a road system that minimizes sedimentation. (s. 3.3.3.6)

For these reasons, the objective of maintaining and restoring sediment regimes would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 6 - In-Stream Flows

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

The project area is prone to rain on snow events. Past road construction and regeneration timber harvest caused some drainages to exceed hydrologic recovery standards. The trend in recent years has been toward full recovery as young stands grow. Compared to regeneration harvest, thinning has much less effect on hydrologic flow patterns and the potential for increased peak streamflows. The hydroelectric dams allow some amelioration of peak flows. (s. 3.3.1.3, s. 3.3.2 to 3.3.2.4, s. 3.3.4.2)

Peak stream flows were examined by assessing the effect of vegetation manipulation and roads on peak stream flows individually and in combination and it was determined that implementation of the project would not impact the timing, magnitude, duration or spatial distribution of in-stream flows. Hydrologic recovery would continue to improve, and the in-stream flow regime, including the magnitude of flows would be maintained. The action area would continue hydrologic recovery beyond the minimum levels identified in the Forest Plan and benefits to in-stream habitat for fish and other aquatic organisms would continue. The project would actively rehabilitate 1.82 miles of old road alignments that were never actively decommissioned or rehabilitated before. On system roads, the project would decommission 4.64 miles, stormproof 11.61 miles, close 1.84 miles and maintain 85 miles. It would repair road problems including adding one culvert where a stream shifted its path. As these enhancements are made, improvements to sediment, nutrient and wood routing would occur at those locations. Implementation of project activities including thinning mid-aged stands, repairing roads, rehabilitating reused temporary roads and decommissioning system roads are not likely to have any negative impact on base stream flows. Protection buffers would provide shade and riparian vegetation sufficient to prevent reduced flows during low flow periods. (s. 1.4.7.1 to 1.4.7.3, s. 3.3.3.6, s. 3.3.2 to 3.3.2.4, s. 3.3.4.2)

For these reasons, the objective of maintaining and restoring in-stream flows would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 7 - Floodplain Inundation

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

The timing, variability and duration of floodplain inundation and water table elevation in some meadows and wetlands have been altered by past clearcutting and the removal of large wood in streams over the past 50 years. Riparian reserves overlay and surround streams, wetlands, and wet meadows. (s. 3.3)

Protection buffers adjacent to streams, seeps, springs, ponds, meadows and wetlands would provide a source of small woody debris recruitment. The felling of trees into streams and the bucking of logs that span streams would provide an immediate benefit to streams. And over time, wood recruited to streams naturally from protection buffers would add complexity and slow flow as meanders and pools are created. By physically protecting these areas and by also protecting the timing, magnitude, duration and spatial distribution of peak, high, and low flows as described in Objective #6, the timing and duration of floodplain inundation and water table elevation in meadows and wetlands would be maintained. The action area would continue hydrologic recovery beyond the minimum levels identified in the Forest Plan as young stands grow, resulting in long-term restoration of floodplain habitats and water tables. (s. 3.3.2 to 3.3.2.4, s. 3.3.4.2, s. 3.4.4.1)

For these reasons, the objective of maintaining and restoring flood plain inundation and water tables would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 8 - Species Composition and Structural Diversity of Plant Communities

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

Past regeneration harvest has changed both the species composition and structure in riparian reserves. Stands are dominated by dense, mid-serial Douglas-fir stands. (s. 1.3.1.5, s. 3.1.2, s. 3.2)

Thinning in uniform mid-aged Douglas-fir stands in riparian reserves would diversify and restore native tree composition including retention of minor tree species. This project would promote the recruitment of structurally diverse plant communities by protecting areas of unique diversity such as wetlands, and by variable density thinning with skips, gaps, heavy thins and forage creation to enhance structural diversity. Gaps, heavy thins and forage areas would allow light to penetrate beneath the canopy and provide space for natural recruitment of diverse plant communities. Protection buffers along streams would provide for short-term wood recruitment needs. Trees would be felled into streams and logs spanning streams would be bucked to provide an immediate benefit. Thinned riparian reserves would promote the growth of trees and over the long term, provide sufficient large woody debris for uplands, riparian areas, and stream communities. (s. 1.3.1.5, s. 3.1.5, s. 3.2, s. 3.4.4.1, s. 3.4.4.2, s. 3.8.2)

For these reasons, the objective of maintaining and restoring species composition and structural diversity of plant communities would be met for this project because it would lead to improved conditions in the long term.

ACS Objective 9 - Well-Distributed Populations of Native Species

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

Past regeneration harvest and road construction has changed both the species composition and structure in riparian reserves. Aquatic species were affected by removal of shade, increases in sedimentation from road construction and the blockage of movement by culverts and dams. Some key aquatic species have become rare, and some unwanted plant species have flourished along roads and are outcompeting desired species. There is an ongoing trend of improving watershed conditions as trees and vegetation regrow, as roads are decommissioned and as uniform riparian vegetation is made more diverse. (s. 3.3.5.2, s. 3.4.1 to 3.4.3, s. 3.4.6, s. 3.4.7, s. 3.14)

Thinning prescriptions would retain minor native tree species and would restore uniform stands to a more diverse mix of native species and accelerate attainment of late-successional characteristics. Design criteria address measures to minimize the spread of invasive plants and to use native species for erosion control. Protection buffers along streams would provide for short-term wood recruitment needs and provide shade to minimize impacts to invertebrate and vertebrate aquatic and riparian-dependent species. Thinned riparian reserves would promote the growth of native trees and over the long term, provide sufficient large woody debris which benefits a wide range of native plant and animal species. A more diverse arrangement of large wood and native plants in riparian reserves and along streams would host native invertebrate, and riparian dependent species for the improved health of the aquatic and riparian system. (s. 1.4.9.G4 to H5, s. 3.2, s. 3.4.4.1, s, 3.4.4.2)

For these reasons, the objective of maintaining and restoring well-distributed populations of native species would be met for this project because it would lead to improved conditions in the long term.

ACS Summary

While some short-term impacts to aquatic resources have been disclosed, the impact would be minimal and in most cases undetectable at the subwatershed scale. The project would lead to improved water quality and enhanced riparian and watershed conditions in the long term because of the following:

- Stream protection buffers would provide sufficient stream shade, a source of woody debris recruitment to streams and would minimize the potential for sediment transport to streams.
- Variable density thinning with skips and gaps would enhance structural diversity in riparian reserves.
- Thinning in riparian reserves would accelerate the development of late-successional conditions.
- Felling trees into streams and bucking logs that cross streams would lead to improved stream conditions as pools develop.
- The decommissioning and stormproofing of system roads would lead to improved water quality.
- The rehabilitation of reconstructed temporary roads that were never actively decommissioned or rehabilitated before would improve drainage and permeability of compacted road surfaces.
- System road repairs and maintenance would allow for safe use while ameliorating water quality issues.

For these reasons, the objective of maintaining existing conditions or implementing actions that restore watershed and landscape-scale features in the long term would be met for this project. This project is consistent with the Aquatic Conservation Strategy Objectives.

3.5 GEOLOGIC STABILITY

This section summarizes the stability specialist report which is incorporated by reference and summarized below. The elements of the proposed action that may affect the initiation or acceleration of landslides include landing and temporary road construction and reconstruction, thinning, cutting trees for down logs, creating snags, and the removal of trees for road, landing, skyline corridor, and skid trail construction.

3.5.1 Methodology

The likelihood of project-induced landslides occurring within an area is determined by inspection of the slope by a slope-stability specialist. Thinning units, logging systems, road construction, reconstruction and repair and fuels treatments were all considered. All proposed thinning units are located in previous regeneration harvest units (clearcuts). Trees have a beneficial effect on slope stability by lowering the groundwater table through evapo-transpiration. Tree roots stabilize the upper several feet of soils. Previous regeneration harvest units that show no signs of shallow or deep-seated post-harvest slope instability are assumed to remain stable after thinning. Similarly, old roads that show no signs of shallow or deep-seated slope instability are assumed to remain stable after they are reused. Areas that have signs of instability are dropped from the project.

The determination of landslide incidence after the original regeneration harvest is accomplished by using historical aerial photos, existing landslide mapping (GIS layer), field reports of landslide incidence by other resource specialists, and field visits to selected units by a slope stability specialist.

3.5.2 Existing Condition

The project area contains three major terrain types: lower elevation hillslopes that are relatively flat, steeper mid-slopes, and higher elevation low-angle hillslopes. Each terrain type is a product of the type of rock, the age of the rock, and the weathering history of the rock. Most of the rock types in this area are of volcanic origin and can be divided into two groups: lava rock and pyroclastic rock. The lava rock is typically andesite or basalt that is resistant to weathering and forms steep hillslopes (older rock) or high elevation plateaus (younger rock). The original minerals present in the pyroclastic rock have typically been altered into clay minerals, resulting in a very weak material that is unable to support even moderately steep hillslopes. Extensive glaciation in the distant past oversteepened the valley walls. Once the glaciers melted and removed lateral support from the valley walls, large portions of those valley walls collapsed as massive landslides composed mostly of the highly altered, clay-rich, pyroclastic material.

The lower elevation relatively flat hill slopes are ancient landslide deposits. These landslide deposits developed thousands of years ago during a much wetter climate than our present climate. During that time unstable hillslopes collapsed and formed earthflows and large debris slides that became large coalescing deposits of landslide material. These landslide deposits can be several square miles in area and may be several hundred feet deep. Slope angles are usually gentle. These landslide deposits are more stable now than they were in the past but there are still portions of them that are adjusting to their “new” slope position. These adjustments are typically expressed as small landslides (slumps or debris slides) that occur at locally steep areas of the ancient landslide deposits, for example, along certain stream banks. These adjustments usually occur during or immediately after major storm events, when the ground water table is high. Most of the ancient landslide deposits are dormant and would require a major change in their hydrology or slope geometry to become active again.

Some ancient landslide deposits have been recognized as being recently active. Evidence for recent movement includes fresh scarps, cracks, very tilted trees, and similar clues. Most of these recently active landslide deposits have been mapped. These usually small areas can include a variety of landslide types, but they are usually earthflows, debris slides, or slumps.

The large, ancient, mostly-dormant, landslide deposits in this area have been classified as high risk earthflows, moderate risk earthflows, and low risk earthflows. The high-moderate-low adjectives describe the relative susceptibility of the terrain to reactivation of ground movement from any cause. High and moderate risk earthflows are included in their own land allocation and are covered by the ‘B8 – Earthflows’ set of Forest Plan standards and guidelines. The low risk earthflows do not have a land allocation because they are relatively stable but are covered by a set of standards and guidelines at FW-001 to FW-021.

Landslide hazards on the steep mid-slope terrain are usually debris slides and debris flows. Debris slides typically occur on slopes that are greater than 60%. Debris flows typically originate in channels that have a gradient that is steeper than about 35%. In this area many of the larger creeks originate on the upper valley walls where the stream gradients are steep, and the channels are incised enough that debris flows are relatively common. Many debris flows are naturally occurring such as the recent one near Station Creek that originated in the Wilderness. These streams are referred to here as debris-flow-prone.

The third major terrain type is the relatively flat, high-elevation plateaus that occur west of Mt. Mitchell, along the top of Oak Grove Butte, and the higher ground east of

Shellrock Creek. As a result of the low slope angles, landslides of any type are very unusual.

The following table displays the Grove units that occur or mostly occur within each of the three major terrain types. The temporary roads associated with these units were also considered.

Terrain type	**Grove Thinning unit numbers**
Ancient landslide deposits	2, 4, 8, 10, 12, 14, 15, 20, 22, 24, 26, 28, 30, 88, 90, 91, 92, 93, 94, 95, 96, 100, 102, 103, 104, 105, 106, 110, 112, 114, 116, 118, 120, 122, 136, 138, 140, 141, 142, 148, 152, 154, 155, 156, 158, 160, 162, 164, 166, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 191, 202, 203, 204, 206, 209, 210, 211, 212, 213, 214, 216, 218, 220, 222, 224 226
Steep mid-slope	16, 17, 34, 36, 38, 42, 44, 46, 54, 56, 57, 58, 64, 66, 68, 70, 72, 74, 78, 82, 84, 86, 124, 126, 128, 130, 132, 134, 192, 194, 196, 198, 200, 208, 228
High elevation plateau	50, 52, 60, 62

Poorly located, poorly constructed, or poorly maintained roads can result in slope stability problems and can result in resource damage. Well-located, well-constructed, and well-maintained roads or decommissioned or rehabilitated roads would have a minimal effect on slope stability. Most of this area was heavily roaded beginning in the late 1950s and continuing through the 1980s. Road construction practices gradually improved though the decades but there remain many roads that were poorly located and/or poorly constructed in the past.   Without proper maintenance these roads can be a threat to water quality and fish habitat. Beginning in the mid-1970s and continuing to the present, many unstable portions of existing roads have been rebuilt or modified to stabilize the road and the hillslope. More recently, road decommissioning projects have removed many problem areas and reduced the potential for road-related landslides and the resulting adverse effects on water quality and fish habitat.

The proposed thinning units were previously logged. The removal of all the trees in an area with regeneration harvest has a much greater impact on the slope stability than a thinning would. The level of stability of the slopes of all the proposed thinning units was therefore "tested" in the past by that original harvest. Similarly, when roads were constructed many years ago, the slope stability was "tested." A conservative approach to evaluating the effects of thinning on slope stability is to identify the areas of the original harvest units that show evidence of landslide activity and exclude those areas from any future harvest. It is presumed that areas that remained stable after the original regeneration harvest would continue to be stable after thinning. Similarly, when evaluating the effects of reconstructing an existing road alignment, the slope stability specialist would examine the route for evidence of landslide activity and exclude any unstable alignments from the proposal.

Debris flows are a natural process in this area and have the beneficial effect of delivering boulders and large woody debris to lower elevation stream segments which enhance fish habitat. Debris flows can have detrimental effects also, such as knocking down riparian vegetation, crushing fish, delivering excess fine sediments to fish habitat, or blocking road crossings and diverting drainages. Poorly designed or poorly located road/creek crossings can impede this natural process and have an adverse effect on fish habitat. When debris flows reach a road, they can pass through the crossing unimpeded, they can be stopped completely, or they can block the culvert, divert the water flow, and cause extensive erosion of the road fill. In a worst case scenario, a debris flow can be temporarily stopped at the crossing and allow more water and sediment to accumulate behind the crossing, until the entire crossing structure fails catastrophically. The debris flow then continues down channel, much larger and more destructive then it would have been without the interference from the road crossing.

3.5.3 Landslide Analysis

The determination of landslide incidence after the original harvest was accomplished by using historical aerial photos, existing landslide mapping, field reports of landslide incidence by other resource specialists, and field visits to selected units by a slope stability specialist.

The slope stability specialist visited all units and roads that contained mapped active landslides and all other units and roads reported to have a landslide by other resource specialists.

The following table displays the units that fell into one of the above two categories and were examined in the field by the slope stability specialist.

Category	Grove Thinning unit number
1	8, 14, 42, 44, 46, 86, 93, 94, 114, 124, 126, 152, 180, 186, 226, 228
2	190

There are some mapping inaccuracies present in the GIS coverage of the mapped active landslides. The GIS layers were developed from mapping that was prepared long before the advent of modern-day digital, spatial and satellite tools. The original GIS layers were generated at a relatively coarse scale of resolution. This resulted in some map overlap between the proposed thinning units and the mapped active landslides that did not actually exist on the ground. Usually these false overlaps were small sliver polygons.

The boundaries of six proposed thinning units were modified to exclude from thinning those areas that were judged to be unstable or potentially unstable: 8, 124, 126, 186, 226, and 228. The roads proposed for reconstruction were found to be stable.

Additional unstable or potentially unstable areas may be discovered during unit layout. If so, then a slope stability specialist would check the area and guide or assist with unit layout.

3.5.4 Direct and Indirect Effects for Landslides

No Action

No thinning would occur. The overcrowded trees would continue to grow slowly. Existing shallow landslide scars within the project area would slowly heal as vegetation became denser. The level of instability of deeper-seated active landslide areas would likely remain about the same.

Road access would remain as it presently exists. No road decommissioning would occur. Little maintenance or repair of existing roads would occur except on primary recreation access roads. As a result, there would be an increasing risk of resource damage from certain segments of the existing road system.

Proposed Action

Thinning would occur in areas that are considered to be stable by a slope stability specialist. Known unstable or potentially unstable areas have already been deleted from the proposed thinning units. Additional unstable areas identified during unit layout would also be deleted or designated as skips. The thinning would enhance tree growth and tree root growth over the long term, moving the desired hill slope stability to original levels. The thinning would likely reduce hill-slope stability slightly for a few years after thinning when dying tree roots have not yet been replaced by new root growth. Existing shallow landslide scars within the project area would be protected and would continue to slowly heal as vegetation on the scars became denser. The level of instability of deeper-seated active landslide areas would be unaffected by the thinning.

The construction of 0.20 mile of new temporary roads and the reconstruction of 5.35 miles of existing road alignments would is proposed. All temporary roads are located on stable ground and their construction or reconstruction would have no perceptible effect on slope stability. These roads would be rehabilitated after use. Existing system roads that would be used for timber haul would be maintained and repaired. These actions would greatly reduce the risk of resource damage from these roads. Decommissioned system roads would total 4.64 miles; closed system roads would total 8.45 miles.

Properly decommissioned roads reduce the potential for road-related landslides and the resulting adverse effects on water quality and fish habitat. Roads that are properly decommissioned or storm-proofed and closed require no maintenance and therefore allow the limited forest road maintenance funds to be applied more effectively to a smaller road system.

3.5.5 Cumulative Effects for Landslides

Recent projects in the analysis area include thinning of second-growth trees, planting trees, road decommissioning and road repair projects.

All thinning projects in this area have been previously examined by a slope stability specialist and the unstable portions of the thinning units if any, have been dropped from the project. The thinning projects would result in a temporary reduction in the tree canopy, which would very slightly increase peak stream flows in the project area. Stream channels would be protected with buffers that would mitigate against increases in channel bank instability. The longer-term effect would be an increase in slope stability and water quality.

The road decommissioning projects would have a beneficial effect on slope stability and water quality. These projects would remove stream crossings and some road segments on potentially unstable ground and allow more road maintenance to occur on the roads that remain.

The road repair projects would also have a beneficial effect on slope stability and water quality. Better maintained roads have less environmental impact than poorly maintained roads.

Recent projects in the analysis area would have a net beneficial effect on slope stability regardless of the impacts of other nearby past, present, or reasonably foreseeable future actions.

3.5.6 Analysis of Direct Indirect and Cumulative Effects for Earthflows

The elements of the proposed action that would affect hydrologic recovery of earthflows include thinning, cutting trees for down logs, creating snags and the removal of trees for road, landing, skyline corridor and skid trail construction. The analysis areas are the individual earthflows (s. 3.5.6.2).

3.5.6.1 Methodology

The Aggregate Recovery Percentage (ARP) index is used to estimate the potential for adverse cumulative effects related to past, present and foreseeable future actions. It is also a tool to determine compliance with Forest Plan standards and guidelines pertaining to cumulative earthflow effects (Forest Plan, B8-031 and B8-032). By measuring the percent of an area in a hydrologically recovered condition, the ARP model evaluates the risk accelerating the movement of earthflows. In stands with little or no forest canopy cover within the transient snow zone, more snow accumulates than beneath a partially or fully hydrologically recovered forest.

The ARP model ranks recovery from 0 to 100 with 100 being fully recovered. Stands that have trees greater than 8 inches in diameter and over 70% canopy cover are considered fully recovered in terms of hydrology (Forest Plan, FW-064, B8-031 and B8-032). In the ARP model, stand age is used to determine whether stands meet these criteria. Forest hydrologists have developed recovery curves to model the changes to hydrology as young stands grow as well as the effects to hydrology for projects such as thinning that remove only a portion of the trees in a stand. A regeneration harvest would result in a stand that would be modeled at zero% recovery. As time goes by the stands would grow and recovery would gradually occur. Depending on site conditions, full recovery may take approximately 25 years. Note: Hydrologic recovery is not the same a soil recovery; with no intervention, detrimentally disturbed soils may take longer to recover.

The ARP analysis includes the elements of the proposed action that would affect hydrologic recovery. Where applicable, the ARP analysis also addresses many other factors including:

- All past timber harvest, road construction, rock quarries, and other openings such as the power line and pipe line;
- Projects that are under contract but not yet completed;
- Recent wildfires;
- Roads that have been recently been decommissioned and others that are planned for the near future; (As these road beds begin to grow trees and close in they would become hydrologically recovered but this process would take many years for full recovery.)
- Other ownership; (In the Project area there is one private parcel of 52 acres owned by PGE. Past vegetation management is included but there are no foreseeable future timber harvest projects on this parcel.)
- Other foreseeable actions. (While it is likely that there would be thinning or other stand management in the future, there are no other current proposed actions to include in the ARP calculation at this time. Future actions cannot be known site specifically at this time. The appropriate consideration of cumulative effects for unspecified future project would be at the time an environmental analysis is conducted for those future projects.)

Ongoing thinning projects within the Earthflows are included in the analysis of cumulative effects. For this area there is only one recent/ongoing project: Swag (120 ac). The analysis also tracks projects by name that were implemented between 2000 and the present. The analysis includes harvest before 2000 even though it is not tracked by name. There have been no recent wildfires that overlap the earthflow analysis areas.

Since it is not practical to visit thousands of stands, the condition of current vegetation was derived from a GIS vegetation layer. This file contains the sizes, shapes, locations and vegetation characteristics for all stands as they have been modified and affected by factors such as past timber harvest, tree growth and fires. A computer model in the analysis file contains the spatial data and ages of the stands derived by intersecting the GIS vegetation layer with the drainage layer.

Earthflow	**Grove Thinning unit numbers**
High Risk - Ripplebrook	2, 4, 8, 10, 12, 14, 20, 22, 24, part of 30, 91, 93, part of 94, 95, part of 96, 100, 102, 103, 104, 105, 106, 110, 112, 114, 116, 118, 120, 122, 136, 138, 140, 141, 142, 148, 152, 154, 155, 156, 158, 160, 162, 164, 166, 170, 172, 174, 176, 178, and the temporary road alignments that access these units including 1.48 miles of existing and 0.2 mile of new temporary roads.
Moderate Risk - Tag	180, 182, 184, 186, 188, 190, 202, 203, 204, 206, 209, 210, 211, part of 212, 214, 216, 218, 220, 222, part of 226, and the temporary road alignments that access these units including 0.45 mile of existing temporary roads.
Low Risk	None

3.5.6.2 Existing Condition

The stands proposed for thinning are currently hydrologically recovered. Because there has been relatively little regeneration harvest in the past two decades, all of the earthflows are steadily moving toward full recovery. The ARP values are increasing by approximately 1% per year in these areas as young stands grow. The following table shows the current condition for each earthflow.

Earthflow Name	Acres	Current Condition
Ripplebrook	5,718	93.1%
Tag	2,792	94.9%

3.5.6.3 Direct and Indirect Effects

There would be no change in terms of earthflow stability as measured by the ARP model under any alternative because the ARP values remain above 90%.

The following table shows the reduction in ARP value with project implementation.

Earthflow Name	Acres Thinned	Percent Change
Ripplebrook	388	1.2%
Tag	354	2.3%

Individual stands that are thinned below 70% canopy cover would be considered partially recovered in terms of the ARP model. These impacts would last a few years until canopy closes in again as trees grow in response to the thinning. With the relatively high levels of hydrologic recovery for these earthflows, the slight changes associated with the project would not likely cause the acceleration of movement of earthflows.

3.5.6.4 Cumulative Effects

Individual earthflows are the logical analysis area for cumulative effects because actions on stable ground outside earthflows are not likely to affect the stability of earthflows. In terms of the time frame, past actions are included where they resulted in stands that are not yet hydrologically recovered: this would include clearcuts that occurred within the past 30 years, and all roads and other created openings regardless of their time of creation because they are currently considered unrecovered. The analysis above includes all past and foreseeable timber harvest, fires, roads, quarries and the power line right-of way. Since there are no other foreseeable future actions to include in the analysis, there would be no additional cumulative effects other than the ones already analyzed.

Cumulative effects pertaining to earthflow stability are not expected because changes to hydrologic recovery as projected by the ARP model are very small in a landscape that is steadily moving toward full recovery.

3.5.6.5 Forest Plan Consistency

This analysis has focused on B8-031 and B8-032. The project is fully consistent with them.

Earthflow Name	Risk Level	Forest Plan Goal	Proposed Action 2014
Ripplebrook	High	90%	92.3%
Tag	Moderate	75%	93.5%

Note: the figures at s. 3.5.6.2 and 3.5.6.3 cannot be subtracted directly to obtain the figures for 2014 because there is additional growth that occurs in all of the plantations on the earthflows. In other words, the ARP values are ever changing as stands grow. Even though 2014 is projected as a harvest date, it is highly likely that this harvest would be spread out over several years and therefore ARP values would likely be even higher by then.

The proposed action is consistent with the following standards and guidelines.

FW-001 to 003	Slope stability has been examined in the field and the project is consistent with goals of maintaining stability.
FW-004 to 009	Active landslides have been avoided. (Earthflows are not active landslides)
FW-010 & 011	Debris slide and debris flow areas have been avoided.
FW-012 to 014	The slope stability specialist report has documented geologic hazards and made recommendations for project adjustments.
FW-015 to 016	Where appropriate, road repairs are proposed on haul roads that would stabilize actively moving areas.
FW-017 to 021	These apply to low risk earthflows. There are no low risk earthflows affected by the project.
B8-009 to 024	These wildlife standards are addressed in the Deer and Elk section 3.8.3.4.
B8-028 to 037	See discussion of B8-031 & 032 above and exception for B8-036 in the soils section at s. 3.6.8. Even with this exception, earthflow stability would not be affected. The slope stability specialist has found the project to be consistent with the goal of maintaining stability.
B8-040	See exception for soil productivity standard B8-040 in the soils section at s. 3.6.8. Even with this exception, earthflow stability would not be affected. The slope stability specialist has found the project to be consistent with the goal of maintaining stability.
B8-048 to 051	Roads were examined in the field and assessed in the slope stability specialist report. Some temporary roads would be reconstructed and then rehabilitated: they do not cross the toe or scarp of any earthflows. Some system roads would be decommissioned and stormproofed in a manner which would add to the stability of earthflows. Road maintenance and repair would also occur with an emphasis on drainage structures. These practices were designed to prevent the reactivation or acceleration of unstable areas. The slope stability specialist has found the project to be consistent with these standards and guidelines.

All unstable and potentially unstable areas have been examined and dropped from this project. This project would maintain the existing slope stability in this area and would improve it as thinning enhanced tree growth and tree root growth.

3.6 SOIL PRODUCTIVITY

This section summarizes the soil specialist report and data in the analysis file. This section details potential effects to the soil resource for the proposed treatment units. Other sections cover related topics including the geology (s. 3.5), water quality (s. 3.3) and fisheries (s. 3.4).

The productivity and health of entire plant communities depend on the maintenance of healthy soils. Soil distribution is complex across the watersheds where this analysis area is located. Soil types are discussed in the soil specialist report, including their qualities such as erosion and compaction hazards.

3.6.1 Methodology

Revised soil mapping - Each soil map unit (number) has been assessed for many risks and hazards called management ratings (e.g. erosion risk, compaction hazard, etc.), which are located in the Mount Hood National Forest Soil Resource Inventory (SRI, Howes, 1979). The SRI is most useful as an initial broad-scale planning tool to identify and display maps of possible soil concerns or sensitive areas. Interpretations are based on observations of soil characteristics at sites representative of the entire soil mapping unit.

Because of the scale of the SRI (1 inch per mile), soil properties can vary significantly within a mapping unit and on-site investigations are often required to refine or modify interpretations. Qualified soil scientists adjust management interpretations to reflect on the ground conditions and provide resolution to the soil map units at a site-specific scale.

Priority stands were chosen for field evaluation and validation of SRI soil mapping. Appropriate map changes were made to reflect field observations. With updated and validated soil mapping, pertinent management interpretations should be more accurate and therefore provide high confidence when determining levels of risk.

The methodology used to gather data for this effects analysis included a review of previous soil reports and mapping in the area, field visits, and aerial photo interpretation. In addition, previous field experience, and professional observation and knowledge of how soils respond to the proposed types of management actions were used to predict impacts.

Assessment of existing soil disturbance condition – The extent of detrimental soil condition was determined from field observations of a sample of proposed treatment units visited during the fall of 2011 and spring of 2012. Stands were chosen based on logging method, with emphasis on ground based systems. Skyline and helicopter stands were not visited as intensively because of the relatively small soil impacts resulting from those logging methods as compared to ground based logging.

The condition of soils was evaluated for the amount of detrimental disturbance from past activities using a combination of qualitative measures and professional judgment. Qualitative data was acquired by classifying soil disturbance using Howes Disturbance Classes, developed on the Wallowa-Whitman National Forest (Howes, 2000). This is a process that breaks soil disturbance into six classes based on visual evidence. The visual evidence is correlated to infiltration rates, percolation, channeling of surface water, productivity, potential restoration work, and Regional and Forest Plan standards and guidelines. Soil disturbance features observed in the field were compared to past treatment activities observed on old aerial photos (from the earliest flight flown after the stand was originally clearcut). The level of disturbance was rated as a percentage of each unit area.

3.6.2 Measures

For this analysis three measures are used to assess impacts; accelerated erosion, soil disturbance and organic matter.

Erosion

Natural, or geologic erosion, is erosion of the earth surface under natural or undisturbed conditions. It includes loss of soil particles from weathering processes and by forces of water, wind and gravity. Natural erosion occurs at a relatively uniform rate except during extreme natural events when large quantities of soil can erode in short periods of time. Under natural conditions, vegetation and other effective ground cover retards erosive processes. Removal of vegetation, concentration of overland flow, or interception of subsurface flow by harvest, road building, or other ground moving activities disturbs natural conditions and the erosion rate accelerates. Accelerated erosion is the increase in soil erosion and sediment production over natural erosion.

Soil erosion can directly affect soil productivity by reducing soil depth and volume, resulting in a loss of nutrients and water holding capacity. An indirect affect from soil erosion is runoff from bare areas carrying soil particles to water bodies where it becomes sediment. Sediment is also addressed in section (s. 3.3.3.6). This hazard rating is based upon soil properties that affect detachability, such as climate, slope gradient and length, soil texture and structure, permeability of the surface soil, and hydrologic characteristics of the soil and bedrock materials. Management ratings for erosion risk, as an example, follow the variability of the soils across the landscape, with some soils mapped with a severe erosion risk, others with slight, and many in between. Although ratings are a good preliminary analysis tool, in actuality almost any soil regardless of rating can become more erosive than rated depending on site specific circumstances. Soils with a slight erosion risk rating that are compacted and bare can become erosive even on gentle slopes. Conversely, erosive soils occurring on very steep slopes in this analysis area may be stable for decades because of sufficient protective groundcover (tree needles, leaves, wood, rocks, etc.). The naturally occurring background levels of erosion and sedimentation are discussed at section 3.3.3.5. Accelerated erosion is measured by acres of exposed soil.

Soil Disturbance
Soil productivity and soil water storage capacity can be affected by compaction, puddling, displacement, erosion and severe burning. These conditions, if severe enough can result in soils that have low levels of porosity, reduced root penetration, increased runoff, reduced infiltration, reduced soil water storage capacity, reduced soil water availability, reduced nutrient availability, and reduced levels of mycorrhizae and other soil organisms. Soil disturbance is measured by percent of units in detrimental soil condition. Not all soil disturbance is wide-spread or severe enough to be considered detrimental: the Forest Service Manual contains guidance on the size and intensity of disturbance sufficient to cross the threshold to detrimental soil condition. (Forest Service Manual 2521.1, Region 6 supplement 2500-96-2, effective 6/4/96)

Organic Matter
Soil fertility and soil biological systems would properly function if certain components are present, such as appropriate levels of organic matter. Organic matter includes all of the material on the forest floor such as duff, leaves, twigs and coarse woody debris. Poor or non-functioning soil biological systems may lead to difficulties in revegetation efforts, a decline in existing desirable vegetation or a reduction of long-term site productivity. Soil biology involves complex interactions occurring between organisms and their soil habitats, including physical and chemical characteristics. Organic matter is measured by acres of soil organic layer removed.

3.6.3 Analysis Area

The analysis areas for soil resources for direct, indirect and cumulative effects are the boundaries of the stands proposed for thinning, the boundaries of the fuel break, and decommissioned road locations. These are appropriate boundaries because actions outside these areas would have little or no affect to soil productivity within the thinning units, and the actions within and adjacent to the thinning boundaries, fuel break and roads, would have little or no affect to soil productivity elsewhere. In terms of the time scale, timber harvest and road construction that has occurred since the 1940s has created soil impacts that remain today.

Elements of proposal that could affect soil productivity

For this project, the following actions have the potential to adversely affect soil productivity: actions that disturb soil such as the skidding and yarding of logs, the use of mechanical tree harvesting equipment, the construction and reconstruction of temporary roads and landings, the creation of a fuel break, and the burning of slash piles. Other aspects of the proposed action such as road reconstruction or repair, road closures, log haul, and the creation of snags would not have a meaningful or measurable effect on soil productivity because they do not alter soil conditions. Some actions are specifically designed to benefit soil productivity including the creation of down logs, road decommissioning, and decompacting temporary roads and landings.

The analysis also considers restorative actions and the design criteria and best management practices that are intended to minimize the extent of detrimental soil impacts. For example: existing roads, landings and skid trails would be reused where feasible, equipment would be restricted to appropriate slopes, erosion control methods such as water bars, seed and mulch or slash cover would be used.

3.6.4 Existing Condition, Direct, Indirect and Cumulative Effects

The current condition described in the analysis below incorporates all past actions that have occurred within the analysis areas which correspond to the proposed project boundaries. There are no other ownerships to consider within the analysis areas. There are also no foreseeable future actions to include. While there may be future thinning or other actions, there is no proposal now for future actions that have sufficient site specificity to conduct an analysis.

3.6.5 Erosion

3.6.5.1 Existing Condition

In the Grove project area, surface soil erosion potential varies from moderate to very severe in some areas but is slight to moderate in other areas. Similarly, subsoil erosion potential ranges from high to low. Ground cover can be used as an indication of erosion risk. All of the units have well above 90% groundcover. Existing surface erosion is mainly confined to exposed soil on active landslides, unpaved road surfaces, road cutbanks, and ditches.

3.6.5.2 Direct and Indirect Effects

Soil erosion can directly affect soil productivity by reducing soil depth and volume, resulting in a loss of nutrients and water holding capacity. An indirect effect from soil erosion is runoff from bare areas carrying soil particles to water bodies where it becomes sediment, (see s. 3.3.3.6). Other negative effects occur such as decreased air quality from dust (silt size soil particles) carried in the atmosphere.

3.6.5.3 No Action

Erosion rates within the analysis area would remain as they are in the short term. Over time, as bare areas become revegetated, erosion levels would decrease. If an existing slide were to become more active, or if new landslides were to occur, an increased level of soil erosion would be expected in the exposed soil areas.

3.6.5.4 Proposed Action

Soil erosion risk would increase with the proposed action because bare soil would be exposed during implementation. Erosion would not occur where duff and other effective ground cover is retained. Therefore, practices which limit the amount of soil exposure, or which re-establish ground cover after soil is exposed, would result in less erosion occurring. Of the proposed yarding systems, ground based systems result in a greater amount of ground exposure than skyline and helicopter systems. Units that are prescribed for ground based yarding systems generally have gentle to moderate slopes, so even if the potential for erosion may be high, eroding materials would not move far before redeposition occurs.

Bare soil would be exposed as logs are dragged on the ground and machines travel over the ground surface. Approximately 6 acres of temporary roads, 26 acres of landings not on existing road surfaces, and 91 acres of felling and yarding area would be used or reused. Most of this acreage was disturbed during past regeneration harvest, but currently has effective ground cover. A total of approximately 123 acres would have potential accelerated erosion as a result of thinning activities. Disturbed areas, particularly where slopes are greater than 25%, would be potential chronic sources of sediment until successfully revegetated or sheltered by effective ground cover.

Actual resource damage (accelerated erosion or sedimentation) is dependent on ground cover and weather events that provide the energy to move soil material from one location to another. In order to diminish this risk while soils are exposed, certain erosion control techniques which limit the amount of soil exposure, or which re-establish ground cover after soil is exposed, are implemented to lessen erosive energies. The use of PDCs for stream protection buffers, designated skid trails, waterbars, and establishing effective ground cover by applying logging slash or seed, fertilizer, and mulch on the disturbed soils, reduce erosion features and disturbance, and results in a low potential for soil to be moved to streams and a low potential for substantive effects to soil productivity.

There are circumstances in which erosion risk is higher. Skyline units with downhill yarding are proposed on steep, highly erosive soils (units 138 & 226). Logs dragging downhill may create depressions in the yarding corridors from which it might be difficult to remove water. Because yarding corridors in a downhill system typically come together at the landing, any water and soil travelling down the corridors could be concentrated at the landing. Unit 138 has a flat area between the downhill skyline section and the landing where waterbars can divert water away from the road. Unit 226 was logged once before with a downhill skyline system and at that time waterbars were sufficient to minimize impact at the road and landing. The risk of water flowing down skyline corridors to create problems at the landing would be minimized by establishment of waterbars and other techniques to divert water to the side and the establishment of ground cover.

The road decommissioning and stormproofing projects would have a beneficial effect on long-term erosion rates and water quality. These projects would increase infiltration capacity of the roadbeds, resulting in a reduction in overland flow, establish effective ground cover on the road surfaces and allow for revegetation.

The fuel break would not use heavy ground disturbing equipment and would not likely result in any erosion.

3.6.5.5 Cumulative Effects - Erosion

See sections 3.6.3 & 3.6.4 for discussions of analysis areas and time frames for cumulative effects analysis. In some areas, past ground disturbance including clearcut logging, and road and landing construction, ground cover was removed. Since then, the stands have regrown groundcover protecting the soil surface and erosion has decreased. Existing surface erosion is mainly confined to exposed soil on unpaved road surfaces, road cutbanks and ditches.

Best Management Practices and design criteria would result in little erosion from the proposed action combined with past actions because sufficient ground cover would be applied or retained. The cumulative effects of the proposed actions when combined with past actions and foreseeable future actions would not be substantial and trees and other vegetation are expected to continue growing and developing at appropriate rates.

3.6.6 Soil Disturbance

3.6.6.1 Existing Condition

Soil disturbance includes soil compaction, soil displacement and puddling, and severe burning. The majority of readily observable detrimental ground disturbances in the field were heavily compacted old skid trails, landings, and temporary roads. Also observed were areas where displacement had occurred from historic logging activity. It was observed that units visited still show signs of skid trail, landing and temporary road compaction or displacement.

In some cases, old skid trails, landings, and temporary roads have trees, brush or other vegetation growing on them. To the casual observer, this vegetation may appear to be evidence that these features have "recovered." While the vegetation does provide some cover to mitigate erosion as discussed in section 3.6.5, it does not indicate the recovery of soil disturbance: the areas remain compacted and displaced top soil has not been replaced. Even where vegetation is growing on some old skid trails, landings or temporary roads, there has not been substantial recovery in terms of soil productivity. Generally, historic disturbance still rates as detrimental in nearly all cases.

The percentage of area in a detrimental soil condition varies from stand to stand due to the occurrence, manner, and extent of past timber harvest and fuel treatment activities. Most stands were clear cut harvested from the 1950s to the mid 1970s and subsequent site preparation included broadcast burning, or machine piling. Management practices at that time did not restrict machine movement, skid trail density, removal of woody debris or intense burning; therefore existing detrimental impacts to soil are generally higher than allowed under the current Forest Plan standards and guidelines. The estimated percent area of detrimental soil condition in each of the treatment units can be found in the analysis file.

Existing detrimental soil condition was calculated to range from 9.5% to 23.5% in the proposed units. The remaining portions of the proposed units have soils in good condition. It is estimated that all units located on earthflow terrain exceed the Forest Plan standard of 8% detrimental condition, and that 21 of the 46 units located on non-earthflow soils exceed the Forest Plan standard of 15% detrimental condition. None of the areas in units previously logged with cable methods exceed 15%.

Direct and Indirect Effects

3.6.6.2 No Action

No further losses or gains in soil productivity in the short or long term are expected with this alternative. Detrimental conditions in the units would remain. Existing temporary logging roads and landings would not be restored, and would likely remain in a detrimental condition for the foreseeable future. Detrimental soil compaction and displacement would remain localized to existing system and temporary roads, skidtrails and landings.

In the long term, percent disturbed soil condition would slowly decline as compacted areas move toward recovery due to physical and biological processes, but the rate would largely be dependent on root growth of vegetation, the resilience of the soil, and the intensity of the disturbance.

The effects of soil displacement on skid trails, roads and landings would last a long time because soil formation is a slow process, on the order of hundreds of years or more.

3.6.6.3 Proposed Action

Changes to disturbed soil condition were estimated. Existing landings, temporary roads, and skid trails would be reused where feasible.

A net increase in disturbed soil condition is predicted particularly where ground-based equipment is used such as mechanical tree fellers and where more skid trails, yarding corridors, landings and roads would be constructed than already exist. This increase is expected to stay below 7.6% on ground based units due to spacing of designated skidtrails at 150’ apart, but on many units, where a large number of skidtrails are existing from the original clearcut entry and would be reused, the increase may be lower, at 3-4%. On skyline units, the increase is estimated at 2% to 3%, and on helicopter units at 1%. The range of estimated changes in detrimental condition created by the proposed action is shown in the table below. The estimated percent area of detrimental soil condition in each of the treatment units can be found in the analysis file.

The proposed action includes temporary road rehabilitation and system road decommissioning. The rehabilitation of skidtrails is not proposed because the roots of trees have penetrated into the skid trails, deep soil tillage on skid trails would cause adverse impacts to roots, leading to reduced growth, and increased root disease and tree mortality. The opportunity to mechanically rehabilitate skid trails may come in the future if and when regeneration harvest occurs.

A net increase in disturbed soil condition is predicted where more skidtrails, yarding corridors, landings and roads would be constructed than already exist. It is estimated that the direct effect of the proposed action would range from a reduction of approximately 6% to an increase of approximately 7.6%. A spread sheet in the analysis file has a calculation for each unit. The reductions come from units that would have temporary roads and landings rehabilitated. Revegetation would initiate sufficient recovery of productivity and increase soil water storage.

There would be no accompanying measureable decrease in site productivity in the units. Decompaction and establishment of effective ground cover on landings and temporary roads would initiate recovery of productivity and increase soil water storage.

3.6.6.4 Cumulative Effects – Soil Disturbance

See sections 3.6.3 & 3.6.4 for discussions of analysis areas and time frames for cumulative effects analysis. The table below shows a summary of effects from past actions, the estimated effects from the proposed action, and the cumulative effects of the past plus proposed actions.

Past Actions	Direct Effect Proposed Action	Cumulative Effect
9.5% to 23.5%	-6% to 7.6%	7.1% to 26.9%

The following non-earthflow units would present the greatest likelihood to exceed 15% detrimental soil condition after treatment: 15, 26, 28, 34, 36, 38, 44, 46, 50, 52, 54, 56, 57, 58, 60, 62, 64, 66, 68, 70, 72, 74, 78, 82, 84, 86, 128, 132, 134, 138, 196, 198, 208, 226, 228.

The following earthflow units would continue to exceed 8% detrimental soil condition after treatment: 2, 4, 8, 10, 12, 14, 20, 22, 24, 30, 90, 91, 92, 93, 94, 95, 96, 100, 102, 103, 104, 105, 106, 110, 112, 114, 116, 118, 120, 136, 140, 141, 142, 148, 152, 154, 155, 156, 158, 160, 162, 164, 166, 170, 172, 174, 176, 178, 180, 182, 184, 186, 188, 190, 191, 202, 203, 204, 206, 209, 210, 211, 212, 213, 214, 216, 218, 220, 222, 224.

Even though many of the units have relatively high levels of detrimental soil condition there is no apparent symptom in the amount or quality of vegetation including trees, currently within these units except on some landings and temporary roads. Detrimental soil condition is built on the premise that soil damage negatively affects vegetative growth by reducing site productivity caused by a reduction of soil water and nutrients. It might be expected that a stand with existing detrimental soil conditions at 24% would have visible signs of stressed trees. Yet this is not the case; all units are growing at appropriate rates as demonstrated by stand exams that show no reduction in site productivity compared to similar stands with low levels of detrimental soil condition (s. 1.3.1.3 & s. 3.1). There are a few factors that may explain this:

- The shape and distribution of the damage is usually long and linear and not concentrated. There may be sufficient undamaged growing space spread out between the old skid trails to support the stand of trees we see today.

- The local climate of the area is very conducive to high levels of vegetative production, and it is possible that the high measured level of detrimental soil impact does not affect site productivity as much as it would in drier areas.

- While soil impacts are long lasting, there is a gradual continuum of recovery that may be underestimated. New data from recent sampling of soil conditions found that, on heavily compacted skid trails, the change in pore-size distribution was different than expected; indicating an unexpected resilience and that certain detrimental soil impacts might not be as long-lived as initially believed.

In dense stands, site and soil resources are used by all the stems to stay alive with little left over for root expansion and stem strength. When high tree density is coupled with the existing extent of detrimental soil conditions, productivity could be considered low. Conversely, thinning to maintain tree spacing and therefore stand health, results in a reallocation of site and soil resources to the remaining trees, therefore offsetting to some degree, the negative effects of detrimental soil condition. The availability of site and soil resources for growth would increase substantially.

The cumulative effects of the proposed actions when combined with past actions and foreseeable future actions would not be substantial and trees and other vegetation are expected to continue growing and developing at appropriate rates.

3.6.7 Organic Matter

3.6.7.1 Existing Condition

Fuel treatments from initial clearcut harvests have reduced duff levels and organic soil materials on all units. Field visits and aerial photo interpretation indicate that fuel treatments included broadcast burning and pile and burn.

Duff layers are relatively thin due to the past harvest and fuel treatment history, and range from 0.5 to 3 inches with an average of 1 inch. Some units have low levels of course woody debris (CWD) on the forest floor. In these areas the level is below historic ranges of CWD that naturally occurred prior to harvest and fuel treatment. CWD plays an important role in nutrient cycling; where there are low levels there is expected to be diminished site productivity in the long term. CWD levels vary between units primarily due to differences in past fuel treatments and the degree of decay in the mature trees and whether cull logs were removed or left in place during the original harvest.

Direct and Indirect Effects

3.6.7.2 No Action

Forest organic litter input, organic decomposition rates, duff layer development and soil fauna and microbe activity would be unchanged. Organic matter decomposition and nutrient cycling is influenced substantially by temperature and moisture which would remain unchanged. Organic materials would be subject to disturbances such as windthrow, fire, and climatic change. As unthinned stands age, trees would die and fall (see snag and down wood analysis in s. 3.8.2). These stands would eventually produce large trees which would be a source of future large decaying logs on the ground.

3.6.7.3 Proposed Action

Logs existing on the forest floor would be retained. The harvesting operations would add small woody debris the size class of the cut trees. This would include the retention of cull logs, tree tops, branches, broken logs and any snags that would be felled for safety reasons. Snags or green trees that fall down after the harvest operation would contribute to the down wood component of the future stand. Treatments to add additional trees and logs are discussed in section 1.4.6.1.

Duff disturbance would be minimized where full suspension yarding occurs in skyline and helicopter operations, and where designated and existing skidtrails are used in ground-based yarding operations. Soil microbial populations would likely be reduced initially in areas of exposed soils. Leaving branches and needles throughout the units where trees are felled should help maintain carbon and nutrient levels. Organic material would be displaced on approximately 123 acres of soil exposed during mechanical felling, yarding and road construction and reconstruction operations.

Road decommissioning and rehabilitation would increase soil organic matter within roadbeds where the road surfaces are decompacted and course woody debris is placed within the road prism.

3.6.7.4 Cumulative Effects – Organic Matter

See sections 3.6.3 & 3.6.4 for discussions of analysis areas and time frames for cumulative effects analysis. In the analysis area, previous timber harvest, fuel treatment, and road construction activities have resulted in reduced duff and large woody debris levels, and a probable change in soil organism communities in disturbed areas. Even though many of the units have low levels of large woody debris, there is no obvious visible symptom in the amount or quality of vegetation currently within these units. It might be expected that a stand with low levels of large woody debris would have visible signs of stressed trees. Yet this is not the case; all units are growing well as demonstrated by stand exams and exhibit no reduction in site productivity (s. 1.3.1.3 & s. 3.1). This is due to the amount of total organic material on-site: there is sufficient total organic material to replenish nutrients. Large down logs are important for other reasons besides tree growth. Decomposition of large wood recycles nutrients, is a significant contributor to biological carbon sequestration, contributes to soil structure, slows evaporation of soil moisture during dry periods, and maintains a moist environment and food source for a large variety of soil and other organisms. Cumulatively the reduction of large wood removed by clearcutting has had long-term impacts to these ecological processes.

The cumulative effect of additional disturbance from the proposed action added to the existing condition would slightly increase displacement of organic material on exposed soils, increase numbers of coarse woody debris logs the size of thinned material, and reduce the decay cycle timeframe of rotting down logs that are moved or run over by equipment.

A sufficient tonnage of branches and down logs left after harvest is completed is expected to remain on site to provide for organic matter input to the ecosystem once all activities are complete. Based on previous experience with similar stands, approximately 27 tons per acre of debris would be retained in the units (s. 1.4.6.6) which is a sufficient level in west side forests to maintain long-term productivity.

The cumulative effects of the proposed actions when combined with past actions and foreseeable future actions would not be substantial and trees and other vegetation are expected to continue growing and developing at appropriate rates.

3.6.8 Forest Plan Standards and Guidelines

Mt. Hood Forest Plan References
Forestwide Soil Productivity Standards and Guidelines - FW-22 to FW-38, page Four-49
Forestwide Geology Standards and Guidelines - FW-1 to FW-21, page Four-46
Earthflow Standards and Guidelines - B8-28 to B8-41, page Four-264
See Mt. Hood FEIS pages IV-11, and IV-155 to IV-167
Northwest Forest Plan - Coarse Woody Debris Standards and Guidelines - page C-40
Soil Disturbance Standards and Guidelines - page C-44
Modify Fire and Pesticide Use, Minimize Soil Disturbance Standards and Guidelines - page C44

FW-1 to 16	Slope stability concern areas have been identified by the Forest Geologist, and have been deleted from the proposed units.
FW-017 to 019	Most units that were logged with ground-based equipment in the original harvest are not consistent with these standards. See discussion below for exception for FW-018.
FW-020	Most units that were logged with ground-based equipment in the original harvest would be logged similarly this time reusing existing landings and skid trails. See discussion below for exception.
FW-021	Natural drainage features would be maintained or improved.
FW-22 to 23	Most units that were logged with ground-based equipment in the original harvest are not consistent with these standards. See discussion below for exception.
FW-24	Minimization of rutting would be achieved through the BT6.6 and CT6.6 provisions in the contract.
FW-25	Ground cover would be maintained at the prescribed levels.
FW-28 to 30	Rehabilitation would be accomplished only on roads and landings used by the operator. Rehabilitative techniques would not restore the soil resource to a level of less than 15% impaired. See discussion below for exception.
FW-31 to 34	Sufficient woody debris would be left on site including existing down logs, tops and branches and trees felled to create coarse woody debris.
FW-037	Many aspects of the project include design features that limit disturbance to the soil's organic horizon: broadcast burning and mechanical fuel treatments would not occur, skyline and helicopter systems are used where appropriate, existing temporary roads, landings and skid trails would be reused where appropriate and mechanical fellers would operate on top of branches and tops.
B8-31 to 32	These are addressed in section 3.5.6.5
B8-36	Most units that were logged with ground-based equipment in the original harvest would be logged similarly this time reusing existing landings and existing skid trails. See discussion below for exception.
B8-40	Most units that were logged with ground-based equipment in the original harvest are not consistent with this standard and guideline. See discussion below for exception.
B8-48 to 49	Road locations have been reviewed by the Forest Geologist.

Exceptions

Exceptions to Forest Plan standards and guidelines FW-022, FW-028, FW-030, B8-036 and B8-040 are proposed.

FW-022

This standard and guideline suggests that cumulative detrimental soil condition should not exceed 15%. Many units already exceed this level and the proposed action would result in some reduction due to the treatment of temporary roads and landings but it also shows some increases for new skid trails and harvester use as described in section 3.6.6.4. Even though there was no standard for long-term soil productivity when the original clearcuts were logged, the stands have grown well and are projected to continue to grow well after the proposed thinning. Stand exams show that stands that have detrimental soils above 15% have similar growth rates compared to nearby similar stands that are below 15%. The proposed action has been designed to minimize additional soil impact and to treat impacted soils where appropriate. In areas not disturbed again, natural recovery would continue to occur, as roots and burrowing animals penetrate and break up compacted soils, as organic matter accumulates, and as soil wetting/drying and freeze/thaw cycles occur. The objective of maintaining long-term site productivity would still be met. Section 3.6.6.4 describes that site productivity has not been impaired and that the cumulative effects of the proposed actions would not be substantial and trees and other vegetation are expected to continue growing and developing at appropriate rates.

FW-028 & FW-030

These standards and guidelines suggest rehabilitation of impacted soils where the cumulative detrimental condition is greater than 15%. While this is proposed for temporary roads and landings, it is not proposed for skid trails in thinning units.

While the existing skid trails are still considered to have detrimental soil conditions, there are some tree roots that have penetrated into the skid trails. Reusing the skid trails again may add some additional compaction around these roots but they would likely remain intact. Mechanical ripping or decompacting of skid trails would break the roots that have penetrated into the trails and lead to reduced growth, and increased root disease and tree mortality.

The proposed action would reuse existing skid trails where appropriate but not all areas that were disturbed in the original logging would be disturbed again because of the requirements of the design criteria; only appropriate existing skid trails would be reused. In areas not disturbed again, such as in skips and stream protection buffers, natural recovery would continue to occur as roots and burrowing animals penetrate and break up compacted soils, and as organic matter accumulates. The opportunity to mechanically rehabilitate skid trails may come in the future if and when regeneration harvest occurs. Most units that were logged with ground-based equipment in the original clearcut harvest would remain above 15% detrimental soil condition.

B8-036

This standard and guideline suggests that ground-based yarding of logs should not occur. For the proposed action, ground-based yarding would be used on earthflow thinning units where ground-based systems were used in the original logging. An exception is proposed because examination of the units has found that the use of existing roads, skid trails and landings with post use decompaction would result in minimal impact. The objective of providing for earthflow stability would still be met. One option considered was to switch to a skyline system, which would overlay the impact of skyline corridors over an existing network of skid trails and in many cases would result in the need to build new roads and landings to facilitate skyline logging. Another option considered was to switch to helicopter logging with its associated increase in cost. These options were adopted in some situations where appropriate but in most earthflow units, the objective of earthflow stability would still be met by thinning to create healthy, productive stands using ground-based methods.

B8-040

This standard and guideline suggests that cumulative detrimental soil condition should not exceed 8% on earthflows. Many units already exceed this level. Even though there was no standard for long-term soil productivity or earthflow stability when the original clearcuts were logged, the stands have grown well and are projected to continue to grow well after the proposed thinning. The proposed action has been designed to minimize additional soil impact and to treat some impacted soils where appropriate. In areas not disturbed again, such as in skips and stream protection buffers, natural recovery would continue to occur as roots and burrowing animals penetrate and break up compacted soils, and as organic matter accumulates. Section 3.6.6.4 describes that site productivity has not been impaired and that the cumulative effects of the proposed actions would not be substantial and trees and other vegetation are expected to continue growing and developing at appropriate rates. The objective of maintaining long-term site productivity and earthflow stability would still be met.

3.7 NORTHERN SPOTTED OWL

This section summarizes analysis in the Grove Wildlife Report and Biological Evaluation which is incorporated by reference. Late-Successional Reserves (LSR) are the primary habitat for spotted owls as designated under the Northwest Forest Plan. Three proposed thinning units are in the LSR. The objective of the LSR is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for the late-successional and old-growth related species including the northern spotted owl (USDA, USDI 1994a).

The project area is covered by the North Willamette LSR Assessment (USDA, USDI 1998). The purpose of the LSR Assessment is to document current conditions and functions of the LSRs and present sideboards for management activities in the LSR to meet the objectives in the Standards and Guidelines of the Northwest Forest Plan.

3.7.1 Endangered Species Act Compliance

The northern spotted owl is federally listed as a threatened species under Section 4 of the Endangered Species Act (ESA). The Forest has consulted on this project with the U.S. Fish and Wildlife Service (USFWS).

The project is covered by multiple consultation efforts:

- The first consultation is documented in a Letter of Concurrence, written by the U.S. Fish & Wildlife Service and dated May 17, 2011 (reference 13420-2011-I-0135) (USDI 2011a) (Grove data is on page 35). This programmatic consultation was initiated with a Biological Assessment dated April 2011(Grove data is on page 60) (USDA 2011c).

- The second consultation is documented in a Biological Opinion written by the U.S. Fish & Wildlife Service and dated February 20, 2013 (reference 01EOFW00-2013-F-0089) (USDI 2013) (Grove data is on page 6). (This second project level consultation was made necessary due to the changes to critical habitat. A reassessment document was prepared to initiate this consultation (USDA 2013a). This Biological Opinion also amended the 2011 Letter of Concurrence to extend its implementation date to December 31, 2015.)

These documents are incorporated by reference and summarized below.

The U.S. Fish and Wildlife Service revised designated Critical Habitat for the northern spotted owl (USDI 2012). This designation, under the Endangered Species Act is not the same as the LSR land allocation. These are different land bases with different management approaches and they are discussed separately in this section.

The northern spotted owl recovery plan has the following recommendation for critical habitat: "*In moist forests managed for spotted owl habitat, land managers should implement silvicultural techniques in plantations, overstocked stands and modified younger stands to accelerate the development of structural complexity and biological diversity that will benefit spotted owl recovery"* (USDI 2011b p. 19). The Revised Critical Habitat for the Northern Spotted Owl recommends, on the basis of extensive scientific analysis, that areas identified as critical habitat should be subject to active management, including logging, in order to produce desired stand characteristics (USDI 2012).

3.7.2 Habitat Methodology & Existing Condition

Spotted owl habitat is divided into suitable, dispersal and capable. "Suitable" describes habitat used by owls for nesting, roosting and foraging (NRF). In general, suitable habitat is 80 years of age or older, canopy cover exceeds 60 percent, stands are multi-storied, and there are sufficient snags and down wood to provide opportunities for nesting, roosting and foraging. Dispersal habitat is typically over 40 years of age with a canopy cover of 40 percent or greater and an average stand tree diameter of 11 inches or greater. Spotted owls use dispersal habitat to move between blocks of suitable habitat and juveniles use it to disperse from natal territories. Dispersal habitat may have roosting and foraging components, enabling spotted owls to survive, but lack structure suitable for nesting. Owls can also disperse through suitable habitat. In this document, the term "dispersal habitat" is used to describe stands that provide for dispersal but are not suitable unless otherwise noted. Sometimes the term total dispersal habitat is used to include the sum of dispersal only habitat and suitable habitat. Capable habitat is other forested lands with the potential to eventually grow and become dispersal or suitable habitat. Young forest plantations fit this category.

Spotted owl locations are sometimes referred to as "activity centers" because in some situations, no nest was actually found at the time of the survey even though the presence of an individual was detected near the location. The site on the map was the closest location that could be determined based on the owls' center of activity. These activity centers are treated as nest locations. More recently the USFWS did an analysis to determine potential locations of owls in suitable habitat where surveys have not been adequately completed to determine presence. The USFWS used the BioMapper habitat model to predict these sites (USDI USDA 2008). In the Forest GIS system these owls are labeled CIS (computer implied sites) and this document refers to them as predicted sites.

For the project area, spotted owl home range is a 1.2 mile radius circle (2,895 acres) centered on the owls' activity center. Incidental 'take' would be presumed to occur when suitable habitat is removed from a home range, and/or if the total suitable habitat is less than 40% of the home range (See Biological Assessment for discussion of 'take'). A core area is defined as the area within a home range that receives disproportionately high use (502 acres or a 0.5 mile radius circle). Incidental take would be presumed to occur when suitable habitat is removed from a core area and/or if suitable habitat is less than 50% of the core area. The nest stand is considered a 300-meter radius circle around the activity center.

Since there are few recent surveys for spotted owls that show the locations of active nest sites, historical spotted owl information is used. Use of historical activity centers is appropriate since studies show nest sites are used for many years. In addition, predicted owl sites are used. The proposed action could potentially affect twenty three historical and one predicted owl pairs because there are thinning units within 1.2

miles. Even though the project does not affect suitable habitat, an analysis of suitable habitat for each owl pair was done to show the relative fragmentation of existing habitats.

There are 23 historic owl activity centers and one predicted spotted owl site that have proposed harvest units within 1.2 miles. Of these 11 have insufficient suitable spotted owl habitat and meet the incidental take methodology threshold (USDI USDA 2008).

Spotted Owl Area of Concern - The LSR Assessment (USDA USDI 1998) identified areas outside the LSRs where there are concerns about dispersal. In 2012, an analysis of the Areas of Concern was completed by Ray Davis, Wildlife Biologist for the Interagency Regional Monitoring Team. Davis found that each of the four areas had over 78 percent coverage of dispersal and suitable habitat, sufficient for northern spotted owl dispersal across the landscape. Based on this analysis the Forest no longer consults on or assesses dispersal habitat for areas of concern.

Barred owls - Barred owls are known to be present on the Forest. Barred owls have been expanding into northern spotted owl territory from northeastern Canada since about 1900 and in some cases have been displacing spotted owls (Anthony 2004) (Courtney 2004) (USDI 2011b). Barred owls may be expanding their range because of changes to forest structure from logging, wildfire or climate change. By casual observation and incidental surveying since 1994, barred owls do appear to be more common on the Forest than they were when surveying began in 1979. Barred owls are currently believed to be widely distributed across the Forest. Regionally barred owls are considered a serious threat to the continued existence of spotted owls. Barred owls are thought to be more aggressive than spotted owls and may be out competing them for food, killing young, and inter breeding. Spotted owl recovery efforts may include killing barred owls (USDI 2011b).

3.7.4 Methodology for Noise Disturbance Effects

The USFWS has concluded that noise can result in a disruption of breeding, feeding, or sheltering behavior of the spotted owl such that it creates the potential for injury to individuals (i.e. incidental take in the form of harassment) (USDI 2011a). For a substantial disruption of spotted owl behavior to occur, the disturbance and spotted owl(s) must be in close proximity.

A spotted owl that may be disturbed at a roost site is presumably capable of moving away from a disturbance without a substantial disruption of its behavior. Since spotted owls forage primarily at night, projects that occur during the day are not likely to disrupt its foraging behavior. The concern about noise is with breeding behavior at active nest sites. In the late breeding period, potential effect from disturbance declines because juvenile spotted owls are increasingly more capable of moving as the nesting season progresses. The critical breeding period is March 1st through July 15th. After July 15th, most fledgling spotted owls are capable of sustained flight and can move away from most disturbances (USDI 2011a).

The USFWS developed disruption distances based on interpretation of best available information (USDI 2003). The actions proposed for this project that generate noise above the local ambient levels are heavy equipment and chainsaw use. Normally the analysis area for noise around known nest sites would be 35 yards for heavy equipment use, and 65 yards for chainsaw use. Type I (large) helicopters have a disruption distance of 0.25 mile. However for historic activity centers that have not been verified recently, 300 meters would be added to these distances.

If a Type I helicopter is used, the restriction would be for 768 yards from March 1-September 30th to protect nesting and juvenile owls. If smaller helicopters are used or Kmax helicopters, the restrictions are reduced as described in the biological assessment.

Log-hauling on open roads is not expected to have adverse effects during anytime of the year, since spotted owls rarely nest at or immediately adjacent to a road. The potential for noise related impacts is also dependent on the background or baseline levels in the environment. In areas that are continually exposed to higher ambient noise levels (e.g. areas near well-traveled roads, campgrounds), spotted owls are probably less susceptible to small increases in disturbances because they are accustomed to such activities.

3.7.5 Direct and Indirect Effects by Alternative

3.7.5.1 No Action

No short-term effects to the spotted owl would occur with this alternative. For the short term (0-10 years), the areas that are currently providing dispersal habitat would continue to function as dispersal habitat. Snag and down wood levels would gradually increase due to overstocked stands and insects and diseases in the area. However, because there is root rot in some of the stands additional trees may fall over and provide additional down wood, but snags may not stand as long as in stands not infected by root rot. No action in young stands in the stem-exclusion phase may keep high densities of flying squirrels.

In the long term, the stands would start to differentiate to varying degrees and show a substantial increase in the levels of snags, down wood and understory development. Where these conditions occur, they would improve the dispersal habitat characteristics being provided within some stands.

Most of the stands currently providing dispersal habitat would grow into low quality Suitable habitat (Nesting, Roosting & Foraging) in the next 50 to 60 years. At 200 years of age these stands would function in a similar fashion to a thinned stand but may have a larger amount of snags and down wood. Compared to Alternative 2, the live trees would be smaller and would not have a multi-layered structure. A recent review of 100 year-old stands on the Forest demonstrated the contrast between two trajectories: stands that were thinned 15 years ago have developed increased size and a multi-layered structure that provides good spotted owl habitat while the unthinned stands were still lacking size and structure to function as suitable habitat (Dyck 2012).

With no action there would be no noise related disturbance to owls.

3.7.5.2 Proposed Action

The stands proposed for thinning are not currently of a size or condition to be considered suitable habitat but they do function as dispersal habitat. Currently the stands targeted for thinning are fragmenting a larger landscape of mature forest. The project would use variable density techniques to speed the creation of suitable spotted owl habitat in LSRs and improve stand growth in the matrix land allocation. The proposed stand treatment calls for opening the canopy to reduce suppression so the stand can grow larger trees and begin to develop a mid-level story preferred by spotted owls for roosting, nesting and foraging. The proposed action would result in a softening of the edge contrast between thinning stands and adjacent mature forest stands.

The thinning units are spotted owl dispersal habitat and they would be altered by this proposed action. The thinning in Matrix has a different emphasis than thinning in LSRs: the proposal for LSRs are designed to accelerate the growth of the trees in the stand to achieve late-successional functions more rapidly with both growth and snag production as part of the prescription (Bauhus 2009). The northern flying squirrel is the principle prey of the northern spotted owl on the west side of the Cascades. There is a trade-off in several aspects of thinning to promote spotted owl habitat: the reduction in snags and down wood and the increased spacing of trees can reduce the productivity of the site for the northern flying squirrel for 20-40 years (Wilson 2009). Wilson also reported that the long-term benefits of variable-density thinning for squirrels are likely to be positive. The proposed action would help stimulate the development a lower canopy layer of trees which is thought to be important to accelerate late-seral conditions and promote prey for spotted owl. The stream buffers and skips would provide some habitat and habitat connectivity for northern flying squirrels during this time period so that long-term goals of promoting late-seral structure do not conflict with habitat requirements of this important species (Manning 2012). Complex structure favorable to flying squirrels may be achieved sooner in younger stands where there is a shorter vertical distance between the ground and the bottom of the canopy. The primary function of dispersal habitat however is for temporary movement and roosting as birds move between locations and is not required to provide optimal foraging opportunities.

The project would reduce dispersal habitat canopy levels below 40% in the matrix land allocation units. The USFWS has concurred that the thinning of dispersal habitat below 40% canopy cover would result in habitat removal, but there would remain sufficient dispersal habitat across the landscape to allow spotted owls to disperse.

Barred Owl/Spotted Owl Interactions

There are potential interactions between barred owls and spotted owls that could be exacerbated by practices such as timber harvest and other silvicultural activities either directly or indirectly that could increase the competitive advantage for barred owls. Three topics are explored below:

Could logging expand the range of barred owls?
Old growth reserves appear to be supporting large populations of barred owls, and in many cases there are more barred owls than spotted owls in the reserves (Pearson 2003). Barred owls successfully colonized Olympic National Park in areas that never had timber harvest (Courtney 2004). The U.S. Fish and Wildlife Service now assumes that barred owls occur at some level in all areas used now or in the past by spotted owls (USDI 2011b). There are no known forest conditions where spotted owls have a competitive advantage over barred owls. Given that barred owls occur throughout the range of spotted owls within the Action Area it is unlikely that the proposed treatments would expand the range of barred owls.

Could silvicultural treatments that thin, create early-seral conditions, or create edge habitat favor barred owls over spotted owls?
Across their range, barred owls are known to use a wide variety of forest types. The spotted owl recovery plan found much evidence that barred owls prefer old-growth and older forest habitat in the Pacific Northwest (USDI 2011b). On the Gifford Pinchot National Forest the density and impact of barred owls appears higher in areas without timber harvest (Pearson 2003). Other studies found that both owls use and avoid similar habitats and that thinning that increases prey species does not selectively favor barred owls (Wiens 2012). The proposed thinning which is designed to enhance growth and diversity in plantations is not likely to result in conditions that favor barred owls over spotted owls.

Could logging that reduces the amount of older forests increase competition between barred and spotted owls?
Both barred owls and northern spotted owls prefer older forest habitat. In the Action Area, stands begin to transition from mature to old growth at 175-200 years of age when the structural complexity and decadence components start to become apparent. The proposed action thins stands between 30 and 60 years of age, creating structural diversity and introducing a multi-storied condition. It is likely that conditions in 140 years would be suitable for either species of owl.

Effect determination for Owls - The USFWS concurs with the Forest Service that the project ***may affect, but is not likely to adversely affect*** territorial or dispersing spotted owls due to habitat modification (USDI 2011a). This effect would be temporary because over time the residual trees would grow and canopy cover would again be over 40%. This effects determination is appropriate because no dispersal habitat would be removed in any of the Areas of Concern identified in the LSR Assessment, no habitat would be removed in nest stands, no thinning that would result in removal of dispersal habitat would occur in LSRs or critical habitat and thinning units are not concentrated in any spotted owl home range to an extent that would impact the ability of a northern spotted owl pair to forage for themselves and young.

Effect determination for Noise Disturbance - The proposed action may have disturbance effects from the use of chain saws, heavy equipment and helicopters. In most cases these factors would be outside the threshold zone for disruption of nesting. For those actions that could adversely affect spotted owls a seasonal restriction that would lower the effect on the owls would be implemented. The effects of various activities and the associated seasons are listed in Table 9 of the USFWS Letter of Concurrence (USDI 2011a). With these seasonal restrictions, the effect would be ***may affect but not likely to affect the northern spotted owl*** for disturbance.

Revised Recovery Plan for the Northern Spotted Owl 2011 - The Revised Recovery plan indicates that the most important range-wide threats to the spotted owl are competition with barred owls, ongoing loss of spotted owl habitat as a result of timber harvest, habitat loss or degradation from stand-replacing wildfire and other disturbances, and the reduction in quantity and alteration of distribution of spotted owl habitat as a result of past activities and disturbances. This project is consistent with the goals and criteria identified in the Revised Recovery Plan for the Northern Spotted Owl (USDI 2011b).

Effect determination for Critical Habitat - There are approximately 993 acres of treatment in the 2012 critical habitat. The USFWS has identified dispersal habitat as a Primary Constituent Elements (PCE) necessary for spotted owl recovery.

The inclusion of 150 acres of heavy thinning patches to enhance diversity would remove dispersal habitat and therefore the USFWS has indicated that this treatment **may affect and is likely to adversely affect 2012 spotted owl critical habitat** in the short term (USDI 2013). This effects determination is based on thinning below 40% canopy cover. Heavy thinning would cause a substantial delay in the stand's re-growth to dispersal habitat. This effect would be temporary because over time the residual trees would grow and canopy cover would again be over 40% and the resulting stands would be more diverse.

Most of the proposed thinning is not heavy thinning patches but is considered moderate to light thinning (843 acres). In these areas the USFWS has indicated that thinning would maintain habitat functionality and **may affect but is not likely to adversely affect** 2012 spotted owl critical habitat and is expected to result in a long-term beneficial effect (USDI 2013).

3.7.5.3 Cumulative Effects

The analysis area for cumulative effects is the area within 2.4 miles of the project actions. This is the diameter of an owl home range circle and is appropriate because it brings in all owl home ranges that could be affected by the project. Because alterations to owl habitat are long lasting, the time frame for cumulative effects analysis goes back to the beginning of active management in the 1940s. This analysis area is 88,185 acres. It incorporates 52 acres of private land. There are no other land ownerships to include. There are also no foreseeable future projects on the Forest to consider other than the ongoing projects listed below. While there may be future logging or other management in the area, there are no current proposals with sufficient site specificity to conduct an analysis.

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. This information comes from the current GIS vegetation, roads and activity layers which include data such as the current condition of forest stands and the age of stands. These layers track forest vegetation and other features as they have been affected by events such as forest fires and past regeneration harvest as well as the growth that has occurred since. The analysis includes road construction, decommissioning, other thinning projects and cumulative mortality and the effects of the PGE hydro projects.

There are fifteen ongoing projects within the analysis area that may create cumulative effects in relation to the Grove Thinning Project. The projects are Bass (120 ac.); Beluga-Orca (12 ac.); Day (68 ac.); Fan (97 ac.); Jelly (94 ac); Pie (190 ac.); Pink (37 ac.); Quarry (252 ac.); Reel (214 ac); Rod (255 ac.); Roman (239 ac.); Rotor (201 ac.); Slip (67 ac.); Swag (292 ac.) and Wolf (52 ac.); for a total of 2,190 acres. These are thinning projects located in dispersal habitat for northern spotted owls.

There have not been any substantial wildfires in recent years within the analysis area.

The thinning projects when combined with the Grove Thinning would have a relatively minor impact on spotted owls. The thinning projects were all consulted on with the USFWS and they considered cumulative effects at the time they made their effects determination. The effects determination for all of these projects was **may affect, not likely to adversely affect the spotted owl (**USDI 2011a). This effects determination considers that spotted owls utilize dispersal habitat for movements between locations and that they are not dependent on dispersal habitat for survival: they would still utilize thinned areas for dispersing. There would be some reduction in prey numbers where thinning has occurred for up to 20-40 years.

The various thinning projects would have some reduction in snag production and some loss of current snags. There would be some snag and down wood creation as part of the projects that would off-set some of the loss of dead wood but overall there would be a net reduction of snags and down wood similar to what is described for the Grove proposed action. Across the landscape, there has been cumulative mortality over time from insect and disease. Snags are discussed in greater detail in section 3.8.2.

The road decommissioning, maintenance, construction, repair and fuel break project would have very little impact on spotted owls because it modifies but does not remove the function of any habitat. There could be some impact from disturbance from the use of heavy equipment but this would be minor since all equipment is used only during the daytime; and has no impact on spotted owl survival, reproduction or feeding.

The Grove project combined with these ongoing thinning projects affect 4% of the analysis area. The cumulative effect of the Grove Thinning when added to these other actions, would be negligible and would not impact spotted owl survival, reproduction, feeding, or care of young. The USFWS has determined that the cumulative effects of the proposed Grove Thinning would not cause the northern spotted owl to be in Jeopardy.

3.7.5.4 LSR Assessment – The proposed action includes 32 acres of thinning in the LSR. Stands are less than 80 years of age and no new road construction would occur in the LSR. The LSR Assessment recommended retaining down wood cover at a rate of 10 to 15%. To achieve this, most of the trees that need to be cut to achieve thinning objectives would need to be left on the ground. The cost of creating down wood at these rates would not allow for an economically viable timber sale (There are no other funding sources available to do this work). There are also negative consequences associated with leaving large quantities of down wood that would attract Douglas-fir bark beetles which would spread and kill trees in adjacent stands. Site-specific conditions and new science drove consideration of treatments that deviate from the down wood recommendations in the LSR Assessment triggering the need for a review by the Regional Ecosystem Office (REO 2012).

The proposed thinning in the LSR would meet the objectives for managing LSRs and is consistent with LSR standards and guidelines. This conclusion was reached in part for the following reasons:

- At the landscape scale, down wood levels are consistent with the objectives for managing LSRs.
- The LSR is currently at approximately 67% late-successional habitat, compared to the minimum level of 70 percent late-successional habitat in the Western Hemlock Zone (Note: Most of the potential harvest units within the LSR occur within this Zone). Mid-seral stands currently are lacking late-successional characteristics of large trees and multiple stories. This project would move stands toward the desired future condition for this LSR.
- Thinning these young stands now would result in a size class distribution and canopy structure that more closely resembles the late-successional habitats that meet the Desired Future Conditions identified in the LSR Assessment in a much shorter length of time than if no treatment occurred.

3.7.6 Forest Plan Standards and Guidelines

Mt. Hood Forest Plan References
Forestwide Wildlife Standards and Guidelines – FW-170 to 186, page Four-69
Northwest Forest Plan - Standards and Guidelines - section C

The proposed action is consistent with the following standards and guidelines

NFP C-12	Thinning in LSRs is consistent with LSR standards and guidelines because stands are less than 80 years old and thinning is designed to accelerate the development of late-successional forest conditions. The proposal was reviewed by the Regional Ecosystem Office and found to be consistent.
FW 170 & 171	This standard and guideline is not applicable to individual projects.
FW-174	Habitat for threatened, endangered and sensitive species has been identified and managed in accordance with the ESA (1973), the Oregon ESA (1987), and FSM 2670.
FW-175	Habitat for threatened, endangered and sensitive species is managed at the landscape scale. This standard and guideline is not applicable to individual projects.
FW -176	A Biological Evaluation has been prepared.
FW 177 & 178	Consultation with USFWS has been completed.
FW-179	The creation of Species Management Guides is not applicable to individual projects. The Northern Spotted Owl Recovery Plan has been completed.
FW-180	The maintenance of lists of threatened, endangered and sensitive species is done but this standard is not applicable to individual projects.
FW-181	This document does not include location information.

3.8 OTHER WILDLIFE

This section discusses wildlife species that are categorized as sensitive species, survey and manage species, management indicator species and migratory birds. It also includes a detailed discussion of snags and down wood which are important for many species.

Diversity is the distribution and abundance of different native plant and animal communities and species (s. 1.3.1.5 & s. 3.2). There are many ways to look at diversity and several scales to consider. Diversity in forests can be categorized by variations in genetics, structure and species composition. Biodiversity is a term sometimes used to describe the abundance of native plant and animal species. At the landscape scale, a mix of forest types and ages can provide habitat for a wide range of species. At the stand scale other elements become more relevant such as tree species composition, snag abundance or the number of canopy layers.

Both human actions and natural processes or events have the potential to alter wildlife diversity. Some actions or natural processes or events may seem to benefit one aspect of diversity and a suite of species while at the same time be less advantageous to other species.

Plantations sometimes lack certain elements of diversity and complexity. They often do not contain the mix of tree species that were present in the original stand and they are relatively uniform in terms of size and spacing. When the original clearcut harvesting occurred within the project area, all of the large trees and snags were removed. The plantations have minimal variability of vertical and horizontal stand structure.

At a landscape scale, the logging that created the plantations fragmented mature forest stands. Prior to the 1940s, the forests in the project area were relatively uniform mature forest but became fragmented by clearcuts as plantations were established. This likely benefitted more than 150 native wildlife species that use early-seral vegetation including deer and elk but likely harmed species such as spotted owls that require large blocks of contiguous mature habitat.

In the past, thinning focused primarily on tree growth and productivity and resulted in continued uniformity. The proposed action however involves variable-density thinning with skips and gaps to provide for greater species diversity. Thinning that incorporates these features can change a uniform plantation into one with more variable vertical and horizontal structure and greater species diversity. These changes would be beneficial to a wide range of plants and animals. There would be a temporary increase in forage for deer and elk and temporary habitat for early-seral dependent species. As the stands continue to grow they would acquire the characteristics of old-growth forests sooner than if left untreated. The fragmented nature of the landscape would become less evident as plantations blend in with surrounding mature forest stands. This is particularly important in LSRs and riparian reserves to restore them to the desired conditions for the key species that rely on unfragmented mature forest conditions.

Recent research (Carey 2003) (Chan 2006) (Tappeiner 1999) has compared variable density thinning with traditional thinning and non-treatment and found that introducing variability resulted in greater numbers of species of birds and small mammals. Many species such as spotted owls, sensitive species, and survey and manage species are at risk because their required habitats have been altered by clearcutting in the past (USDA USDI 1994b). Variable density thinning may result in short-term impacts to some species but in the long term, many wildlife species would benefit as stands and landscapes become more diverse.

3.8.1 SENSITIVE SPECIES AND SURVEY AND MANAGE SPECIES

Sensitive Species

A biological evaluation has been developed by a wildlife biologist to address the potential effect of activities on sensitive species. The objective is to avoid a trend toward Federal listing under the ESA. This section summarizes the biological evaluation which is incorporated by reference.

Methodology for Sensitive Species

The most recent list was used for sensitive species (Region 6, Regional Forester's Special Status Species List, 12/01/2011). A literature review of species habitat requirements was used to compare existing habitat conditions based on field visits and GIS analysis to suggest potential presence of species and the effect the project would have on that species. Professional knowledge and experience with the species was used to determine the effect the project would have on each species analyzed.

Background

Sensitive Species are plants and animals identified by the Regional Forester for which population viability is a concern, as evidenced by a current or predicted downward trends in population numbers or density and habitat capability that would reduce a species' existing distribution (FSM 2670.5). The species suspected or documented to be found on the Clackamas River Ranger District were analyzed to determine if habitat for them was present in the project area and if the project would have any impact on the population on the Forest.

Survey and Manage Species

Methodology for Survey and Manage Species

A literature review, conservation assessments, and survey protocols were used to assess species habitat requirements (http://www.blm.gov/or/plans/surveyandmanage). Existing habitat conditions based on field visits and GIS analysis were used to determine potential presence of species and the effect the project would have on that species. Professional knowledge and experience with the species was used to determine the effect the project would have on each species analyzed.

Background

The Survey and Manage standard and guideline has changed several times since its inception and has been the subject of several court cases. Currently the 2001 list is being used (USDA USDI 2001) with the Pechman exemption. The court, in Northwest Ecosystem Alliance v. Rey, No. 04-844-MJP (W.D. Wash. Oct 10, 2006) has exempted surveys for stands less than 80 years of age. In another case, the Ninth Circuit Court, on June 19, 2013, remanded a survey and manage case back to the District Court. The parties are presently briefing the issue of remedy following the NEPA violations found by the District Court in December 2009. Because the stands are less than 80 years of age, the survey and manage standard and guideline does not apply at this time. There are no known existing sites for survey and manage wildlife species in the proposed thinning units.

3.8.1.1 Summary of the effects to Sensitive Species and Survey and Manage Species from the Biological Evaluation.

Sensitive Species	Suitable Habitat Presence	Impact of Proposed Action
Johnson's Hairstreak	Yes	MII-NLFL
Mardon Skipper	No (no suitable meadows)	No Impact
Oregon Slender Salamander	No (Stands too young)	No Impact
Larch Mountain Salamander	No (Outside known range and lack of habitat)	No Impact
Cope's Giant Salamander	Yes	No Impact with riparian protection buffers
Oregon Spotted Frog	No (No suitable meadows)	No Impact
Lewis's Woodpecker	No (Outside Range)	No Impact
White-Headed Woodpecker	No (Outside Range)	No Impact
Bufflehead	No (No suitable ponds)	No Impact
Harlequin Duck	No (No suitable river habitat)	No Impact
Bald Eagle	Yes- No Use in this Area	No Impact
American Peregrine Falcon	No	No Impact
Townsend's Big-eared Bat	No (No cave habitat)	No Impact
Fringed Myotis	No (No cave habitat)	No Impact
California Wolverine	No (Below 7,000 feet)	No Impact
Cascades Axetail Slug	No (no mature habitat)	No Impact
Puget Oregonian	No (no mature habitat)	No Impact
Columbia Oregonian	No (no mature habitat)	No Impact
Evening Fieldslug	No habitat	No Impact
Dalles Sideband	No (eastside species)	No Impact
Crater Lake Tightcoil	No	No Impact
Crowned Tightcoil	No (no mature habitat, no records for Forest)	No Impact
California Shield-backed Bug	No impact to grasslands or balds	No Impact
Beller's Ground Beetle	No impact to bogs or meadows	No Impact
Western Bumblebee	No impact to flowering plants in meadows	No Impact

Survey and Manage Species	Suitable Habitat Presence	Impact of Proposed Action
Larch Mountain Salamander	No (Outside known range and lack of habitat)	No Impact
Great Gray Owl	No (no 10 acre meadows)	No Impact
Red Tree Vole	No (no mature habitat)	No Impact
Oregon Megomphix	No (no mature habitat)	No Impact
Puget Oregonian	No (no mature habitat)	No Impact
Columbia Gorge Oregonian	No (no mature habitat)	No Impact
Evening Fieldslug	No habitat	No Impact
Dalles Sideband	No (eastside species)	No Impact
Crater Lake Tightcoil	No	No Impact

*MII-NLFL = May Impact Individuals, but not likely to Cause a Trend to Federal Listing or Loss of Viability to the Species.

3.8.1.2 Species Discussion

Johnson's Hairstreak
Johnson's hairstreak butterflies use dwarf mistletoe for their primary habitat. There may be some removal of hemlock with dwarf mistletoe during the proposed thinning; however, the surrounding stands outside the units have sufficient dwarf mistletoe to offset any loss of habitat in the thinning units. In 2006, Raymond Davis estimated that there were approximately 206,000 acres on the Forest with potential habitat for western hemlock dwarf mistletoe and Johnson's hairstreak butterfly. While there may be an impact to individual butterflies it would not reduce the viability of the species in the watershed because there is abundant dwarf mistletoe across the landscape to provide for viable populations.

Cope's Giant Salamander
Cope's giant salamanders utilize cold rocky streams for most of their life cycle. There is potential habitat for these salamanders in the streams adjacent to proposed thinning units. For Cope's giant salamander to occur the rock has to be non-abrasive, and the stream gradient high, with no silt embedding the cobble substrate, and the water has to be cold. There is some potential for this species to occur in the Oak Grove Fork and Middle Clackamas watersheds although there are no records in the database for the species in these watersheds at this time. Project design criteria for stream buffers and erosion control would minimize impacts to this species. There would not likely be substantial impacts to Cope's giant salamander individuals or the viability of the species in the project area.

Bald Eagle
Bald eagles do not use the area.

Townsend's Big-eared Bats
There are two mines that have Townsend's big-eared bats occupying them as hibernacula and bats have occupied the buildings at the Oak Grove Work Center. But this project would not impact those bats since neither the buildings or the mines would be affected by the project.

Terrestrial Mollusks
Many of the terrestrial mollusks are listed as both sensitive and Survey and Manage species. None of the species would be impacted by the proposed project due to lack of suitable habitat. The species are either found in mature habitats or in the case of the evening fieldslug are found in marshy/wetland conditions. The Dalles Sideband is an eastside Cascades species. Creation of down wood by the project would add habitat that could be occupied by many of these mollusk as the stands reach maturity.

Great Gray Owl
This species typically nests near large meadows. One meadow exists in the project area however the nearest unit is over 2,000 feet away. The project would not affect suitable habitat.

Cumulative Effects

For cumulative effects analysis for sensitive and survey and manage species the Action Area boundary is used. All past actions such as logging and road construction are considered along with ongoing and planned thinning. One recent thinning projects in the analysis area is Swag (228 ac.). The recent and planned actions in the project area involve plantation thinning which were found to have little effect on sensitive species because they do not involve harvest of mature trees and have protections for riparian and aquatic resources. Based on this analysis, all of these cumulative actions are not likely to cause a trend to federal listing or loss of viability to the species.

3.8.2 SNAGS AND DOWN WOOD

This section summarizes the wildlife report and the stand data in the analysis file.

3.8.2.1 Methodology
Snags and down wood analysis is based on several analysis tools. Standards and Guidelines for the Forest Plan, DecAID analysis tool, Gradient Nearest Neighbor (GNN) analysis, Forest Vegetation Simulator modeling, and species use information from DecAID. These tools are described below and additional elaboration is in the analysis file.

DecAID is a planning tool intended to advise and guide managers in their analysis to conserve and manage snags, partially dead trees and down wood for biodiversity (Mellen 2003). It also can help managers decide on snag and down wood sizes and levels needed to help meet wildlife management objectives. DecAID was developed to collect and synthesize the best available science on wildlife relationships with dead wood (Mellen 2003). DecAID is designed to be applied at scales of at least the subwatershed or larger watersheds, sub-basins, physiographic provinces, or landscape administrative units such as Ranger Districts or National Forests. DecAID is not intended to directly predict occurrence of wildlife at the scale of individual forest stands or specific locations. It is intended to be a broader 'descriptor' planning tool.

GNN uses satellite imagery to determine vegetation condition, and for this analysis it is used to determine the amount of snags and down wood from 2006 satellite imagery. A Forest-wide analysis was completed in 2010 to determine the current condition of snags and down wood in the watersheds using GNN data. This data is incorporated into this analysis to show the current condition in comparison to the reference condition described in DecAID.

The Forest Vegetation Simulator (FVS) is an individual-tree, distance-independent, growth and yield model (USDA 2009a). FVS can simulate a wide range of silvicultural treatments for most major forest tree species, forest types, and stand conditions. The Forest Vegetation Simulator is a system of highly integrated analytical tools that is based upon a body of scientific knowledge developed from decades of natural resources research and experience. FVS answers questions about how forest vegetation would change in response to natural succession, disturbances and proposed management actions (http://www.fs.fed.us/fmsc/fvs/).

The charts below in s. 3.8.2.3 show stacked bars with the largest size at the bottom and progressively smaller snags added as the bar goes up. Since DecAID divides snags into small (< 20 inches diameter) and large (> 20 inches diameter), these breaks are shown in the charts. The total quantity of large snags can be visualized by looking at the blue and red portions of each bar. Three charts represent the range of thinning intensity with the proposed action; 80, 100 and 120 square feet of basal area retained after thinning (a lower number represents a wider leave tree spacing). The thinning level for LSRs and riparian reserves would be at approximately 120 square feet of basal area after thinning. These charts represent a weighted average that combines the projected snags for skips, gaps and thinning. Skips are areas not thinned and include riparian protection buffers as well as smaller skips scattered in harvest units. Snags in skips would be similar to what is projected for no action. Gaps are small openings scattered in the harvest units. Gaps would naturally regenerate to young trees, and as time goes by they would likely resemble skips with an age 40 or 50 years younger than the surrounding stand. The data, and spread sheet that were used for these calculations are in the analysis file.

3.8.2.2 Introduction and Existing Situation

Across the Forest snags and down wood exist at lower levels than the historic range of variability due to large stand-replacing fires early in the 20th century, past timber harvest and firewood cutting. Between the years of 1870 to 1920, roughly 300,000 acres or nearly one third of the Forest was burned by stand replacement fires. There have been 350,000 acres harvested since 1900. The combination of large-scale stand replacing fires and harvest have contributed to the current situation where almost 60% of the forest is in a mid stage of stand development with relatively few large snags. However, in recent years large wildfires have burned around Mt. Hood, Olallie Butte and in the Bull of the Woods Wilderness creating some concentrations of snags.

The project area is located within the Western Low Land Conifer Zone with the majority of the acreage composed of Douglas-fir and western hemlock. The primary and secondary cavity nesting species for the Western Low Land Conifer Zone are: pileated woodpecker, northern flicker, hairy woodpecker, red-breasted sapsucker, chestnut-backed chickadee and the red-breasted nuthatch. Due to past harvest, the planning area has three times as many acres of land with no large snags than would be found in a natural condition based on DecAID analysis and Gradient Nearest Neighbor data analysis (GNN).

The original regeneration harvest removed all of the trees along with all of the snags. Some down wood was removed and some was retained depending on the methods for logging and site preparation. Under current conditions, these mid-aged stands would experience suppression mortality that would likely result in an abundance of medium to small snags and down wood. There is some large diameter down wood scattered throughout the proposed thinning units; most of which came from past harvest which left unmerchantable trees on the ground. If current conditions are left unchanged, the availability of new down wood in the near future would be medium to small in size. At the time stand exams were conducted, the stands had approximately 100 dead trees per acre (some standing and some down): mostly planted trees, averaging approximately 4 inches in diameter. Because snags this small do not stand very long they were not carried through to the projections of future snags in the graphs below. There are few if any large snags greater than 20 inches, and 5 to 6 snags per acre greater than 10 inches diameter. The current tree sizes average 13 inches diameter and snags typically come from the smaller size suppressed trees that die.

The watersheds are currently at or above the 50% tolerance level for pileated woodpeckers on 16% of the Oak Grove Fork Watershed and on 21% of the Middle Clackamas Watershed.

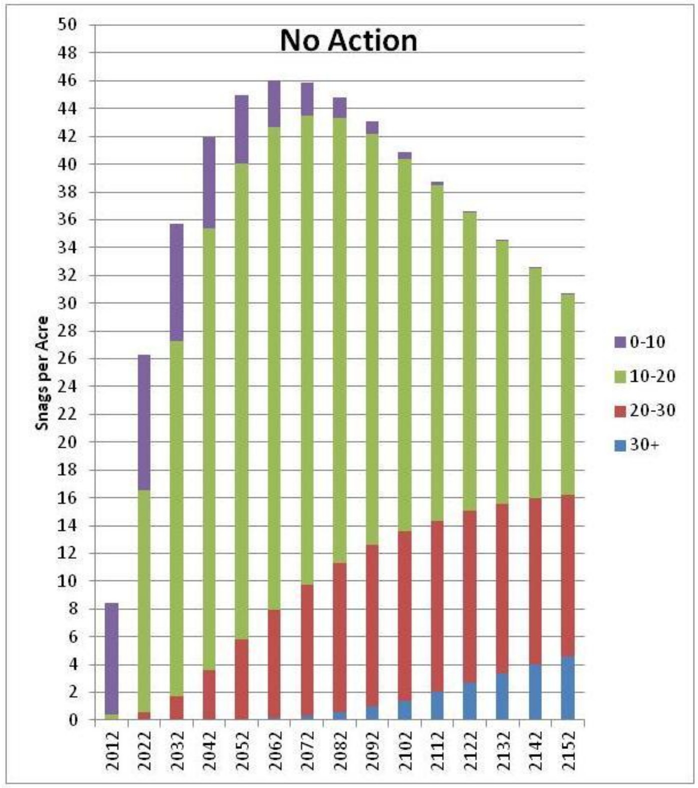
In addition to snags, DecAID recognizes the importance of defective trees or those that have the elements of decay. Hollow structures are created in living trees by heartrot decay organisms over many years. These hollow structures in living trees provide especially valuable habitat for a variety of wildlife, including cavity users. Trees that have heart rot decay present may include features such as openings in the bole, broken boles with bayonet tops, large dead tops or branches, punk knots, flattened stem faces, old wounds on the bole, crooks in the bole signifying previous breakage, and the presence of fruiting bodies. Defective trees with deformities such as forked tops, broken tops, damaged and loose bark or brooms caused by mistletoe or rust can also provide important habitat for a number of species. These defective live trees are not present in large quantities in proposed units but are likely to develop as stands age. These are not included in the analyses below.

3.8.2.3 DIRECT AND INDIRECT EFFECTS

No Action

Most of the stands that are more than 100 feet or so from an open road would continue to provide the current levels of snags and down wood in the near term. DecAID coarse woody debris tolerance levels would range from 30 to over 50%.

The project area would continue to experience mortality. Small snags generally less than 20 inches diameter would substantially increase in numbers in these stands. Live trees would fall from the effects of weakened roots from root rot. These two factors would eventually create a subsequent increase in the down woody debris. Even with no action, the Forest would continue to manage the road and trail system for public safety which includes the felling of danger trees.



This chart shows the projected level of snags over time in the plantations. There would be an abundance of snags in the 10 to 20 inch diameter range.

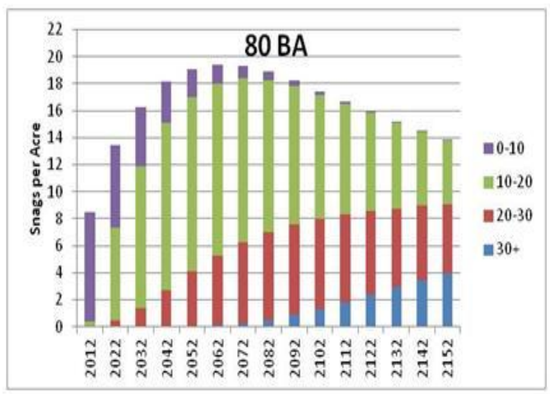
Proposed Action

The following actions have the potential to affect snags and down logs. Since snags may be hazardous some of them may be felled adjacent to operations such as tree felling, landing use, skidding, road use, road construction, road repair, road closure and log haul. Existing down logs may be disturbed by harvest operations but would be left on-site.

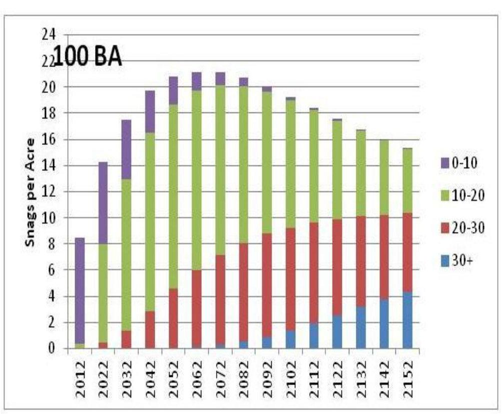
Currently the stands contain small snags. Some of the small snags are difficult to retain during logging and road construction because of their inherent instability. It is likely that some snags would need to be cut down during harvest operations due to safety considerations and that some downed logs would be degraded or moved through the process of logging.

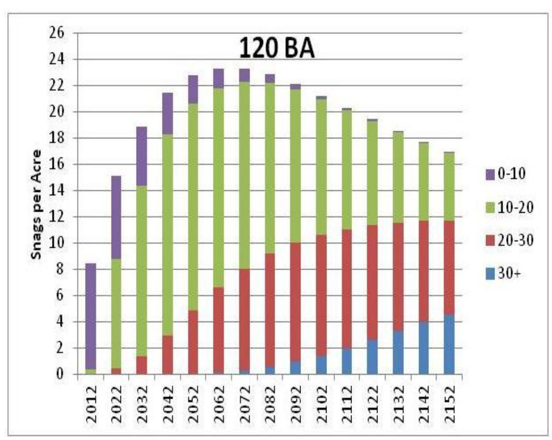
The proposed action involves the use of approximately 312 landings as described in s. 1.4.7.1. Snags or live trees with decadence that are hazardous would have to be felled for safety reasons adjacent to landings. However any landing adjacent to an open road would already have danger trees felled as part of routine road maintenance. Approximately 57% of these proposed landings are directly adjacent to or on open roads and should have few if any additional snags felled. Previous experience with landings on similar thinning projects is that most landings have no hazard snags that need to be cut and that occasionally one or two snags per landing may be cut if they lean toward the landing. Helicopter landings pose additional risks due the effect of rotor wash that might create a hazard that would not exist with other logging methods. All of the helicopter landings and service landings are on existing open roads and many are in rock quarries which already have a very large cleared area. A few hazard snags may need to be felled for each of the approximate 15 helicopter landings. A precise estimate of hazards cannot be made at this time because some snags or trees that are hazardous now may fall before operations begin and some trees that are alive or stable now may die or become unstable by the time operations begin.

The proposed action would result in fewer snags and less down wood compared to no action. The thinning options shown in the charts represent the range of thinning prescribed: A basal area of 80 square feet per acre (80 BA) would be a relatively heavy thin compared to a basal area of 120 square feet per acre (120 BA). These charts show roughly as many snags in the largest size classes compared to no action. The thinning options also result in larger live trees that could be treated manually to create snags if needed in the future (s. 3.1.4).



The proposed action would create new small snags and down logs by topping, girdling and felling some trees. The creation of snags is a valid technique for supplementing





other snags across the landscape where harvest has been part of the landscape history. Research has shown that cavity-nesting birds use created snags at rates equal to or greater than trees that die of natural causes (Walter 2005). Local experience with similar snag creation indicates that these created snags are used for foraging at first but that actual cavity nesting use increases with time and requires the snags to get to later stages of decay for maximum use. The created snags would represent the largest size class available in the stand and would be larger than those that would die with no action from natural causes. Smaller snags, regardless of how they die would not stand as long as large snags. Local experience with snag creation indicates created snags still standing and functioning after ten or more years.

Utilization of snags increases with the size of the snags. Large diameter snags are used more frequently as nest sites and also show more evidence of woodpecker foraging than smaller snags. Consequently, greater numbers of cavity-nesting wildlife are present when large snags are available than where few or no large snags exist. There would be fewer smaller snags compared to no action, but small snags are not as valuable as large snags for most snag dependent species. Thinning would increase the development of larger trees but stands would be healthier and trees are not as likely to die compared to no action. With the proposed action, some acreage would be managed similarly to that described for no action in riparian protection buffers and skips where there would be an abundance of small and medium sized snags and down logs.

The proposed action would provide fewer snags between 20 and 30 inches diameter and the same level of snags greater than 30 inches diameter compared to no action.

	No Action	LSR & Riparian Prescription	Matrix Prescriptions
Snags/ac. > 20 inches diameter in 100 years	14	11	8-9
Snags/ac. > 30 inches diameter in 100 years	2	2	2

Logs existing on the forest floor would be retained. The harvesting operations would also add small woody debris of the size class of the cut trees to the site. This would include the retention of any snags that would be felled for safety reasons. Snags or green trees that fall down after the harvest operation would contribute to the down wood component of the future stand.

3.8.2.4 Cumulative Effects to Snags and Down Wood

The analysis area for cumulative effects is the area within 2.4 miles of the project actions. This is size is appropriate because it is large enough to incorporate the home ranges of snag dependent species such as pileated woodpeckers. Because alterations to snags and down wood are long lasting, the time frame for cumulative effects analysis goes back to the beginning of active management in the 1940s. This analysis area is 88,185 acres. It incorporates 190 acres of private land. There are no other land ownerships to include. There are also no foreseeable future projects on the Forest to consider other than the ongoing projects listed below. While there may be future logging or other management in the area, there are no current proposals with sufficient site specificity to conduct an analysis.

This analysis relies on current environmental conditions as a proxy for the impacts of past actions. This information comes from the current GIS vegetation, roads and activity layers which include data such as the current condition of forest stands and the age of stands. These layers track forest vegetation and other features as they have been affected by events such as forest fires and past regeneration harvest as well as the growth that has occurred since. The analysis includes road construction, decommissioning, other thinning projects and cumulative mortality and the effects of the PGE hydro projects.

There are fifteen ongoing projects within the analysis area that may create cumulative effects in relation to the Grove Thinning Project. The projects are Bass (120 ac.); Beluga-Orca (12 ac.); Day (68 ac.); Fan (97 ac.); Jelly (94 ac); Pie (190 ac.); Pink (37 ac.); Quarry (252 ac.); Reel (214 ac); Rod (255 ac.); Roman (239 ac.); Rotor (201 ac.); Slip (67 ac.); Swag (292 ac.) and Wolf (52 ac.); for a total of 2,190 acres. These are thinning projects located in dispersal habitat for northern spotted owls. There have not been any substantial wildfires in recent years within the analysis area.

Snags are created across the landscape by several other mechanisms:

- Lightning strikes occur regularly across the watershed, particularly the higher elevations. While lightning strikes sometimes cause large wildfires to burn, most of them only damage individual trees or very small groups of trees.
- Overcrowding results in mortality in dense young stands as trees compete for resources.
- Insects such as Douglas-fir bark beetle are endemic in the watershed and kill live trees every year.
- Root diseases gradually move through many stands in the watershed killing susceptible species (s. 3.1).

The other ongoing thinning projects would have similar impacts to snags and down logs as described for the Grove proposed action. The combined effect of the proposed action with the ongoing thinning would be approximately 3,946 acres where there could be some loss of hazardous snags during the harvest operation. This loss would be offset by the creation of new snags by topping and girdling in all of the ongoing thinning projects.

At the analysis area scale, because of the combination of insect, disease and lightning mortality that have been occurring across the landscape, there has been a net gain of snag and down wood for the watershed. Portions of the watershed exceed the

DecAID 80% tolerance levels due to landscape level disturbances. Sufficient levels of snags and down wood would occur across the landscape to provide for the viability of snag and down wood dependent species such as pileated woodpeckers.

3.8.2.5 Forest Plan Standards and Guidelines

Snags and Wildlife Trees - Forest Plan standards and guidelines FW-215, FW-216, FW-234 & FW-235

The standard and guideline from the Forest Plan (FW-215) for harvest units is 2.4 snags and wildlife trees per acre in the medium to large size class for the units within the Pacific silver fir zone and 2.3 snags and wildlife trees per acre in the western hemlock zone.

Currently most of the trees are not large enough to produce snags of the desired size, (FW-234 describes 22 inches diameter as the minimum snag size) but FW-235 allows the retention of smaller trees if the treated stand is too young to have trees of that size. In these cases, snags and green leave trees retained should be representative of the largest size class present in the stand.

Past experience and monitoring indicate that there would likely be sufficient snags scattered through the units after harvest. In addition skips would be created and new snags would be created.

Thinning units average between five and six small snags per acre. It is estimated that approximately two per acre would be lost as a result of project operations leaving between three and four snags per acre. The propose action would create one new snag per acre in Matrix units and eight snags per acre in LSR units (s. 1.4.6.1). The resulting snag levels would meet these standards and guidelines.

FW-216 indicates that snags and wildlife trees at the landscape scale should be at 1.5 in the Pacific silver fir zone and 1.6 snags per acre in the western hemlock zone. The analysis using the GNN method indicates that there are 5.2 snags per acre greater than 20 inches diameter at the landscape scale. The proposed thinning and past and ongoing thinning projects remove few if any snags greater than 20 inches diameter because snags in thinning units are much smaller. The levels of snags at the landscape scale would be well over 1.6 snags per acre.

Down Logs - Forest Plan standards and guidelines FW-219, FW-223, FW-225 & FW-226

FW-219 and FW-223 indicate that stands should have six logs per acre in decomposition class 1, 2, and 3 and that they should be at least 20 inches in diameter and greater than 20 feet in length. Currently the trees are not large enough to produce down logs of the desired size. However, FW-225 and FW-226 indicate that smaller size logs may be retained if the stand is too young to have 20 inch trees. In these, cases, logs representing the largest tree diameter class present in the stand should be retained. No existing down logs would be removed and the proposed action would result in additional creation of snags and down woody debris which to meet these standards (s. 1.4.6.1 & s. 1.4.6.2).

The standards and guidelines for the Northwest Forest Plan suggest that thinning be designed reflect the timing of stand development cycles. The proposed levels of down wood meet this requirement.

3.8.2.6 Snags and Down Wood Summary

The current condition based on the GNN data shows a sufficient level of snags and down wood across the landscape to maintain viability for snag and down wood dependent species.

The analysis shows that approximately two of the five to six existing snags may be lost in the thinning operation. The proposed action would create eight snags per acre by topping and girdling in the LSR and one per acre elsewhere. These levels are sufficient to meet Forest Plan standards and guidelines.

Stands in the LSR would be managed to provide a higher amount of snags both from a harvest prescription with skips and creating snags (post harvest) and should provide adequate habitat for snag and down wood users as the stands reach a late-successional state. The proposed action would likely reach 50-80% tolerance level by the time the stand reaches maturity at 200 years of age. Stands in the Matrix would likely meet the 30% tolerance level by retaining snags and creating additional snags.

In the short term, supplemental snag creation would offset some of the potential for loss of hazard snags. In the long term, the FVS model indicates that there would be fewer snags between 20 and 30 inches diameter and the same level of snags greater than 30 inches diameter compared to no action.

Snag and down wood management on a watershed scale would maintain viability of species that depend on snags and down wood.

3.8.3 MANAGEMENT INDICATOR SPECIES (MIS)

3.8.3.1 Methodology

A literature review of species habitat requirements was used to compare existing habitat conditions based on field visits and GIS analysis to suggest potential presence of species and the effect the project would have on that species. Professional knowledge and experience with the species was used to determine the effect the project would have on each species analyzed. A Forest-wide analysis for Management Indicator Species was developed in 2011 and is incorporated by reference (USDA 2011b).

3.8.3.2 Background

The National Forest Management Act (NFMA) requires the Forest Service to manage wildlife habitat to maintain viable populations of existing native and desired non-native vertebrate species. The Forest Plan identified Management Indicator Species. The primary assumption of this process is that indicator species represent the habitat needs of other species that have similar habitat requirements.

Mt. Hood National Forest Westside Management Indicator Species

MIS	Habitat Description
Northern Spotted Owl	Old Growth
Deer	Early Forest Succession and Mature/Old Growth
Elk	Early Forest Succession and Mature/Old Growth
Pileated Woodpecker	Mature/Over-Mature
American Marten	Mature/Over-Mature
Salmonids	Aquatic

With the selection of some of these species there was a special emphasis on mature, over mature, and old growth habitat. The selection was done at a time when timber harvest was planned to replace many older stands with younger more rapidly growing stands: it was suspected that the mature and over mature stands would decline and the species associated with this habitat could be lost. Several species were selected to represent all of the species that required this type of habitat.

A Forest-wide analysis for Management Indicator Species has been conducted. It summarizes the Forest's consistency with the National Forest Management Act goal of managing wildlife habitat to maintain viable populations of existing native and desired non-native vertebrate species. The Forest-wide analysis was conducted at a coarse scale using available GIS data. The project level interdisciplinary team took the Forest-wide data and refined it based on field examinations and local knowledge of habitat conditions.

Forest monitoring results are documented in Annual Monitoring Reports available on the Forest's web site (http://www.fs.usda.gov/mthood/). Surveys were not conducted to gather site-specific, project-scale population data. Habitat is used as a proxy for population monitoring. The Forest Plan as amended provides habitat to maintain viable populations of these species. Land allocations near or adjacent to the project area that provide habitat for these species include Wild and Scenic Rivers (A1), Wilderness (A2), Pileated Woodpecker and Pine Marten Habitat Areas (B5), Late-successional Reserves (LSR), and Riparian Reserves (RR) for pine marten, pileated woodpecker and the northern spotted owl; Winter Range (B10) and Summer Range (B11) for deer and elk; and Riparian Reserves (RR) for fish. There are also numerous

Forest-wide standards and guidelines that pertain to these species. This project has been designed to minimize effects on management indicator species.

3.8.3.3 Northern Spotted Owl

The spotted owl was selected as a MIS because it represents old-growth habitats. The owl section (3.7) has detail on the species and its habitat requirements.

The overall trend for spotted owl populations is declining in the Pacific Northwest. The recovery for the species is covered under the *USFWS Revised Recovery Plan for the Northern Spotted Owl* (Strix occidentalis causarina)(USDI 2011b). Because the northern spotted owl is listed as a threatened species, the Forest consults on the effects to the species and its habitat with the USFWS prior to making decisions. The project would not place the northern spotted owl in jeopardy. The degree of effect to spotted owls for this project when combined with other projects that affect dispersal habitat would not contribute to a negative trend in viability on the Forest for the northern spotted owl because suitable habitat is not affected and there is abundant dispersal habitat across the landscape.

3.8.3.4 Deer and Elk

Deer and elk were selected as management indicator species because they are economically important game animals. Deer and elk utilize early-successional forest habitat for foraging along with their use of forest stands for cover.

Existing Condition

Recent research has indicated that elk do not rely as much on cover as was once thought; research indicates that forage is much more critical (Cook 2010). Telemetry data indicated that elk were negatively associated with cover. Cook indicated that openings (early-seral habitats) are far more valuable for elk than cover. With the reduction in timber harvest on the Forest in the past two decades and continued tree growth, cover habitats now far exceed the desired levels for optimal and thermal cover but openings for forage are becoming scarce. Currently 13% of the planning area is in early-seral habitat and that figure is declining each year. As the change in forest management has moved from widespread regeneration harvest to selective thinning, past harvest units have grown a thick stand of young trees that shade out the grasses and forbs used as forage for deer and elk.

The project occurs in both winter range and summer range.

Elk herds exhibit a close association with riparian habitat in areas of gentle terrain and low road density (Toweill 2002, pp 535-536). Forage is available but is generally of low quality on the west side of the Cascades. The low quality of the forage, especially in winter range, and the lack of wetlands and permanent low-gradient streams within winter range are limiting factors for elk and deer on the Forest and in the project area.

The project area has plentiful cover but is experiencing a trend of declining forage as stands created through regeneration harvest age and conifers shade out palatable plants.

Direct and Indirect Effects

No Action

The No-action alternative would allow the stands to continue to grow thicker and denser allowing very little light to reach the forest floor. The lack of light would suppress the growth of forage for deer and elk.

There would be no noise disturbance or change in open road density.

Proposed Action

Thinning would allow more sunlight to reach the forest floor and would create more forbs and browse plants to grow which would create increased forage for deer and elk. The units in Matrix would be thinned to wider spacing in some areas with the intention of benefiting forage. The current method of leaving skips and gaps as part of the prescription would create forage openings and cover opportunities scattered across the thinning units. The increased forage opportunities could improve deer and elk production and health in the watershed. The increase in forage opportunities is especially important in winter range where forage is critical to deer and elk survival. Increases in forage in summer range also helps build fat reserves prior to winter and so is also very important to elk survival. However, the relatively small quantity of forage created would not likely reverse the trend in declining forage across the landscape.

The proposed action does not involve the creation of new open roads but does include road closure and decommissioning. Approximately 8.45 miles of roads that are currently open would be closed (s. 1.4.7). Open road density would decline.

Noise from equipment and road use would temporarily cause some harassment resulting in a temporary decrease in use of the area. After use, road closure, decommissioning and seeding with a mixture of blue wild rye and Columbia brome in the road bed and landings could create some temporary forage opportunities until they are shaded out.

The use of helicopters could create some deer and elk disturbance that could cause the deer and elk to seek less used areas of the watershed until that operation is concluded.

Cumulative Effects

The analysis area for deer and elk is the project action area divided into several sub analysis areas based on winter and summer ranges. This analysis area is 42,500 acres. It incorporates 52 acres of private land. The time frame for analysis of forage is approximately 20 years because stands that are opened to the sun have valuable forage which gradually declines for 20 years as trees grow and shade becomes too dense.

There other recent thinning projects near or adjacent to the Grove project that could affect forage. Thinning projects and road decommissioning may result in slight increases in forage, but at the landscape scale these changes would not likely be enough to reverse the trend of declining forage. A project is being planned concurrently that would remove scotch broom and other brush that is encroaching on the Ripplebrook Heliport for fuel hazard reduction: it would result in transitioning from unpalatable brush to other native browse plants. One recent thinning projects in the analysis area is Swag (292 ac.) which also provided some minor increase in forage. The 2014 Clackamas Restoration Project would decommission 2 miles of system roads.

While there may be other future logging or other management in the area that may create forage, or reduce road density, there are no other current proposals with sufficient site specificity to conduct an analysis.

The Forest is examining watersheds incrementally for large scale road decommissioning, as funding allows. The Oak Grove Fork was identified as increment 4 and the Middle Clackamas was identified as increment 6. (At this time 2 increments have been completed; neither overlaps the project area.) Originally it was thought that funding would be allocated so that increment 4 could be planned at the same time as the Grove Thin project but increment 4 has had to be deferred as funding went to higher priority projects nationwide. Simultaneously, the Forest is developing a Travel Analysis Plan as outlined in 36 CFR 212.5(b). While there may be future road closure or decommissioning in the area, there are no current proposals with sufficient site specificity to conduct an analysis.

Open Road Density

Analysis area	Square miles	Pre Open miles	Pre density	Post open miles	Post density
SR1	8.7	9.9	1.1	9.9	1.1
SR2	8.7	18.9	2.2	18.7	2.1
SR4	8.3	11.5	1.4	11.5	1.4
SR6	9.0	16.6	1.8	16.6	1.8
SR7	10.9	26.7	2.4	26.7	2.4
WR1	3.9	13.4	3.4	10.5	2.7

WR12	3.1	5.6	1.8	4.6	1.5
KW2	8.1	19	2.4	19	2.4
KW3	5.7	7.1	1.3	6.2	1.1
Total/Average	66.4	128.7	1.93	123.7	1.86

Some of these analysis areas have roads that cannot be closed. They include Highway 224, roads 46, 57, 58, 4630, and 4631 that are primary access routes to the Forest.

Proposed road decommissioning and road closure would help reduce road densities while no new open roads are proposed. Some portions of the project area would have low levels of open road density and others are higher. The average for the entire analysis area is below 1.9 miles per square mile.

After logging, the roads that were temporarily opened would be closed. There would be no increase in the long-term harassment of deer and elk with this alternative; effects would be short term only.

Cumulatively, this and other projects would improve conditions for deer and elk. The Grove Thinning Project would not contribute to a negative trend in viability on the Forest for deer and elk.

Forest Plan Standards and Guidelines

The project is consistent with all applicable standards and guidelines for deer and elk including B8-009 to 024.

3.8.3.5 American Marten

Introduction

The American marten was once known as the pine marten. The older name was used in the Forest Plan and other documents. This species was selected as a management indicator species because of its association with mature and over-mature habitat, and their need for large snags and large amounts of down wood. Shrinking habitat and trapping pressure led to the concern for marten populations (USDA 1990a).

General description

American marten are typically associated with late-seral coniferous forests with closed canopies, large trees, and abundant snags and down woody.

On the Forest, martens are closely associated with higher elevation stands. Recent tracking records and remote camera work on the Forest over the past 8 years indicates that this species may not use old-growth habitat on the west side of the Cascades as was previously thought. More research would need to be completed to validate this observation. Based on snow tracking, remote cameras, and observations martens are typically associated with stands from 3,000 feet to tree line or about 7,500 feet.

Habitat Characteristics and Ecology
A marten habitat distribution model was created by Ray Davis (Davis 2008), Umpqua National Forest wildlife biologist, based on known marten locations. The analysis shows there are 11,000-22,000 acres of habitat that has a 30-40% or higher probability of supporting American marten on the Forest. The current trend for American marten is stable (USDA 2011b).

Effects on American Marten

The project occurs at lower elevations and in habitat that is considered the lowest value to American martens. Martens would not select this area for denning, resting or hunting due to the low elevation. The project would have little to no effect on marten. Because this project does not impact habitat for American marten there would be no impact on their viability. There are no cumulative impacts for marten because there is no high quality marten habitat in the project area.

Forest Plan Standards and Guidelines
There are no B5 Land allocations for marten in the project area. The project is consistent with all applicable standards and guidelines for marten.

3.8.3.6 Pileated Woodpecker

The pileated woodpecker was chosen as an MIS because of its need for large snags, large amounts of down woody material for foraging, and large defective trees for nesting, roosting and foraging. They are listed as an indicator of mature and over-mature habitat.

Habitat Characteristics and Ecology
Pileated woodpeckers use mature and older, closed canopy stands for nesting and roosting, but may use younger (40-70 years), closed-canopy stands for foraging if large snags are available; large snags and decadent trees are critical habitat components for pileated woodpeckers; down logs do not appear to be an important foraging substrate for pileated woodpeckers on the west side of Oregon and Washington (Mellen 1987, Mellen 1992).

The pileated woodpecker is associated with forest habitats that have large trees, especially large snags (> 20 inches diameter) for nesting and foraging. It uses both coniferous and deciduous trees, but tends to be most common in old-growth Douglas-fir forests in western Oregon.

The watersheds are currently at or above the 50% tolerance level for pileated woodpeckers on 16% of the Oak Grove Fork Watershed and on 21% of the Middle

Clackamas Watershed. The Forest conducts regular aerial surveys and there has been a trend of increasing insect and disease mortality across the landscape. The cumulative mortality from insects and disease regularly creates new snags and down logs.

Direct and Indirect Effects

Refer to the snag discussion in section 3.8.2.

No Action
There would be no change in current snags in the proposed harvest units. Over time there would be a large increase in small snags as suppression mortality continues. There would be ample foraging opportunities for pileated woodpeckers in the next 20-60 years. Pileated woodpeckers would begin to have roosting or nesting opportunities within 20 to 60 years in the stands with no action. Foraging opportunities would be greatest in year 2041 to 2081. No action would result in more snags and down wood that would benefit pileated woodpeckers sooner than any proposed treatment. With no action, the stands would achieve the DecAID 50% tolerance level of 7 snags per acre greater than 20 inches diameter in approximately 45 years.

Proposed Action
There would be an immediate reduction in snag levels from loss of snags (approximately one to two per acre) from harvest activities and safety removals. Snags would be created artificially and would have to decay for 20 plus years to become soft snags that would be used for foraging and nesting. When the stand reaches 200 years of age there would be a similar number of the largest category of snags per acre in the LSR stands and a reduced amount of snags in the Matrix stands compared to No Action. The LSR stands should provide good home range and dispersal habitat for all cavity users throughout the stands life. There would be sufficient snags from implementation through the age of maturity to provide roosting and foraging habitat to pileated woodpeckers and other cavity users.

The current trend for pileated woodpecker is increasing (USDA 2011b). The thinning units do not contain any mature forest. This project would not contribute to a negative trend in viability on the Forest for pileated woodpecker.

Following implementation the stands would achieve the DecAID 50% tolerance level of 7 snags per acre greater than 20 inches diameter in 55 years in the LSR and riparian reserves and up to 70 years elsewhere.

Cumulative effects for pileated woodpeckers are addressed in s. 3.8.2.4 above. That section summarized that there are an abundance of snags at the landscape scale. When combined with the insect, disease and lightning mortality that typically occur across the landscape there has been a net gain of snag and down wood for the watershed. Sufficient levels of snags and down wood would occur across the landscape to provide for the viability of snag and down wood dependent species such as pileated woodpeckers.

Forest Plan Standards and Guidelines
There are no B5 land allocations for pileated woodpecker in the project area therefore there are no relevant standards and guidelines. Snag standards and guidelines are addressed in the snag section 3.8.2.5.

3.8.4 Migratory and Resident Birds of Concern

The appropriate Bird Conservation Plan and Birds of Conservation Concern species list for the project area was reviewed. The Conservation Strategy for Landbirds in Coniferous Forest of Western Oregon and Washington (Altman 2012) is applicable to the project area. The project falls within Bird Conservation Region #5 (Northern Pacific Forest). Those species and habitats that are within the project area are incorporated and effects disclosed in this analysis. The following table displays a list of Birds of Conservation Concern that are known or likely to be present in the Planning Area and could be affected by the proposed actions.

Bird Conservation Region #5 (Northern Pacific Forest - U.S. portions only)

Western Grebe (nb)	Black Swift
Bald Eagle (b)	Rufous Hummingbird
Northern Goshawk (laingi ssp.)	Olive-sided Flycatcher
Peregrine Falcon (b)	Willow Flycatcher (c)
Lesser Yellowlegs (nb)	Horned Lark (strigata ssp.) (a)
Purple Finch	Oregon Vesper Sparrow (affinis ssp.)

(a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (nb) non-breeding in this area.

Habitat Conditions and Existing Condition

There are approximately 114 land birds that utilize the Forest either as residents or migrants; 12 of them are considered birds of concern. Approximately 30 species use 30-60 year old stands or their fringes. The cavity nesters effects have been covered under the snags and down wood section. The other species would be affected by nest disruption when thinning occurs during nesting. The nesting season for some species can go as late as August 15th.

Direct, Indirect, and Cumulative Effects for Land Birds

No Action would result in a continuation of uniform dense stands that are favored by some species. For the proposed action, the effect of thinning on the utilization of the habitat may cause a shift in species composition but rarely eliminates the use by any species. Research has shown that some species benefit from thinning while others decline. Skips and gaps would provide varied habitat to accommodate most species (Hayes 2003). There would likely be some reduction in productivity and loss of nest success for some species during the implementation of the project. There may be some shifts in species composition but no substantial changes are likely at the landscape scale because there are abundant dense second-growth stands not thinned that are available for those species that depend on that habitat. For example, protection buffers remain unthinned along streams, and plantations are not thinned in new wilderness areas or in the Fish Creek watershed where all of the roads have been decommissioned.

Cumulative Effects to Land Birds

The analysis area for land birds is the entire Mt. Hood National Forest because birds are wide ranging and can select areas to nest or forage over a very wide landscape.

Across the landscape, recent and ongoing thinning, and road decommissioning may have an effect both positive and negative on land bird use of the watershed. There would be some loss of productivity for some species from thinning activities in the watershed. There may be some increase in productivity for other species that favor thinning. Road decommissioning would likely result in improved conditions for most bird species due to increased solitude. The proposed action combined with other actions and events would not likely impact the viability of any migratory or resident Birds of Concern because sufficient habitats are present across the landscape.

The project is consistent with the Migratory Bird Treaty Act of 1918 and Executive Order 13186 that address practices that protect these species.

3.9 SCENERY

This section summarizes the scenery/recreation report which is incorporated by reference. There are several aspects of the proposed action that have the potential to affect scenery. Thinning and fuels treatments can alter canopy density and texture, stumps remain and red slash remains on the ground or in piles. Bare soil and straight lines can be created at landings, skid trails and skyline corridors. Fuels treatment, road construction, reconstruction and decommissioning also have the potential to alter scenery. A stand is generally no longer considered visually disturbed when the trees reach an average of 20 feet in height (Forest Plan – FW-562).

This analysis examines the various visual quality objectives associated with specific land allocations and describes the character of the existing landscape from various viewer positions and the likely outcome for each alternative.

3.9.1 Existing Situation

The stands proposed for thinning currently meet the criteria of being visually recovered. The analysis area is experiencing a period of steady visual recovery because there has been relatively little regeneration harvest in the past two decades and young stands are growing rapidly. On the landscape scale, there are some areas where a "patchwork" pattern exists and observers can see the difference in texture and line between plantations and adjacent mature forest stands. This pattern is subtle as seen from the most sensitive viewer positions but is much more noticeable from local forest roads. Power lines and pipe lines cross through the area creating a straight line effect.

Portions of the project area can be viewed from the administrative sites of Timber Lake Job Corps and Ripplebrook Guard Station including their associated residential areas. The administrative sites do not have specific scenery objectives defined in the Forest Plan. The following developed campgrounds are in the project area: Alder Flat, Ripplebrook, Rainbow, Riverside, Harriet, Shellrock and Hideaway.

The following table lists the areas and viewer positions ranked from most sensitive to least in terms of scenery.

Area	**Viewer Position**
Clackamas River	river banks, trails
Oak Grove Fork	river banks above Lake Harriet
Highway 224 and roads 46 & 57	roads, camp grounds
All other areas	local open roads

3.9.2 Direct and Indirect Effects

No Action

Changes in scenery would come slowly from forest growth. Gradually, over approximately 50 years, the contrast between young or mid-aged stands and mature forest would become less evident but stands would remain dense and uniform in texture.

Proposed Action

The proposed action involves the creation of variability in the stands. Portions of the stands in stream protection buffers and skips would be unthinned. Other portions of the stands would have gaps, temporary road construction, landings, helicopter landings, skid trails and skyline corridors that would be open. The rest of each stand would have variable-density thinning. The fuel break treatment would create some short-term visual alteration during project implementation.

3.9.3 **Effects to scenery as seen from sensitive viewer positions:** Sensitive viewer positions identified in the Forest Plan include Clackamas River, Oak Grove Fork, trails, campgrounds, Highway 224, Road 46 and Road 57. Most of the thinning cannot be seen from these viewpoints. The only units that could be seen are 110, 112 and 178 which are adjacent to highway 224. For all of the other units and the fuel break, alterations to scenery if any would be very slight because of a combination of topographic screening, vegetative screening near the viewer position, the density of green trees retained within thinning units, the distance and the viewer angle. No special treatments are needed to meet scenery objectives because these factors would result in no noticeable change to the casual observer; the viewer would not notice any dramatic changes in forest structure or see bare ground or slash. Similar thinning has been implemented in other viewsheds and the results there confirm that this type of treatment has very little if any affect to scenery. For units 110, 112 and 178, design criteria K5 specifies treatments to meet the retention visual quality objective. Within 100 feet of Highway 224, stumps would be cut close to the ground, slash and other debris would be removed using techniques such as whole tree yarding and a thinning prescription with greater leave tree density would be used. Landings would be on side roads.

When comparing the proposed action to no action, variable-density thinning in the long term, would result in accelerated tree growth and the breaking up of the solid “patchwork” pattern between young or mid-aged stands and adjacent mature forest stands. In the long term, the proposed action would result in improved scenery and this improvement would occur much faster with the proposed action than with no action.

3.9.4 **Effects to scenery as seen from local roads:** Local roads are generally roads that were built by loggers to access the forest for timber harvest. Drivers on these local roads would expect to see other roads and some evidence of logging. They would see a closer view of the “patchwork” pattern that exists and would see landings, stumps, skid trails and rock quarries.

Some minor changes to foreground views from local open roads would occur with the proposed action. The proposed action would emphasize the reuse of existing roads, landings and skid trails. Log landings, temporary roads, skid trails and skyline corridors that lead to the landings and landing slash piles would be noticeable by viewer positions at the landings. Landing size would be kept to the minimum size needed for safety and areas of bare soil would be seeded with grass or covered with ground cover or slash. The thinned forest may have some bare soil, red slash and stumps visible in the short term, but in a few years this would become less noticeable. From other more distant viewer positions, the thinning would not be evident to the casual observer. In some cases landings occur on closed system roads or on temporary roads. When these roads are reclosed or rehabilitated, most of the visual impact would not be seen from open roads except for the berms and the first section of closed road. Road decommissioning actions would have bare exposed soil until erosion control seed grows and other vegetation becomes established. The proposed action would close 8.45 miles of roads that are currently open. This would make fewer logging operations visible in the foreground.

When comparing the proposed action to no action, variable-density thinning in the long term, would result in accelerated tree growth and the breaking up of the solid "patchwork" pattern between mid-aged stands and adjacent mature forest stands. In the long term, the proposed action would result in improved scenery.

3.9.5 Cumulative Effects

To see multiple actions at the same time, a viewer would have to be so far back that the thinning would not be noticeable. Because the visual alterations associated with the proposed action would have to be viewed from very close range (standing at a landing for example) there are few other actions that could be seen at the same time. Since alterations of scenery would be minimal there would not likely be any substantive cumulative effects.

3.9.6 Forest Plan standards and guidelines

Mt. Hood Forest Plan References
Forestwide Visual Resource Standards and Guidelines - FW-552 to FW-597, page Four-107
Scenic Viewsheds Standards and Guidelines - B2-12 to B2-42, page Four-221
Mt. Hood FEIS pages IV-127, IV-131, IV-142, and IV-155 to IV-167

FW-554 & B2-012 Visual Quality Objectives

Management Area or Designated Viewshed	Viewer Position	Fore-ground	Middle-ground	Back-ground
A1- Clackamas River (Recreational Segment)	River, trails, camp grounds	PR	PR	PR
A1- Clackamas River (Scenic Section)	River, trails, camp grounds	R	PR	PR
B1- Oak Grove (Recreational Section)	River	PR	PR	N/A
B2- Highway 224, Roads 46 & 57	Road, Recreation Sites	PR	PR	M
B7- Riparian Reserve	Stream	PR	M	N/A
All other areas	Local Roads	M	M	M

R = Retention
PR = Partial Retention
M = Modification

The proposed action involves the creation of variability in the stands. Portions of the stands in stream protection buffers and skips would be unthinned. Other portions of the stands would have gaps, temporary road construction, landings, helicopter landings, skid trails and skyline corridors that would be open. The rest of each stand would have variable-density thinning. The proposed action is consistent with the prescribed visual quality objectives. Similar thinning has been implemented in other viewsheds and the results there confirm that this type of treatment has very little effect to scenery.

3.10 RECREATION

This section summarizes the scenery/recreation report which is incorporated by reference. The actions that affect scenery are discussed in the previous section. There are several aspects of the proposed action that have the potential to affect recreation. The proposed thinning could affect dispersed recreation opportunities in thinned stands and along roads and at landings. Log haul, road construction, reconstruction, closure and decommissioning also have the potential to affect recreation.

This analysis examines the various recreation opportunity spectrum objectives associated with specific land allocations and describes the available opportunities across the landscape and how recreation could be affected by each alternative.

Existing Situation

The project area is seen by forest visitors on their way to recreational destinations, and viewing scenery is an important recreational activity. Highway 224 and roads 46 and 57 are primary travel routes to many of the Forest's recreation areas including, Ollalie Lake, Bagby Hotsprings, Timothy Lake, several Wilderness areas and many campgrounds. The following developed campgrounds are in the project area: Alder Flat, Ripplebrook, Rainbow, Riverside, Harriet, Shellrock and Hideaway. Several roads access wilderness trail heads.

The primary uses in the vicinity of the proposed actions are dispersed camping and hunting. Fire rings are present at old landings and road junctions.

Some of the units are adjacent to the Roaring River Wilderness. The boundary has been surveyed and accidental intrusion into the wilderness is not likely. Roads lie between the units and the Wilderness boundary.

The proposed project is not in an Inventoried Roadless Area. Areas that were once roadless areas have been incorporated into the Roaring River Wilderness. Potential Wilderness is defined by FSH 1909.12 chapter 71. The project area does not meet Forest Service criteria for Potential Wilderness because the unroaded/undeveloped portions of the landscape are less than 5,000 acres in size, are not contiguous to existing wilderness, and are not self-contained ecosystems.

There are no areas with unroaded and undeveloped character identified during public scoping.

3.10.1 Recreation Opportunity Spectrum

The project area crosses land with various recreational objectives. The Recreation Opportunity Spectrum (ROS) is a framework to inventory, plan, and manage recreational opportunities. The ROS objective for most of the project area is Roaded Natural.

3.10.2 Direct and Indirect Effects

With no action, the roads needed for recreation access would not be repaired. They would soon reach the point where they would need to be closed to the public because they would become unsafe. The roads that are currently accessible to the public would remain accessible, at least in the short term.

With the proposed action, roads that access primary recreation opportunities would be maintained and repaired. There would be short-term disruptions of dispersed recreation and road related recreation during project implementation. However, some roads would be closed or decommissioned resulting in a longer-term reduction in road-related dispersed recreation opportunities. Approximately 8.45 miles of roads that are currently open would be closed or decommissioned. Some users may be able to shift to other open roads. In the long term, the project would not substantively change remoteness, scenic quality, the level of development of facilities, the number or type of social encounters or the degree of naturalness encountered by visitors.

3.10.3 Cumulative Effects

The Forest may undertake a landscape-scale road decommissioning planning effort for the Oak Grove. At this time there is insufficient funding for this planning and it is uncertain when it might occur. Because there is no firm proposal at this time, the action cannot be considered reasonably foreseeable.

However, across the Forest, roaded recreation opportunities have been gradually declining as road decommissioning and other road closures occur. The proposed action would remove approximately 8.45 miles of open roads and the 2014 Clackamas Restoration EA includes approximately 2 miles of system road decommissioning in the project area. These contribute to the cumulative decline of roaded recreation opportunities Forest wide.

3.10.4 Forest Plan standards and guidelines

Mt. Hood Forest Plan References
Forestwide Dispersed Recreation Activities Standards and Guidelines - FW-453 to FW-466, page Four-98

The proposed action is consistent with recreation standards and guidelines. The Recreation Opportunity Spectrum objectives would be met.

3.11 SCENIC and RECREATIONAL RIVER

Under the Wild and Scenic Rivers Act, portions of the Clackamas River have been designated with both recreational and scenic segments. A river management plan was completed in 1993 and is incorporated by reference. It established a boundary and included standards and guidelines. The river corridor land allocation was changed from B1 to A1. The river is also a state scenic waterway. The outstandingly remarkable values include: Botany/Ecology, Fish, Wildlife, Recreation and Cultural Resources. In the project area the scenic section is north of Tar Creek and the recreational section is south of Tar Creek.

Unit 178 is in the scenic section and a portion of unit 228 is in the recreational section.

The effects and benefits of each alternative in relation to the outstandingly remarkable values are disclosed in sections 3.3, 3.4, 3.7, 3.8, 3.10, 3.13 and 3.19.1. The maps in Appendix A show that the units listed above are in the outer portion of the river buffer. These units cannot be seen from the river bank. Based upon the above discussion, neither alternative would have a "direct and adverse effect" to the values for which the rivers were added to the National Wild and Scenic River System. For the proposed action, the distance from the river bank, the variable density thinning with skips and gaps, and the protection of the outstandingly remarkable values would result in little or no adverse effect.

3.11.1 Forest Plan standards and guidelines

Mt. Hood Forest Plan References
Clackamas River Management Plan , standards and guidelines A1-CLA-01 to A1-CLA-70, Appendix F, pages F10 to F15.

The proposed action is consistent with these standards and guidelines. The ORVs would be protected. Visual Quality Objectives are addressed in s. 3.9.

3.12 TRANSPORTATION

A Roads Analysis has been developed at the Forest scale; it is incorporated by reference and summarized below (USDA 2003). Road management decisions are informed by this Forest-level analysis, and are focused by project-level specific information. This project specific analysis helps ensure that the future road system can be one that, from a transportation perspective, is safe, environmentally sound, efficient and cost effective.

The Commensurate Share Policy is used to determine maintenance and reconstruction responsibilities for any project that has commercial haul. Under this policy all competing users would be assessed their commensurate share of responsibility for maintenance and reconstruction. The commensurate share of responsibility for any given commercial haul is determined by examining typical structural degradation of roads under heavy haul.

For considering structural design of the subgrade, base, and surfacing of roads, the weight-per-axel loading of typical log haul trucks over the life of the contract is calculated using an estimated volume of timber passed over each segment of roadway. The result of this calculation is used to determine structural degradation and maintenance needs of the road system. The calculation is based on the Normal Operating Season, generally from June 1st through October 31st, and excepts unusual conditions which may occur, such as higher than normal moisture content or frozen subgrade.

3.12.1 Existing Condition

The Forest's transportation system provides multi-use access for trans-forest travelers, the recreating public, commercial users and administrative users. System roads within the Forest range from Maintenance Level 5 (commonly paved or continuously dust controlled for travel at speeds of nominally 35 mph) to Maintenance Level 1 (storage roads closed to public traffic and not maintained for use), and include asphalt paved roads, aggregate (gravel) surfaced roads, improved (stabilized or pit-run aggregate) roads, and native surface roads. Maintenance for these roads is conducted utilizing appropriated funding which is prioritized to focus on maintenance for those roads which accommodate higher levels of traffic and are commonly used by passenger vehicles. The maintenance and reconstruction of roads used primarily for commercial use is provided through the contract and is funded by the value of the timber removed.

However, across the Forest funding for road maintenance is lower than the level needed to properly maintain the approximate 3,000 miles of open roads on the Forest. The Forest-wide Roads Analysis identified the need to change maintenance levels to lower standards, to store roads in a maintenance-level-one category, or to decommission roads.

Limited funding for road maintenance over the past decades has resulted in a backlog of uncompleted road maintenance and repairs. This has left roads that are overgrown with vegetation, have non-functional or poorly functioning drainage systems, have travel surfaces in disrepair, and have multiple subgrade or road base failures.

Effects Analysis

3.12.2 Direct and Indirect Effects - No Action

The No-Action Alternative would involve no haul of logs, no road reconstruction, no road decommissioning and no contract related road maintenance. Since heavy haul of materials is the most impactful action regularly applied to the transportation resource, the No-Action Alternative would result in no additional heavy haul wear and tear on the roads. The only wear and tear that would occur would come from trans-forest travel, recreation, and administrative use; normally in passenger vehicles. Volume of public use on this system would likely decrease slightly over time due to decreased navigability of the roads. Current road failures, drainage failures, and erosion control problems that have been identified (s. 1.4.7.1) within this road system would not be repaired.

Limited funding for road maintenance over the past decades has resulted in a backlog of uncompleted road maintenance (Deferred Maintenance). This has left roads that are overgrown with vegetation, have non-functional or poorly functioning drainage systems, have travel surfaces in disrepair, and have multiple subgrade or road base failures.

Lack of road maintenance exhibits a strong adverse effect with respect to both safety and the environment. Road surface, road subgrade, and road base failures present physical hazards to drivers, reduce a driver's ability to maintain positive control over a vehicle, and increase the potential for the development of erosion hazards on road slopes including soil slumps and slides due to pooling of water and increased soil saturation in the road bed. Failed or poorly functioning drainage systems increase sedimentation in streams and waterways due to their failure to properly mitigate erosion. They also increase the likelihood of waterway contamination from vehicular fluids due to water being forced onto roadways prior to draining into natural stream courses. Unbrushed roadways also present an additional safety hazard to road users due to decreased sight/stopping distance.

In the longer term, as maintenance and minor repairs continue to be deferred, the condition of system roads would deteriorate to the point where major repairs are needed or roads would need to be closed to the public as they become unsafe. Many uses of the road system would be hindered including recreation, Wilderness trailhead access, special forest product gathering, fire suppression activities and utility infrastructure access.

This alternative would not include system road status changes such as road closures or decommissioning, and consequently, there would be no displacement with respect to the transportation system users. The current use pattern of roads within the planning area would not change in the short term, but eventually roads would deteriorate to the point where they are not safe to use.

3.12.3 Direct and Indirect Effects - Proposed Action

The needed repair and maintenance items discussed in section 1.4.7.1 would be performed by the contractor prior to and during operations for haul roads. Some road repairs are needed above and beyond the scope of what is considered road maintenance. It would also be performed by the contractor prior to haul to bring the road up to acceptable standards in order to ensure safe transport of products and to provide for the protection of the Forest's natural resources and its transportation resource.

Proper road maintenance and timely repairs result in an improved transportation system with respect to both safety and the environment. Road surface, road subgrade, and road base failures would be repaired to minimize physical hazards to drivers and reduce the potential for erosion.

In addition to National Forest System Roads, the project would utilize other non-system roads sometimes referred to as temporary roads. Temporary roads are constructed upon stable native soils and are intended for project use only. These temporary access roads are built or reconstructed in order to access landings needed for logging, and are rehabilitated upon completion of operations in each unit.

To minimize impacts to the environment and natural resources, pre-existing alignments are utilized wherever practicable. Even though all of the units were clear-cut logged in the past, there are cases where it is not feasible or desirable to use the same alignments, landings, or logging methods used before at certain sites. In some places, in order to protect residual trees, soil, and water, new temporary roads are proposed to access landings where existing system roads and old alignments are not adequate for accessing strategic locations on the ground. Section 1.4.7.3 contains a table showing the temporary roads.

Commercial haul under this proposal would occur during the dry season, generally June 1 to October 31 dependent upon moisture conditions in the materials of the road base and subgrade. Moisture must remain below the plasticity limit to remain within design parameters. Under these conditions, the stresses produced by heavy haul would result in relatively normal wear and tear that does not create undo cost and damage to resources. Road conditions would be monitored during haul (even during the dry season when rains come) to ensure timely enforcement of contract provisions that require log haul to be suspended when wet weather conditions make continued haul unsafe, would contribute to stream sedimentation, or would threaten the integrity of the road's surface or subgrade.

The proposed action would decommission or close a number of system roads within the project boundary, decreasing road densities in the area. Site-specific treatments would be tailored to site-specific conditions as described in section 1.4.7.2.

These road status changes affect roads that receive relatively low use by the recreating public.

3.12.4 Road and motorized trail statistics for the planning area

Route Miles, Stream Crossings, and Routes in Riparian Reserves	Existing Condition	Proposed Action	Change
Project Action Area Acres (Non-Wilderness)	**37,733**	**37,733**	**0**
Action Area Acres Open to Motorized Cross-country Travel	**0**	**0**	**0**
Grand Total Motorized Route Miles: System	**225**	**220**	**-5**
1. Total Miles of Roads	**225**	**220**	**-5**
a. Miles designated as open yearlong	127	119	-8
b. Miles designated as open seasonally	12	11	-1
c. Miles designated as closed yearlong	86	90	4
2. Total Miles of Motorized Trails	**0**	**0**	**0**
a. Miles of designated roads open year round for use of OHVs	0	0	0
b. Miles of designated road open seasonally for use of OHVs	0	0	0
c. Miles of trail available for use by OHVs < 50 in wide	0	0	0
d. Miles of trail available for use by OHVs > 50 in wide	0	0	0
e. Miles of trail designated for motorcycle use	0	0	0
3. Total Miles of Routes in Riparian Reserves	**68**	**67**	**-1**
a. Total miles of designated open OHV trails in RRs	0	0	0
b. Total miles of designated open roads in RRs	50	48	-2
c. Total miles of designated closed OHV trails in RRs	0	0	0
d. Total miles of designated closed roads in RRs	18	19	1
4. Total Stream Crossings by Designated Route	**360**	**354**	**-6**
a. Total number of open OHV trail stream crossings	0	0	0
b. Total number of open road stream crossings	216	214	-2
c. Total number of closed OHV trail stream crossings	0	0	0
d. Total number of closed road stream crossings	144	142	-2
5. Total Miles of Designated Routes Available to OHVs	**0**	**0**	**0**

3.12.5 Cumulative Effects

The analysis area for cumulative effects is the project area and the haul roads outside the planning area. PGE uses and provides maintenance on several roads in the project area.

The Forest may undertake a planning effort for decommissioning in the Oak Grove Fork (Increment 4), but funding is uncertain. While this project may occur in the future there is insufficient site specificity to consider it foreseeable in terms of cumulative effects.

The proposed action would result in increased effectiveness and overall value of the Forest's transportation system while minimizing impacts to other resources.

3.12.6 Forest Plan standards and guidelines

Forest Plan References
Forestwide Transportation System Standards and Guidelines - FW-407 to FW-437, page Four-95
See FEIS page IV-123

All proposed actions related to the Forest Transportation System are consistent with the Forestwide Transportation Standards and Guidelines; FW-407 through FW-437, pages Four–95 through Four–97.

The Forest-wide Roads Analysis (2003) and this assessment document constancy with FW-416.

All temporary roads constructed or reconstructed for project use would be rehabilitated and/or blocked and treated to meet or exceed the standards of FW-433 and FW-436.

Other standards and guidelines related to transportation are specifically addressed and enforced through contract provisions included with each individual contract.

3.13 BOTANY

A biological evaluation and botany specialist report have been prepared by an agency botanist to address the potential effect of activities on special status/sensitive species; they are incorporated by reference and summarized below. The objective is to avoid a trend toward Federal listing under the ESA.

Because this project involves thinning stands less than 80 years of age, the standards and guidelines outlined in the 2001 Record of Decision for the Amendments to the

Survey and Manage, Protection Buffer, and other Mitigation Measures are not applicable, as the Pechman exemption applies to these stands.

This section addresses special status/sensitive species including fungi, bryophytes, lichens and vascular plants on the Regional Forester's Special Status/Sensitive Species list. Invasive species are discussed in s. 3.14.

No federally listed endangered or threatened plant species, or plant species proposed for federal listing, are known to occur on the Mt. Hood National Forest (MTH).

Intuitive-controlled field surveys were conducted to protocol for sensitive botanical species in 2011.

Surveys to detect the presence of most fungi species are not considered practical because of the variability in fruiting-body production from year to year. Therefore, fungi (other than *Bridgeoporus nobilissimus*) were not targeted during field surveys.

3.13.1 Direct and Indirect Effects

With no action there would be no potential for impact to any special status/sensitive species that are known or suspected to occur in the proposed project area.

The elements of the proposed action that could affect botanical species include thinning, fuels treatment, cutting trees for down logs, creating snags, and the removal of trees for road, landing, skyline corridor, and skid trail construction. For the proposed action, there would some potential effects to species even if they were not found during surveys.

Where field surveys determined the presence of suitable habitat for a particular species of fungi, it was presumed to be present. There are 24 species of special status/sensitive fungi identified as having potential habitat in the project area. For these fungi, the proposed action would have an effects determination of **May Impact Individuals or habitat but is not likely to lead to a trend toward federal listing.**

Where habitat is present for special status/sensitive species that were not found during field surveys there is still the potential to alter their habitat. There are 18 species of vascular plants, 6 species of bryophytes, 7 species of lichens, and 24 species of fungi identified as having potential habitat in the project area. Because it is possible to miss present species during surveys, the action would have an effects determination of **May Impact Individuals or habitat but is not likely to lead to a trend toward federal listing.**

Surveys found no special status/sensitive species. Two survey and manage lichens were found and they would be included in skips.

3.13.2 Cumulative Effects

The analysis areas for botanical species for cumulative effects are the thinning units and the areas directly adjacent to them, including riparian reserves. These are appropriate boundaries because actions more than a few hundred feet outside the unit boundaries would have little or no effect to botanical species within the units, and the actions within the unit boundaries would have little or no effect to species elsewhere. The time scale for cumulative effects analysis is quite long: some impacts from 30 to 60 years ago when stands were clearcut persist today particularly for species that are old-growth dependent; and alterations made during thinning have the potential to affect special status/sensitive species that may be present in the stands for many years into the future. The Biological Evaluation has discussions of the rarity of species across the Forest and Region based on impacts from all past actions and habitat availability.

The recent Swag Thinning project had some units that were adjacent to some of the Grove units. These Swag units were also surveyed and no rare species were found in them. Since there would be little negative direct or indirect effect to special status/sensitive botanical species with the proposed action or the adjacent actions, there would be no incremental impact and no substantial cumulative effect.

Project design criteria, including the retention of live trees, snags, riparian reserves and skips would minimize impacts to special status/sensitive species that may be present but were not discovered. The proposed action would not likely contribute substantially to changes to species across their range and it is not likely to lead to a trend toward federal listing.

3.13.3 Forest Plan Standards and Guidelines

Mt. Hood Forest Plan References
Forestwide Threatened, Endangered and Sensitive Plants and Animals Standards and Guidelines - FW-170 to FW-186, page Four-69

The appropriate surveys and analysis has been conducted for sensitive species as described in FW-176.

2001 Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (2001 ROD) (USDA USDI 2001).

This project is a thinning of stands less than 80 years of age and is exempt from the requirements of the survey and manage standards and guidelines.

3.14 INVASIVE SPECIES

This section addresses invasive plants. A biological evaluation and botanist report have been developed by a botanist to address the potential effect of activities on invasive species; they are incorporated by reference and summarized below. Invasive plants are sometimes called noxious weeds.

The Pacific Northwest Region Invasive Plant Program Preventing and Managing Invasive Plants FEIS, was completed in 2005, and the "Site-Specific Invasive Plant Treatments for the Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, including Forest Plan Amendment #16" FEIS, was completed in 2008. The invasive plant risk assessment for the proposed project is tiered to the 2005 and 2008 FEIS. The 2005 FEIS provides invasive plant management direction to all National Forest Land and Resource Management Plans in Region 6. The management direction includes invasive plant prevention and treatment/restoration standards intended to help achieve stated desired future conditions, goals, and objectives, and is expected to result in decreased rates of spread of invasive plants while protecting human health and the environment from the adverse effects of invasive plant treatment. The 2008 FEIS, in turn, is tiered to the 2005 FEIS. It identifies 208 invasive plant treatment areas on the Mt. Hood National Forest and Columbia River Gorge National Scenic Area, where integrated invasive plant management methods (e.g., manual, mechanical, chemical, biological, and/or cultural treatments) would occur; authorizes the use of 10 herbicides; and provides for an early detection/rapid response (ED/RR) program. The goal of ED/RR is to identify and treat invasive plant populations early when they are still small since treatment and control become more difficult as populations get larger. Like the 2005 FEIS, the 2008 FEIS seeks to protect human health and the environment from the adverse effects of invasive plant treatment by minimizing risks to human health; drinking water; and botanical, terrestrial wildlife, and aquatic species. The design criteria in Section 1.4.9 related to invasive species were developed from the recommendations of these plans.

3.14.1 Introduction

Non-native plants are species that have been introduced either intentionally or unintentionally to areas where they do not naturally occur. Most invasive non-native plants in the Pacific Northwest originate from Europe and Asia. The predators and diseases that control these plant species in their native habitats are not present in the habitats where they have been introduced. Unchecked by predators or disease, such plants may become invasive and dominate a site, displacing native plants and altering a site's biological and ecological integrity. For example, invasive plants can reduce biological diversity, displace entire native plant communities, decrease and degrade wildlife habitat, alter fire regimes, change hydrology, disrupt mycorrhizal associations, alter nutrient dynamics, and increase soil erosion. Invasive plants can also poison livestock and reduce the quality of recreational experiences.

3.14.2 Risk Assessment

The risk level for the introduction, establishment and spread of invasive plants/noxious weeds is moderate for this project. The following species are present in the project area.

Species Name	Common Name
Alliaria petiolata	garlic mustard
Brachypodium sylvaticum	false brome
Centaurea stoebe (=*C. maculosa*)	spotted knapweed
Centaurea diffusa	diffuse knapweed
Cirsium arvense	Canada thistle
Cirsium vulgare	bull thistle
Cytisus scoparius	Scotch broom
Geranium lucidum	shiny leaf geranium
Geranium robertianum	herb Robert
Hedera helix	English ivy
Hieracium aurantiacum	orange hawkweed
Hieracium pratense	meadow hawkweed
Hypericum perforatum	St. John's-wort
Hypochaeris radicata	hairy cat's-ear
Senecio jacobaea	tansy ragwort

These noxious weed species present in or nearby the proposed project area are included in the Oregon Department of Agriculture's (ODA) "A" or "B" List. Some of these species (e.g., Canada thistle, bull thistle, Scotch broom, St. John's-wort, tansy ragwort) are widely established regionally and management objectives are to control infestations on a case-by-case basis. However, the others are considered "ecosystem-altering" species because of their ability to quickly overrun and alter natural habitats and negatively affect ecosystem functions. Garlic mustard, false brome, orange hawkweed, meadow hawkweed, spotted knapweed, and diffuse knapweed, are not at all widely established; so early detection followed by rapid response (implementation of control measures) is recommended to check the spread of these species.

3.14.3 Direct and Indirect Effects

With no action there would be less potential for the spread of invasive species, including noxious weeds; however, they may continue to spread even with no action because of vehicles traveling on open roads. Vehicles, people, and animals can transport invasive plant seed and other plant propagules (e.g., stem and root fragments) capable of generating new plants.

With the exception of the "ecosystem-altering" invasive species listed above, the other invasive plant species are common along roadsides and trailsides, in old landings, in clearcuts, and in other areas with a history of ground disturbance throughout much of the Clackamas River Ranger District. With the proposed action, vehicles and heavy equipment can be a major vector for the spread of invasive plants along roads and from roads into forest and forest openings.

The project design criteria in Section 1.4.9 would reduce the spread of invasive plants. Design criteria s. 1.4.9.C would minimize soil disturbance, s. 1.4.9.G would prevent erosion and specifies the use of weed-free erosion control methods, and s. 1.4.9.H would require the cleaning of equipment and other practices to minimize the spread of weeds. These PDCs implement the standards and guidelines of the Region 6 FEIS for Preventing and Managing Invasive Plants (USDA 2005). The FEIS rates the effectiveness of these practices and explains the rationale for the effectiveness ranking. The use of native plant materials (particularly locally collected seed, cuttings, and divisions, and nursery-grown seedlings propagated from them) in revegetation of bare soils and the utilization of certified straw and mulch are considered highly effective. The cleaning of off-road equipment and the use of gravel from weed-free sources are ranked as moderately effective.

3.14.4 Cumulative Effects

The analysis areas for invasive plant management for cumulative effects are the thinning units and the areas directly adjacent and the roads leading to the project. The time scale for cumulative effects analysis is quite long: some impacts from 30 to 60 years ago when roads were constructed and the stands were clearcut persist today, and activities during thinning, particularly along roads, have the potential to affect the spread of invasive plant species that could be persist for many years into the future.

The 2005 Record of Decision and FEIS for Preventing and Managing Invasive Plants and the 2008 Record of Decision and FEIS for Site-Specific Invasive Plant Treatments for the Mt. Hood National Forest and Columbia River Gorge National Scenic Area provide additional cumulative effects discussion across a broader landscape. The former applies to all national forests in the Pacific Northwest Region (Region 6).

Other ongoing actions across the Forest include the spraying of certain invasive plant hot spots approved by the 2008 Record of Decision. There are no potential spray areas in or directly adjacent to thinning units. The Oregon Department of Agriculture treats populations of Japanese knotweed, spotted and diffuse knapweed, rush skeletonweed, herb Robert, and Canada thistle that are scattered in the Clackamas District annually or biennially depending on the species and population persistence. A number of these populations are located along haul routes (e.g., Highway 224; FS roads 46). Several roads are planned for decommissioning or closure after the thinning is finished. Closing these roads to public access may reduce the potential for invasive plants spread by the recreating public and their vehicles.

A number of the species listed above are relatively common along roadsides. Generally, these and other common, widespread invasive plant species associated with roads are not targeted for treatment because other species have been ranked with a higher priority. Species targeted for treatment are those that are highly invasive and capable of altering ecosystems (e.g., Japanese knotweed, false brome, garlic mustard) and relatively new invaders that are on the increase (e.g., shiny leaf geranium and herb Robert). Populations for some common and widespread invasive plant species are targeted if they threaten other natural resources (e.g., riparian areas, wetlands, rare plant sites) or can spread easily because of their location in or along frequented campgrounds, trails, and parking areas. The proposed action and all of the existing contracts that use the same roads have similar contract provisions to minimize the likelihood of spreading existing species or introducing new invasive species from outside the project area. Practices such as the washing of equipment and the use of certified weed-free straw for erosion control and the use of certified weed-free seed for revegetation have been found to be effective in reducing the introduction, establishment, and spread of unwanted species.

3.15 FUELS AND FIRE HAZARD

The proposed action involves creating a fuel break around the administrative facilities in the project area (s. 1.4.6.6).

Timber Lake Civilian Conservation Center (TLCCC) is the site of Job Corp technical training facility. The center has 50 buildings on site including: dormitories, classrooms, offices, and a water treatment plant. There are approximately 320 students, staff and residents at this site. Ripplebrook Guard Station (RGS) has 36 buildings including: offices, a fire station, a heli-base, residential housing and contractor operated convenience store. There are approximately 20 individuals living in the Ripplebrook housing area. During the summer months there can be 30-40 individuals working in the guard station. This number can increase when it is used for fire camp and Incident Command Post during wildfire suppression.

These areas are within the Wildland-Urban Interface (WUI). National Wildfire Coordination Group defines WUI as: “an area, or zone where structures and other human developments meet or intermingle with undeveloped wildland vegetative fuels.

Forest Service Manual 5101 defines the Authorities under which the Forest Service Fire Management organization operates. Fire management includes all activities undertaken for the following purposes:

1. Firefighter safety, public safety, and community protection.

2. The protection of resources and other values from wildfire.

3. The use of prescribed and wildland fire to meet land and resource management goals and objectives.

The 2012 Clackamas County Wildfire Protection Plan (CCWPP) has identified this area as a Community at Risk and a Fuels Reduction Priority.

> "A core focus of the CCWPP is reducing hazardous fuels around homes, along transportation corridors and in surrounding forested lands can significantly minimize losses to life, property, and natural resources from wildfire. Fuels reduction projects can and should be accomplished at the local scale, which is the creation of defensible space around homes, as well as the landscape scale to extend vegetation treatments onto adjacent forested land and natural areas."

3.15.1 Fire Potential

The fuel model for this area is categorized in the Fire Behavior Prediction System as Fuel Model 10. The fire behavior for this fuel model is described as, "burning in the surface and ground fuels with greater fire intensity than the other timber litter models. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties." While this area is often described as "wet," the summer and fall conditions can become very high fire danger levels. This area is prone to summertime lighting storms, which spark the majority of fires on the district. Most fires are usually contained while small but recently fires have increased in size and complexity. Evacuations could be difficult due to the large number of resident in the area.

While lightning is the primary source of natural ignition, there is also the potential for a human caused fire to start. For example, a residence or other building could catch fire and threaten other buildings or adjacent resources.

While fire frequency tends to be low because of moist habitats, when fires do occur they tend to be large and stand-replacing (killing all or most trees). Fire suppression in the past 100 years has not dramatically altered the structure of stands or increased fire hazard. However, fire suppression has resulted in a landscape where there are few large patches of young fire created stands; fires that did occur were kept small.

3.15.2 Methodology

The Fuels Characteristic Classification System (FCCS) was used to model the effects of implementing treatments described in the Proposed Action. FCCS calculates the relative fire hazard for each fuelbed, including surface fire behavior potential, crown fire potential, and available fuel potential.

3.15.3 Existing Condition

An assessment of existing condition was completed using FCCS. The site-specific assessments are focused on the existing or pre-treatment fire potential for the areas adjacent to RGS, TLCCC and Forest Service Road 4630. The existing fire potential is high to very high and flame lengths and rates of spread are predicted to be greater than what ground resources can effectively and safely suppress a fire.

3.15.4 Direct and Indirect Effects

No Action

With the No-Action alternative, fire occurrence and fire suppression would continue at present levels; the area would increase in surface and ladder fuels; and wildfire severity would continue to increase. Continued accumulation of surface and ladder fuels would make control of wildfires difficult for suppression resources. Fire management options would become more complex, fires would be of longer duration and require increased use of ground disturbing equipment and firefighting resources. Larger and more intense fires increase firefighter and public exposure to hazards during evacuations as well as the risk of losing buildings and residences.

Proposed Action

FCCS was used to model the effects of implementing Proposed Action treatments. The modeled results are indicate that the resulting fire potential would be very low and flame lengths and rates of spread would be well within the range where ground resources can effectively and safely suppress a fire.

Branches and tops and other debris created by the thinning units outside the wildland-urban interface would be retained on the ground to decompose naturally to enhance soils and site productivity. In units operated with a harvester machine, branches and tops would be placed in front of the machine and compressed. Previous experience with similar thinning has shown that snow pack and natural processes of decay cause the debris to break down and compress quickly to the point where fire hazard is not a concern. Some incidental quantities of debris typically end up coming to the landing where it would be piled. If it is not removed for firewood or as biomass it would be burned. Based on previous experience with similar stands, approximately 27 tons per acre of debris would be retained in the units.

3.15.5 Cumulative Effects

There are no other actions or foreseeable projects in the vicinity of the administrative sites that would contribute cumulatively to increased fire hazard. Another fuel reduction project is being planned concurrently that would remove scotch broom and other brush that is encroaching on the Ripplebrook Heliport. That project would complement the fuel break project proposed in this assessment and result in reduced fire hazard.

3.15.6 Forest Plan standards and guidelines

Forestwide Administrative Sites Standards and Guidelines - FW-660 to FW-681, page Four-126.

The intent of these standards and guidelines is to assure Forest Service buildings and facilities are operated and maintained for safe use and to provide for a healthful environment. The project is consistent with these Forest Plan standards and guidelines.

The Proposed Action complies with the following documents:

Forest Service Manual (FSM) - FSM 5100, Fire Management, Chapter 5140-Fire Use and the 2008 Interagency Prescribed Fire Planning and Implementation Procedures Guide. FSM 5140 requires that planning, approval, and implementation of all prescribed fire projects comply with the 2008 guide. All prescribed fire treatments described in the Proposed Action would be planned, approved and implemented through a site-specific prescribed fire burn plan.

National Cohesive Wildland Fire Plan – The Fire Plan has goals and objectives of reducing hazardous fuels and the potential for severe wildland fire behavior and potential for wildfire and post-fire resource and property damage (USDA USDI 2011).

Mt. Hood National Forest Fire Management Plan (USDA 2013b).

Clackamas County Wildfire Protection Plan – This plan identifies priority projects for reducing hazardous fuels. Fuels reduction projects would focus on protecting life and property (Clackamas 2012).

Mt. Hood National Forest Fuels Treatment Placement Plan - This plan identifies RGS and TLCCC as high value areas that are in need of hazardous fuel reduction (USDA 2012c).

3.16 AIR QUALITY

The following actions have the potential to affect air quality: burning slash, exhaust generated by vehicles, equipment, chainsaws and helicopters and dust created by vehicles that drive on aggregate surface and native surface roads.

The following are areas of concern for smoke and pollution intrusion: Portland/ Vancouver Metropolitan Area, Mt. Hood Wilderness, Bull of the Woods Wilderness, Salmon –Huckleberry Wilderness and Mt. Jefferson Wilderness. Other small wildernesses also exist on the Forest. The analysis area includes a large airshed that incorporates the west side of the Mt. Hood National Forest, the area west of the Forest and the specific listed areas of concern.

3.16.1 **Methodology**

National Ambient Air Quality Standards (NAAQS) and thresholds for criteria pollutants are established by the US Environmental Protection Agency (USEPA) to protect public health (ODEQ, 2011). For the purpose of analyzing the air quality effects of prescribed fire and wildfire, this report focusses on NAAQS standards for Particulate Matter 10 (PM10) and PM2.5. These small particulates can be inhaled and cause respiratory problems, especially in smoke sensitive portions of the population, such as the young, elderly, or those predisposed to respiratory ailments. Coarse particles can accumulate in the respiratory system and aggravate health problem such as asthma. Fine particulates, which penetrate deeply into the lungs, are more likely than coarse particles to contribute to the health effects associated with hospital admissions.

The Oregon Department of Environmental Quality (ODEQ) Air Quality Division is responsible for protecting Oregon’s air quality. ODEQ monitors air pollution to ensure that communities meet the national ambient air quality health standards (NAAQS), to report hourly levels to the public, and to protect Oregon’s pristine views (ODEQ, 2011).

The effects of PM10 and PM2.5 particles are reductions in visibility due to absorption and scattering of light by suspended particles. Almost all smoke particles a from wildfire and prescribed fire, residential wood stoves and fireplaces, industrial boilers, field burning, diesel combustion, and other combustion processes can be characterized as fine particulate, primarily PM2.5 (ODEQ, 2011).

3.16.2 **Existing Condition**

The 2010 Oregon Air Quality Data Summary is the most current information available for the Mt. Hood and Mt. Jefferson areas. The Air Quality Index (AQI) report spans June through September and shows that the both areas have an AQI of “good” with 100 percent of the days within this category.

3.16.3 Direct and Indirect Effects

No Action
With no action, effects to Class I airsheds would remain mostly unchanged.

Proposed Action

The fuel break project is designed to provide added protection for the administrative sites in the event of a wildfire, but if a fire does occur the effect to air quality in the airshed would likely be similar to no action.

In thinning units, some incidental quantities of debris typically end up coming to the landing where it would be piled. Piling would also occur with the fuel break. If the slash and other wood are not removed or used as ground cover on roads, skid trails and landings, it would be burned.

Prescribed fire or the burning of slash piles would be implemented during fall, winter or early spring. Traditionally, pile burning prescribed fires are conducted when the ground is frozen or saturated. This reduces the potential of smoldering and creeping into adjacent fuels. Also, these time periods are during reduced recreation season.

Burning cured piles would result in more complete combustion and therefore fewer emissions. Prescribed burning would occur when the weather conditions would minimize visibility effects to Class I airsheds.

Air quality throughout Oregon has steadily continued to improve and this trend is likely to continue with implementation of the Proposed Action prescribed fire treatment. During implementation of Proposed Action prescribed fire treatments short-duration (several hours to several days) increased in particulate levels and smoke exposure would be expected.

Proposed Actions would not reduce wildfire occurrence. Occurrence is largely based on lightning storms. However, should a wildfire occur the dynamic nature of landscape wildfires and movement patterns are unknown and unpredictable, the fuel reduction treatments would reduce the spread and intensity of a wildfire, so emissions would be reduced compared to no treatment.

Health effects to humans are directly related to exposure to smoke. Prescribed fires near housing areas and occupied buildings would be timed to minimize impact. Notifications would be given so that sensitive individuals can avoid exposure. Some material may be chipped and removed where necessary.

3.16.4 **Cumulative Effects**

Cumulative effects to Air Quality are possible when combined with other particulates that share the airshed. Air quality can be affected by actions such as forest fires and controlled burning elsewhere on the Forest, on the Warm Springs Reservation, on private lands and lands managed by other agencies. Field burning, smoke from household wood stoves, smoke from camp fires, motor vehicle exhaust and smoke stack sources from industry also affect air quality.

The projects considered in this cumulative effects analysis include other fuel reduction projects on the Clackamas River Ranger District and areas that overlap this airshed. Many thinning units are logged each year in the airshed and incidental quantities of debris typically end up coming to the landing where it is piled and burned.

The proposed action and other projects that involve burning in the airshed would affect air quality but would not likely be experienced in substantial quantities in the Wildernesses or adjacent communities due to the timing of burning as described above. There is a low likelihood of this project contributing to a substantial cumulative effect to air quality.

3.16.5 **Mt. Hood Forest Plan References**

Forestwide Air Quality Standards and Guidelines – FW-39 to FW-53, page Four-51
See Mt. Hood FEIS pages IV-19, and IV-155 to IV-167.

The analysis above shows that the project would be consistent with air quality standards and guidelines FW-039 through FW-053.

The Oregon Smoke Management Plan, which is administered by the Oregon State Forester, regulates the amount of forestry related burning that can be done at any one time. The amount of burning that can occur on any one day depends upon the specific type of burning, the tons of fuel loading to be ignited, and the atmospheric conditions available to promote particulate matter mixing and transportation of smoke away from sensitive areas. Through compliance and cooperation in the implementation of the Oregon Smoke Management Plan, the Proposed Action would comply with the following laws and regulations.

- The Federal Clean Air Act (CAA), which is the primary legal basis for air quality regulations across the country.
- Oregon Smoke Management Plan, OS477.013, as administered by Oregon Department of Forestry.
- Oregon State Implementation Plan (The Federal Clean Air Act Implementation Plan)
- Oregon Administrative Rules OAR 629-0048-0001: Smoke Management Rules.

- Oregon Visibility Protection Plan for Class I Areas, OAR 340-200-0040, Section 5.2.
- Forest Service Best Smoke Management Practices 2012
- Forest Service Manual 2500-Watershed and Air Management, Chapter 2580-Air Resource Management. The project would minimize the impacts on air quality through compliance and cooperation with Federal, state and local air regulations to prevent significant adverse effects of air pollutants, mitigation of adverse impacts form prescribed fire on air resources though the application of Best Smoke Management Practices, and protection of air quality related values within Class I areas.

Prescribed Fire Burn Plans

As required by Agency policy (Forest Service Manual 5100 - Fire Management, Chapter 5140 Fire Use and through inclusion, the 2008 Interagency Prescribed Fire Implementation Procedures Guide, a site-specific prescribed fire burn plan would be developed for all prescribed fire units in the Proposed Action area. Prescribed fire plans are implementation documents to ensure that purposed and need goals and resource management objectives identified in the Proposed Action are clearly defined, that site-specific prescriptions are developed to meet these goal and objectives, and to ensure plans and mitigations are in place to mitigate against undesirable fire effects, including smoke intrusions into sensitive airsheds, visibility impairment to Class I and II airsheds, and human health effects.

PDCs would be incorporated into prescribed fire burn plans where appropriate.

3.17 ECONOMICS – FINANCIAL ANALYSIS

One of the aspects of the purpose and need (s. 1.3) and 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 offered to bidders. For contracts to receive bids 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.

The purpose of this analysis is to provide a comparison of the alternatives.

The no-action alternative would not provide forest products consistent with the Northwest Forest Plan goal of maintaining the stability of local and regional economies now and in the future. It would not provide the employment associated with road repair or decommissioning.

The proposed action would provide for jobs associated with logging and sawmill operations and would contribute to meeting society's forest product needs. The NFP (p. 3&4-297) contains an analysis of employment in the timber industry. The annual incremental contribution of each million board feet of timber is approximately 8.3 jobs. The purpose and need (s. 1.3) is not solely to create jobs but to provide forest products consistent with the Northwest Forest Plan goal of maintaining the stability of local and regional economies. Jobs are only a part of that equation. Thinning is needed to keep forests healthy and productive to provide wood products now and in the future – people need and use wood products. Approximately 19 MMBF of wood products would be produced now and stands would be made healthier and more productive for future management.

Cost effectiveness is considered in the design of the thinning and in the road treatments proposed.

Based on past experience with thinning similar stands with similar prescriptions, it is likely that there would be sufficient value of timber removed to accomplish thinning. The exception may be with helicopter logging which is very expensive. The economic viability of helicopter logging is marginal given the value of the timber and the high cost of jet fuel. A recent similar helicopter offering received a minimal bid.

3.17.1 Forest Plan standards and guidelines

Forest Plan References
Forest Management Goals - 19, page Four-3, page Four-26, See FEIS page IV-112
Northwest Forest Plan Standards and Guidelines page A-1, and FSEIS pages 3&4-288 to 318

The proposed action is consistent with Forest Plan goal to efficiently provide forest products.

3.18 CLIMATE CHANGE

3.18.1 Introduction – A growing body of scientific evidence and climate modeling indicate that climate change is occurring. While there are no specific projections for the project area, the situation would likely be one where the summers are drier and the snow melts earlier in the spring (Bare 2005) (Mote 2003), (Mote 2005), **(**Dale 2001). There are some who believe that climate change is not occurring or that it is not human caused. This document is not intended to present arguments on any of these theories because they are well documented elsewhere and are outside the scope of this analysis.

This project was not specifically designed to mitigate or respond to potential climate change. This section qualitatively addresses aspects of the project that may affect carbon emission or sequestration and how the project may help or hinder the forest's ability to deal with climate change. This analysis does not attempt to quantify carbon emission or sequestration.

3.18.2 Existing Situation

This project involves the thinning of second-growth stands and removing the logs for utilization in wood products. Rapidly growing forests are recognized as a means of carbon sequestration (FAO 2007). Forest health and growth issues are discussed in section 3.1.

3.18.3 Direct, Indirect and Cumulative Effects

This project is not likely to have direct localized effects on climate. By its very nature, the discussion of a project's effect on climate change is indirect and cumulative because the effects occur at a different time and place, and because the scale of the discussion is global. Since it is not reasonable to measure a project's global impact, the discussion here focuses on key elements of forest management discussed in the scientific literature.

For this proposal, the following actions have the potential to affect carbon emissions or sequestration:

- Thinning to enhance the health of the residual stand would result in trees that are better able to withstand stresses such as dry summer conditions (Millar 2007) (Spittlehouse 2003). The no-action alternative would result in trees that are stressed by moisture competition.

- Variable density thinning with skips and gaps and the retention of minor species would result in stands that are resilient and better able to respond to whatever changes come in the future (Millar 2007). The no-action alternative would result in uniform crowded stands.

- Fossil fuel is used by equipment such as saws, tractors, skyline yarders, helicopters and log trucks. It is possible for some of this equipment to use biofuels, and it is likely to be used where it is available and price competitive. Helicopters would use more fuel than other yarding options. The no-action alternative would not use fuel.

- Small quantities of debris and other wood would be burned, releasing carbon into the atmosphere. It may either be removed as firewood for burning in residences or potentially burned at power generation facilities. Some of the debris that is not removed would be burned on site. Some pile burning would result from the creation of the fuel break in the wildland-urban interface. In the rest of the project area, the quantity of material burned would be minimal because most tree tops and branches of harvested trees would be left scattered in the forest. This debris on the ground would readily decay and would not result in a high fire hazard situation. The no-action alternative would not have any burning.

- Woody debris retained on the ground increases soil carbon sequestration (Millar 2007). The proposed action would retain existing debris and logs on the ground and would add more in the form of logging slash such as branches and tree tops and trees felled to create coarse woody debris. The no-action alternative would result in stagnation of trees and some would die and fall to the ground.

- Utilizing trees to create long-lived wood products sequesters carbon (IPCC 2007) (FAO 2007) (Stavins 2005) (Upton 2007). The no-action alternative would not create any long-lived wood products.

The no action alternative would not result in carbon emissions from vehicles or burning and would result in the retention of relatively slow growing trees. The mortality that results would be retained on site (s. 3.1.3, s, 3.8.2).

The proposed action would affect approximately 1,756 acres of forest by thinning and approximately 49 acres by fuel break creation. Variable density thinning is designed to improve health and growth and enhance elements of diversity include the inclusions of skips, gaps, patches of heavy thinning, forage openings, brushing, snag and down log creation. The fuel break would remove small trees and brush to help protect administrative sites and residences from wildfire.

The Forest is comprised of about 1.1 million acres. The proposed action equates to approximately 0.2% of the Forest. This scope and degree of change would be minor relative to the amount of forested land as a whole. A project of this magnitude would have such minimal contributions of greenhouse gasses that its impact on global climate change would be infinitesimal. Therefore, at the global scale, the proposed action's direct and indirect contribution to greenhouse gasses and climate change would be negligible.

In addition, because the direct and indirect effects would be negligible, the proposed action's contribution to cumulative effects on greenhouse gasses and climate change would also be negligible.

The Intergovernmental Panel on Climate Change (IPCC) has summarized the contributions to climate change of global human activity sectors in its Fourth Assessment Report (IPCC 2007). The top three anthropogenic (human-caused) contributors to greenhouse gas emissions (from 1970-2004) are: fossil fuel combustion (56.6% of global total), deforestation (17.3%), and agriculture/waste/energy (14.3%). IPCC subdivides the deforestation category into land use conversions and large scale deforestation. Deforestation is defined as removal of all trees for conversion of forest into agricultural land or developed landscapes (IPCC 2000).

This thinning project does not fall within any of these main contributors of greenhouse gas emissions. Forested land would remain forested and not converted to agriculture or development. In fact, forest stands are being retained and thinned to maintain a vigorous forested condition that can continue to support trees and sequester carbon in the long term.

This project is also consistent with IPCC recommendations for land use to help mitigate climate change. The 2007 IPCC report summarizes sector-specific key mitigation "technologies". For the forestry sector, the report recommends forest management including management to "improve tree species" and increase biomass. The proposed action is consistent with these recommendations because it would enhance the health and growth of mid-aged stands and would sequester some wood in long-lived wood products.

Timber management projects can influence carbon sequestration in three main ways: (1) by increasing new forests (afforestation), (2) by avoiding deforestation, and (3) by manipulating existing forest cover (managed forests). Land-use changes, specifically deforestation and regrowth, are by far the biggest factors on a global scale in forests' role as sources or sinks of carbon, respectively (IPCC 2000). Projects that create forests or improve forest conditions and capacity to grow trees are positive factors in carbon sequestration. The proposed action falls into this category.

The proposed action would result in some carbon emissions and some carbon sequestration. The benefits to forest health and resiliency with the proposed action would allow stands to adapt to the future climate (s. 3.1.4).

3.19 OTHER REQUIRED DISCLOSURES

3.19.1 Heritage Resources

Section 106 of the National Historic Preservation Act of 1966 requires documentation of a determination of whether each undertaking would affect historic properties. The Forest operates under a programmatic agreement between the Oregon State Historic Preservation Office (SHPO) and the Advisory Council on Historic Preservation for consultation on project determination. Consultation with SHPO was completed for this project.

Surveys have been conducted for this project and are discussed in heritage report number 2012-060605-002. The report found that the project would have no effect on archaeological resources.

Contracts would contain provisions for the protection of sites found during project activities. Based on the proposed protective measures, the project meets the criteria in the Programmatic Agreement for “Historic Properties Avoided” determination (Stipulation III (B) 2).

This action is consistent with Forest Plan goal to protect important cultural and historic resources.

3.19.2 Consumers, Civil Rights, Minority Groups, Women, and Environmental Justice

Executive Order 12898 directs agencies to identify and address disproportionately high and adverse human health or environmental effects of projects on certain populations. This includes Asian Americans, African Americans, Hispanics, American Indians, low-income populations and subsistence uses. The Civil Rights Act of 1964 prohibits discrimination in program delivery and employment. There are communities with minorities and low-income populations that may be affected by the project. The town of Estacada (the nearest community) is approximately 25 miles away. Even farther away, but potentially affected are the American Indian communities of Warm Springs and Grande Ronde. There are no known areas of religious significance in the area. There are no known special places for minority or low-income communities in the area. Individuals may work, recreate, gather forest products or have other interests in the area. Neither the impacts nor benefits of this project would fall disproportionately on minorities or low-income populations.

No disproportionate impacts to consumers, civil rights, minority groups, and women are expected from this project. Thinning work would be implemented by contracts with private businesses. Project contracting for the project’s activities would use approved management direction to protect the rights of these private companies. No adverse civil rights impacts were identified. There would be no meaningful or measurable direct, indirect or cumulative effects to environmental justice or civil rights.

3.19.3 Floodplains and Wetlands

The Clean Water Act of 1977 and subsequent amendments established the basic structure of regulating discharges of pollutants into waters of the United States. The Environmental Protection Agency (EPA) has the authority to implement pollution control programs and to set water quality standards for all contaminants in surface waters. The EPA delegated implementation of the CWA to the States; the State of Oregon recognizes the Forest Service as the Designated Management Agency for meeting CWA requirements on National Forest System lands. The proposed action is in compliance with the Clean Water Act as described in s. 3.3.

There would be very limited impacts to floodplains or wetlands from this project. Due to the steepness of the topography, small stream size and confined nature of streams in this area, floodplain width is fairly limited. The impacts to wetland and floodplains are discussed in Section 3.3. Due to the PDCs and BMPs which are aimed at minimizing the impacts to wetlands and floodplains, there would be minimal direct and indirect effects.

3.19.4 Wild and Scenic Rivers

Section 7(a) of the 1986 Wild and Scenic Rivers Act prohibits agencies of the United States from assisting in any water resources project that "…would have a direct and adverse effect on the values for which such a river was established…" Section 7 provides authority to the Secretary of Agriculture to evaluate and make a determination on water resources projects that affect wild and scenic rivers. The authority for that determination for projects on National Forest System lands is delegated to the Forest Supervisor (Forest Service Manual 2350). The project is in scenic and recreational sections of the Clackamas Wild and Scenic River corridor. A management plan for the Clackamas River was completed in 1993. Compliance is addressed in Section 3.11.

3.19.5 Air Quality

The Clean Air Act as amended in 1977 addresses the air quality in Wilderness areas. All planned ignitions are conducted according to the Operational Guidance for the Oregon Smoke Management Program (OSMP). The Operational Guidance contains the direction for meeting the terms of the OSMP. The Environmental Protection Agency has approved the OSMP as meeting the requirements of the Clean Air Act, as amended. The OSMP, which is administered by the Oregon State Forester, regulates the amount of forestry related burning that could be done at any one time. Also, in compliance with the Clean Air Act, the Forest Service is operating under the Oregon Administrative Rule (OAR) 629-43-043. The proposed action is in compliance with the Clean Air Act as described in s. 3.15.

3.19.6 National Forest Management Act

The National Forest Management Act (NFMA) of 1976 requires that the Agency develop land management plans. It also requires the Forest to determine the suitability of a specific land area for timber management and contains other requirements that are built into Forest Plan standards and guidelines. The proposed action was developed to be in full compliance with NFMA via compliance with the Forest Plan, as amended. This document contains numerous references as to how this project complies with Forest Plan, as amended, and the Silvicultural Prescription in the Analysis File contains a discussion of compliance with NFMA's requirement to identify lands unsuited for management.

3.19.7 Treaty Resources and Reserved Indian Rights

No impacts on American Indian social, economic, or subsistence rights are anticipated. No impacts are anticipated related to the American Indian Religious Freedom Act. The Confederated Tribe of Warm Springs and the Confederated Tribes of Grand Ronde were contacted in reference to this Proposed Action.

3.19.8 Inventoried Roadless Areas, Unroaded and Potential Wilderness Areas

The proposed project is not in an Inventoried Roadless Area. Areas that were once roadless areas have been incorporated into the Roaring River Wilderness. The project area does not meet Forest Service criteria for Potential Wilderness because the unroaded/undeveloped portions of the landscape are less than 5,000 acres in size, are not contiguous to existing wilderness, and are not self-contained ecosystems. There are no areas with unroaded and undeveloped character identified during public scoping. See section 3.10.

3.19.9 Prime Farmlands, Rangelands, and Forestlands

None of the alternatives would have an adverse impact to the productivity of farmland, rangeland, or forestland. No reductions in long-term productivity are expected. See section 3.6.

3.19.10 Potential or Unusual Expenditures of Energy

The No Action alternative would not require any expenditure of fuel or energy. The Proposed Action would require expenditures of fuel for workers to access the project area, use power equipment, and to utilize the logging systems. Jet fuel use for helicopter operations would also occur. Overall, the proposed action would not result in any unusual expenditure of fuel (s. 3.18).

3.19.11 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that are forever lost and cannot be reversed. Irretrievable commitments of resources are considered to be those that are lost for a period of time and, in time, can be replaced. The use of rock for road surfacing is an irreversible resource commitment; however rock quarries have sufficient capacity to provide for the long-term needs for surfacing rock.

3.19.12 Conflicts with Plans, Policies, or Other Jurisdictions

NEPA at 40 CRF 1502.25(a) directs "to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with . . . other environmental review lands and executive orders."

The proposed action would not conflict with the plans or policies of other jurisdictions, including the Tribes. It would not conflict with any other policies and regulations or laws, including the Clean Water Act, Clean Air Act, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, or National Historic Preservation Act. Refer to the following sections for discussions regarding these laws:

- Section 3.3 – Clean Water Act;
- Section 3.4 and 3.7 – Endangered Species Act;
- Section 3.4 - Magnuson-Stevens Fishery Conservation and Management Act;
- Section 3.19.1 – National Historic Preservation Act; and
- Section 3.16 – Clean Air Act

3.19.13 Competing and Unwanted Vegetation

The Record of Decision and Mediated Agreement for the "Managing Competing and Unwanted Vegetation" Final Environmental Impact Statement (USDA 1998) no longer apply to invasive species management but are still applicable to unwanted native vegetation, brush control and fuel treatments. Fuels treatments in thinning projects are exempt. Slash treatments associated with road construction is included. However the slash, woody debris and root wads that result from the temporary road construction associated with this project would be temporarily set aside and used to block the road when logging is completed. There would be no burning of this material. This project is consistent with standards and guidelines for competing and unwanted vegetation.

4.0 CONSULTATION AND COORDINATION

The Forest Service consulted the following Federal, State, and local agencies and tribes during the development of this assessment:

4.1 FEDERAL, STATE, AND LOCAL AGENCIES

U.S. Fish and Wildlife Service	National Marine Fisheries Service
Oregon Historic Preservation Office	Portland General Electric
South Fork Water Board	Clackamas River Water
Mt. Scott Water District	Oak Lodge Water Board

City of Gladstone	Bureau of Land Management
City of West Linn	Clackamas River Basin Council
City of Estacada	Oregon Department of Fish and Wildlife
City of Lake Oswego	Clackamas County
City of Oregon City	Environmental Protection Agency

Consultation with the U.S. Fish and Wildlife Service is documented in section 3.7.1.
Consultation with the National Marine Fisheries Service is ongoing: effects to listed fish are documented in section 3.4.
Consultation with the Oregon Historic Preservation Office is documented in section 3.19.1.

4.2 TRIBES

Confederated Tribes of Warm Springs
Confederated Tribes of Grand Ronde

4.3 LIST OF PREPARERS

Gwen Collier - Soil Scientist. Gwen has a B.S. in Biology and Environmental Science from Willamette University and a B.S. in Soil Science from Oregon State University. She has worked for the Forest Service for 33 years in Oregon, Washington and Idaho. She is a specialist in soil science and hydrology.

Tom DeRoo - Geologist. Tom graduated from the University of Washington in 1978 with a B.S. in Geology. He has worked as a geologist for the Forest Service for 36 years in Washington and Oregon, including 28 years on the Forest.

Alan Dyck - Forest Wildlife Biologist. Alan has a B.S. in Wildlife Management from Humboldt State University, 1980 and an A.A. from Orange Coast College 1978. Alan has worked on the Mt. Hood National Forest since 2000. He has also worked for the Natural Resources Conservation Service from 1996-2000 and the US Army as a Wildlife Administrator for eight years. Alan started his career on the Cottage Grove Ranger District in Oregon as the District's wildlife specialist in 1980.

Glenda Goodwyne, - Forester, Certified Silviculturist. Glenda has B.S. Forest Management from Oregon State University, 1985 and an A.A.S. Forest Management from Tuskegee University, 1980. She completed Silviculture Institute at Oregon State University/University of Washington in 1998, and is certified as a silviculturist and most recently re-certified in 2011. Glenda has worked as a forester with the Forest Service for 30 years in Oregon, Washington, and California.

Lucas Jimenez - Roads Project Engineer. Certified as an Engineer in Training (EIT) and Land Surveyor in Training (LSIT) through the California State Board for Professional Engineers and Land Surveyors. Received specialized training for the design and construction of Low-Volume Roads through the United States Marine Corps Engineer Specialist's Course, Fort Leonard Wood, MO. Lucas has 15 years of experience as a Civil Engineering Technician and Survey Crew Chief, along with 5 years of experience in construction inspection.

David Lebo - Westside Zone Botanist, Mt. Hood National Forest. B.A. Frostburg State College; M.A. University of Montana; M.S. University of Washington (forest ecology). David specializes in forest ecology and botany with a particular interest in cryptogamic botany (fungi, lichens, and bryophytes). He has worked for the Forest Service for two decades in Washington and Oregon including a six-year stint as interagency ecologist for the BLM and Forest Service in the Klamath Basin in southern Oregon.

Ian Turner - Forester, Logging Systems. Ian has B.S. in Forest Ecosystem Management from the University of Idaho, 2000 and an A.A.S. Forest Resource Technology from Mt. Hood Community College, 1994. He completed the SALHI - Sale Area Layout & Harvesting Institute at Oregon State University/University of Idaho in 2004. Ian has worked as a forester with the Forest Service for 20 years in Oregon, Washington, and California.

Jim Roden - Writer/Editor. Jim has a B.S. in Forest Management from Northern Arizona University. He has worked as a forester for the Forest Service for 36 years in Wyoming, California, Idaho and Oregon. He is a specialist in timber sale planning and geographic information systems.

Todd Parker – Hydrologist. Todd has a B.S. in Forest Management and a B.S. in Business Management from Oregon State University, 1981. He has been the Hydrologist on the Columbia Gorge and Zigzag Ranger Districts since 1992. He has considerable experience with watershed resources, watershed restoration and geographic information systems.

Jack Williamson - Fish Biologist. Jack has a M.S. in Fish Biology from Colorado State University and B.S. in Philosophy and General Science from University of Oregon. He has worked for the federal government for 16 years in California and Oregon and for the state of Oregon for 6 years.

Mark Boyll - Botanist. Mark earned his BS in Botany at Oregon State University. In addition to vascular plants his areas of expertise include lichenology, mycology and myxomycology. He has worked for the Forest Service in Oregon, Washington, California, Montana and Idaho since 1989.

Debbie Ortiz – Archaeologist. Debbie graduated from New Mexico State University in 2010 with a Master's Degree in Archaeology. She has worked as an archaeologist for the Forest Service on Mt. Hood for 8 years.

4.4 REFERENCES

Altman, B. 2012. Conservation Strategy for Landbirds in Coniferous Forest of Western Oregon and Washington, Partners in Flight. http://www.orwapif.org/conservation-plans. August, 2012.

Amann Joseph R. 2004. Sediment Production from Forest Roads in the Upper Oak Creek Watershed of the Oregon Coast Range. Master's thesis, Bioresource Engineering and Forest Engineering, Oregon State University.

Anthony, R.G., et al. 2004. Status and Trends in Demography of Northern Spotted Owls. A Draft Report to the Interagency Regional Monitoring Program. Portland, Oregon.

Bare, B. B., Gustafson, R., Mote, P., Brubaker, L., Perez-Garcia, J. 2005. Effect of global climate change on northwest forests. University of Washington. Denman Forestry Issues. Retrieved December 15, 2007 from http://uwtv.org/programs/displayevent.aspx?rID=2797

Bauhus J, K Puettmann, C Messier. 2009. Silviculture for old-growth attributes. Forest Ecology and Management, Elsevier.

Burroughs, E.R., Jr., John G. King. 1989. Reduction of soil erosion on forest roads. General Technical Report INT-264. USDA Forest Service, Intermountain Research Station. Ogden, Utah. 21pp.

Carey, A.B., 2003 Biocomplexity and restoration of biodiversity in temperate coniferous forest: inducing spatial heterogeneity with variable-density thinning. *Forestry* **76**, No. 2, 127-136.

Chan, S.S., Larson, D.J., Maas-Hebner, K.G., Emmingham, W.H., Johnston, S.R., and Mikowski, D.A. 2006. Overstory and understory development in thinned and underplanted Oregon Coast Range Douglas-fir stands. Can. J. For. Res. **36**: 2696-2711.

Christner, J. 1982. Water Resource Recommendation for Controlling the Amount of timber Harvest in a Sub-Drainage. USDA Forest Service.

Clackamas County. 2012. Clackamas County Wildfire Protection Plan. http://www.clackamas.us/emergency/ccwpp.html

Clackamas River Water Providers. 2013. Annual Report. *http://clackamasproviders.org/images/stories/CRWP_Annual_Report_FY2012-13_FINAL.pdf*

Clackamas Stewardship Partners (CSP). 2012. Final Report for Project ID#LD-606 to the National Forest Foundation, August 31, 2012.

Cook, John. 2010. Workshop: Elk habitat selection in western Oregon and Washington: *Models for a new century.* USFS Pacific Northwest Research Station. cookjg.ncasi@gmail.com http://www.fs.fed.us/pnw/calendar/workshop/elk/elk-habitat-modeling-workshop.pdf June 2010.

Courtney, S P, J A Blakesley, R E Bigley, M L Cody, J P Dumbacher, R C Fleischer, AB Franklin, J F Franklin, R J Gutiérrez, J M Marzluff, L Sztukowski. 2004. Scientific evaluation of the status of the Northern Spotted Owl. Sustainable Ecosystems Institute of Portland Oregon. September 2004. <http://www.sei.org/owl/finalreport/finalreport.htm>

Crookston, N.L., Stage, A.R., 1999. Percent Canopy Cover and Stand Structure Statistics from the Forest Vegetation Simulator. General Technical Report RMRS-GTR-24. USDA Forest Service, Rocky Mountain Research Station, Ogden, Utah.

Curtis, R.O. 1982. A simple index of stand density for Douglas-fir. Forest Service, Vol. 28, No.1. 92-94 p

Dale, V., L. Joyce, S. McNulty, R. Neilson, M. Ayres, M. Flannigan, P. Hanson, L. Irland, R. Lugo, C. Peterson, D. Simberloff, F. Swanson, B. Stocks, M. Wotton. 2001. Climate change and forest disturbances. BioScience 51: 723-734.

Davis, Raymond J., 2008. Pine Marten Habitat Similarity Index Map for the Oregon Cascades (v1.0). GIS habitat model. rjdavis@fs.fed.us
Davis, Raymond J. 2013. Personal communication with Alan Dyck about the abundance of habitat for Johnson's hairstreak butterfly.

Dodson, E.K., A. Ares, K.J. Puettmann. 2012. Early responses to thinning treatments designed to accelerate late successional forest structure in young coniferous stands of western Oregon, USA. Canadian Journal of Forestry 2012. 42:345 365

Dubé, Kathy; Walter F. Megahan; Marc McCalmon. 2004. Washington Road Surface Erosion Module. State of Washington Department of Natural Resources.

Dyck, Alan. 2012. Personal observation on the development of thinned plantations.

Ellen, D. 1983. Curtis' Relative Density in Practical Use. An informal paper discussing a field procedure using Curtis' Relative Density to regulate density in variable stands. USDA Forest Service, Estacada, OR. 2-18 p

Elliot, W. J., D. E. Hall and D.L. Scheele. 2000. Disturbed WEPP (Draft 02/2000); WEPP Interface for Disturbed Forest and Range; Runoff, Erosion and Sediment

Delivery; Technical Documentation: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Fiala, A., S. Garman, A. Gray. 2006. Comparison of five canopy cover estimation techniques in western Oregon Cascades. Forest Ecology and Management 232 (2006) 188-197.

Grant, Gordon E.; Lewis, Sarah L.; Swanson, Frederick J.; Cissel, John H.; McDonnell, Jeffrey J. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p.

Hayes, J. P.; J. M. Weikel; and M. M. P. Huso. 2003. Response of Birds to Thinning Young Douglas-fir Forests. *Ecological Applications,* 13(5), 2003, pp. 1222–1232 q 2003 by the Ecological Society of America.

Howes, S.W. 1979. Soil Resource Inventory, USDA Forest Service, Pacific Northwest Region, Mt. Hood National Forest.

Howes, S.W. 2000; Proposed Soil Resource Condition Assessment; Wallowa-Whitman National Forest. USDA Forest Service, Pacific Northwest Region, Baker City, Oregon.

Intergovernmental Panel on Climate Change [IPCC]. 2007. Climate Change 2007: the IPCC fourth assessment report. Synthesis Report, section 2, Causes of Change,. IPCC, Geneva, Switzerland. 3 pp.

Intergovernmental Panel on Climate Change [IPCC]. 2000. Special Report on Land Use, Land Use Change and Forestry, Summary for Policy Makers, 2000. IPCC, Geneva, Switzerland. 20 pp.

Johnston, N.T., S.A. Bird, D.L. Hogan, and E.A. MacIsaac. 2011. *Mechanisms and source distances for the input of large woody debris to forested streams in British Columbia, Canada.* Can. J. For. Res. 41:2231-2246.

Lakel, William A. III; W. M. Aust, M. C. Bolding, C. A. Dolloff, P. Keyser, R. Feldt. 2010. Sediment Trapping by Streamside Management Zones of Various Widths after Forest Harvest and Site Preparation. Forest Science.

LaMarche, J.L. and D.P. Lettenmaier. 2001. Effects of Forest Roads on Flood Flows in the Deschutes River, Washington. Earth Surface Processes and Landforms. 26: 115-134.

Lanigan, S. H.; S. N. Gordon; P. Eldred; M. Isley; S. Wilcox; C. Moyer; H. Andersen. 2012. Northwest Forest Plan—the first 15 years (1994–2008): watershed condition status and trend. Gen. Tech. Rep. PNW-GTR-856. Portland, OR: U.S. Department of

Agriculture, Forest Service, Pacific Northwest Research Station. 155 p.

Litschert, S. E. and L. H. MacDonald. 2009. Frequency and characteristics of sediment delivery pathways from forest harvest units to streams. Forest Ecology and Management 259(2): 143-150.

Manning, T., Hagar, J.C., McComb, B.C., 2012. Thinning of oung Douglas-fir forests decreases density of northern flying squirrels in the Oregon Cascades. Forest Ecology and Management 264 (2012) 115-124.

Maser, C., J.M. Trappe. 1984. The Seen and unseen world of the fallen tree. USDA Forest Service Pacific Northwest Forest and Range Experiment Station, Portland, OR. General Report

Mellen, T. Kim. 1987. Home range and habitat use of pileated woodpeckers, western Oregon. M.S. Thesis, Oregon State Univ., Corvallis. 96 pp.

Mellen, T. K., E.C. Meslow, R. W. Mannan. 1992 Source Summertime Home Range and Habitat Use of Pileated Woodpeckers in Western: The Journal of Wildlife Management, Vol. 56, No. 1 (Jan., 1992), pp. 96-103Published by: Allen PressStable URL: http://www.jstor.org/stable/3808796 .

Mellen, T, K. 2003. DecAID, the Decayed Wood Advisor for Managing Snags, Partially Dead Trees, and Down Wood for Biodiversity in Forests of Washington and Oregon. Pacific Northwest Research Station, USDA Forest Service. <http://wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf>

Millar, C., Stephenson, L., Stephens, S. 2007. Climate change and forests of the future: managing in the face of uncertainty. Ecological Applications, 17(8), 2007, pp. 2145–2151 _ 2007 by the Ecological Society of America.

Mote, P.W. 2003. Trends in snow water equivalent in the Pacific Northwest and their climatic causes. Geophysical Research Letters. 30: 1601.

Mote, P.W.; Hamlet, A.F.; Clark, M.; Lettenmaier, D.P. 2005. Declining mountain snowpack in western North America. Bulletin of the American Meteorological Society. 86: 39-49.

Nelson, Nathan; T. Black; C. Luce; and R. Cissel. 2012. Legacy Roads and Trails Monitoring Project Update 2012. US Forest Service, Rocky Mountain Research Station.

Oliver, C.D.; B.C. Larson. 1996. Forest Stand Dynamics. John Wiley & Sons, Inc. New York. p. 37-39, 75, 216, 217, 228, 229, 232, 233.

Oregon. 2012. Historical Look at Oregon's Wood Product Industry. January 23, 2012. http://oregoneconomicanalysis.wordpress.com/2012/01/23/historical-look-at-oregons-wood-product-industry/

Packer, P.E. 1967. Criteria for designing and locating logging roads to control sediment. Forest Science 13 (1). l8pp.

Pearson, R. R., and K. B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. Journal of Raptor Research 37:265–276.

Perry, D.A., et al. 1989. Maintaining the Long-Term Productivity of Pacific Northwest Forest Ecosystems.

PGE (Portland General Electric). 2009. Evaluation and Findings Report on the Application for Certification Pursuant to Section 401 of the Federal Clean Water Act. State of Oregon Department of Environmental Quality.

RAPID Stream Shade Assessment Model. USDA Forest Service ArcGIS Tool

Rashin, E. B., C. J. Clishe, A. T. Loch, J. M Bell. 2006. Effectiveness of Timber Harvest Practices for Controlling Sediment Related Water Quality Impacts. Journal-American Water Resources Association, Vol. 42 (5): 1307-1328

RIEC Regional Interagency Executive Committee. 2013. USDA Forest Service, USDI National Marine Fisheries Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management. Documentation of issues elevated to the Regional Executive Team from the Northwest Oregon Level 2 Team. June 6, 2013.

REO Regional Ecosystem Office. 2012. Memorandum to Mt. Hood National Forest on consistency with the Northwest Forest Plan. May 15, 2012.

Spittlehouse, D.L. and Stewart, R.B. 2003. Adaptation to climate change in forest management. BC Journal of Ecosystems and Management 4 (1): 1-11.

Stavins, R.N., Richards, K.R. 2005. The cost of U.S. forest-based carbon sequestration. Prepared for the Pew Center on Global Climate Change. *January 2005*

Stockdale, Dave. 2013. A Stream Shade Model for ArcGIS. USFS Region 6 Data Resources Management. ESRI Federal GIS User Conference February 2013.

Swanson, F. J.; C. T. Dyrness. 1975. Impact of clear-cutting and road construction on soil erosion by landslides in the western Cascade Range, Oregon. *Geology* 1975;3;393-396

Tappeiner, John C. 1999. Thinning young stands and biological diversity. Forest and Rangeland Ecosystem Science Center OSU Corvallis, OR.

Thomas, J.W. September 1979. Wildlife Habitats in Managed Forest the Blue Mountains of Oregon and Washington. U.S. Department of Agriculture, Forest Service. Agriculture Handbook No. 553.

Toweill, D.E, and J.W. Thomas. 2002. North American Elk: Ecology and Management. Wildlife Management Institute. Smithsonian Institution Press. 962Pp.

Upton, B.; Miner, R.; Spinney, M.; Heath, L.S. 2007. the greenhouse gas and energy impacts of using wood instead of alternatives in residential construction in the United States. Biomass and Bioenergy. 32:1-10

USDA Forest Service. 1988. General Best Management Practices, Pacific Northwest Region, 11/88.

USDA Forest Service. 1990a. Final Environmental Impact Statement for the Mt. Hood National Forest Land and Resource Management Plan and Record of Decision (Forest Plan).

USDA Forest Service. 1990b. Mt. Hood National Forest Land and Resource Management Plan. (Forest Plan).

USDA Forest Service. 1993. Forest ecosystem management; and ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team, July 1993.

USDA Forest Service. 1996a. *Oak Grove Watershed Analysis.* Mount Hood National Forest.

USDA Forest Service. 1996b. *Lower Clackamas River Watershed Analysis.* Mount Hood National Forest.

USDA Forest Service. 1998. Final Environmental Impact Statement on Managing Competing and Unwanted Vegetation and the Record of Decision and the Mediated Agreement. Pacific Northwest Region.

USDA Forest Service. 2003. Mt. Hood National Forest Roads Analysis. Pacific Northwest Region. <http://www.fs.fed.us/r6/mthood/documents/current/forest-wide-roads-analysis/roads-analysis-0903.pdf>

USDA Forest Service. 2004. General Water Quality Best Management Practices, Mt. Hood National Forest, August 2004.

USDA Forest Service. 2005. Record of Decision for Preventing and Managing Invasive Plants, October 11, 2005.

USDA Forest Service. 2008. Record of Decision for Site-Specific Invasive Plant Treatments for Mt. Hood National Forest and Columbia River Gorge National Scenic Area in Oregon, including Forest Plan Amendment #16. February 2008.

USDA Forest Service. 2009a. Forest Vegetation Simulator (FVS) http://www.fs.fed.us/fmsc/fvs/

USDA Forest Service. 2009b. Estimating Snag Densities and Down Wood Using Aerial Survey Data. http://fhm.fs.fed.us/posters/posters08/snag_densities.pdf

USDA Forest Service. 2011a. Watershed Condition Framework; A Framework for Assessing and Tracking Changes to Watershed Condition. FS-977. May 2011. http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf.

USDA Forest Service. 2011b. Management Indicator Species, Forest-wide Analysis.

USDA Forest Service. 2011c. Biological Assessment of NLAA Projects with the Potential to Modify the Habitat of Northern Spotted Owls. Willamette Planning Province – CY 2011-2012. April 2001.

USDA Forest Service. 2012a. Sufficiency Analysis for Stream Temperature: Evaluation of the adequacy of the Northwest Forest Plan Riparian Reserves to achieve and maintain stream temperature water quality standards. Portland, OR.

USDA Forest Service. 2012b. National Best Management Practices for Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide, April 2012, FS-990a.

USDA Forest Service. 2012c. Mt. Hood National Forest Fuels Treatment Placement Plan.

USDA Forest Service. 2013a. Reinitiation of Projects Planned but Not Sold in 2013 Critical Habitat with the Potential to Modify the Habitat of Northern Spotted Owls. Mt. Hood National Forest. January 24, 2013.

USDA Forest Service. 2013b. Mt. Hood National Forest Fire Management Plan

USDA Forest Service. 2014. Memorandum of Understanding between State of Oregon Department of Environmental Quality and the USDA Forest Service Pacific Northwest Region documenting the U.S. Forest Service and DEQ strategy for managing and controlling nonpoint source pollution for U.S. Forest Service managed lands in the State of Oregon.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-

Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl (Northwest Forest Plan). Portland, Oregon.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl; Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest related Species within the Range of the Northern Spotted Owl (Northwest Forest Plan). Portland, Oregon.

USDA Forest Service and USDI Bureau of Land Management. 1998. North Willamette LSR Assessment, Mt Hood National Forest Cascades Resource Area, Salem BLM.

USDA Forest Service and USDI Bureau of Land Management. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. (Survey and Manage Plan)

USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, USDI National Park Service. 2011. National Cohesive Wildland Fire Management Strategy.

USDA Forest Service and USDI Bureau of Land Management. 2012. Northwest Forest Plan Temperature TMDL Implementation Strategies: Evaluation of the Northwest Forest Plan Aquatic Conservation Strategy and Associated Tools.

USDI Fish and Wildlife Service. 2003. Estimates of distances at which incidental take of murrelets and spotted owls due to harassment are anticipated from sound-generating, forest-management activities in Olympia National Forest. Lacey, WA.

USDI Fish and Wildlife Service. 2008. Final Recovery Plan for the Northern Spotted Owl, *Strix occidentalis caurina*. U.S. Fish and Wildlife Service, Portland, Oregon. xii + 142 pp.

USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDA Forest Service. 2008. Methodology for Estimating the Number of Northern Spotted Owls affected by Proposed Federal Actions version 2. Sept. 15, 2008.

USDI Fish and Wildlife Service. 2011a. Letter of Concurrence Regarding the Effects of Habitat Modification Activities within the Willamette Province, CY 2011-2012, proposed by the Salem District, Bureau of Land Management; Mt. Hood National Forest; and Willamette National Forest on the Northern Spotted Owl (*Strix occidentalis caurina*) and its Critical Habitat (FWS Reference Number 13420-2011-I-0135)

USDI Fish and Wildlife Service. 2011b. Revised Recovery Plan for the Northern

Spotted Owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon. xvi + 258 pp.

USDI Fish and Wildlife Service. 2012. Endangered and threatened wildlife and plants; Revised Critical Habitat for the Northern Spotted Owl (*Strix occidentalis caurina*). December 4, 20123. Federal Register 77(233): 71876-72068.

USDI Fish and Wildlife Service. 2013. Biological Opinion Regarding Reinitiation of Projects Planned but Not Sold in 2012 Critical Habitat with the Potential to modifiy the Habitat of Northern Spotted Owls on the Mt. Hood National Forest [FWS referenence: 01EOFW00-2013-F-0089]. February 20, 2013

Walter, Scott T. and Chris C. Maguire. 2005. Snags, Cavity-Nesting Birds, and Silvicultural Treatments in Western Oregon. Author(s): Source: The Journal of Wildlife Management, Vol. 69, No. 4 (Oct., 2005), pp. 1578-1591 Published by: Allen Press Stable URL: http://www.jstor.org/stable/3803517

Wemple, B. C., J. A. Jones, and G. E. Grant. 1996. "Channel network extension by logging roads in two basins, western Cascades, Oregon." *Water Resour. Res*. 32(6): 1195-1207.

Wiens, J. D. 2012. Competitive Interactions and Resource Partitioning Between Northern Spotted Owls and Barred Owls in Western Oregon. PhD Dissertation, Oregon State University, Corvallis, OR.

Wilson, Todd. 2009. Personal communications with Alan Dyck about flying squirrels.