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Forest Service

Pacific Northwest Region

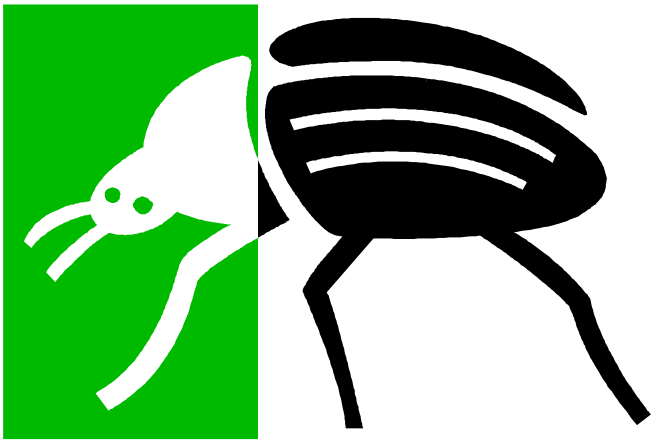
D-Bug Hazard Reduction Timber Sale Project

Final Environmental Impact Statement

Umpqua National Forest

Diamond Lake Ranger District

August 2010



D-BUG HAZARD REDUCTION TIMBER SALE PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

Douglas County, Oregon

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This FEIS was prepared under the authority of the Healthy Forest Restoration Act and is subject to the objection process under 36 CFR 218.3. Only those who have submitted specific written comments related to the proposed project during the comment period may file an objection (36 CFR 218.6). Comments must have been submitted within 87 days from the date the Notice of Availability appears in the Federal Register.

Objections are due no later than:

Electronic objections can be e-mailed to:
appeals-pacificnorthwest-regional-office@fs.fed.us

Abstract:

This Final Environmental Impact Statement documents two action alternatives and the no action alternative considered for commercially harvesting timber, treating activity generated fuels, reducing hazardous fuels, conducting road improvement, constructing temporary roads and road maintenance, and implementing connected actions within the following land allocations: riparian reserve, matrix, Oregon Cascades Recreation Area, and inventoried roadless areas within the Lemolo Lake and Diamond Lake watersheds of the Umpqua National Forest. This project is being conducted under the authority of the Healthy Forest Restoration Act. Alternative 5 has been identified as the preferred alternative.

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SUMMARY

Chapter 1—Purpose and Need for Action

CHANGES BETWEEN DRAFT AND FINAL

This Final Environmental Impact Statement (FEIS) contains a number of refinements and clarifications received during the 45-day comment period. A new alternative (Alternative 5) was developed in response to public comments and further refined based on input received during a collaborative meeting with the public. Details on Alternative 5 appear in Chapter 2. Alternative 3 was eliminated because Alternative 5, which is similar in concept and treatments, makes greater progress towards reaching common ground with the public and better responds to issues. Alternative 4 was eliminated because of opposition to the extent of treatments into undeveloped areas.

The Forest Plan amendment for timber harvest in the lodgepole pine climax ecoclasses was eliminated from both action alternatives. On further examination, it was determined that National Forest Management Act (NFMA) supported activity in these areas in order to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area to meet overall multiple-use objectives” (16 USC 1604(g)(3)(B)). Futhermore, regulations at 36 CFR 219.27(c)(1-2) support activity in these areas, precluding the need for an amendment. The regulations state that “sales necessary to protect other multiple-use values or activities that meet other objectives” may occur on lands not suitable for timber production if the Forest Plan supports the action. Furthermore, stands that are in “imminent danger of insect or disease attack” may count towards planned volume, so long as the harvest is consistent with silvicultural and environmental standards. The Forest Plan Standards and Guidelines for Timber/Vegetation Management support harvest on unsuitable lands when needed to enhance other resource objectives, so long as activities are documented in the environmental analysis.

Changes were made to the OCRA, IRAs, and Potential Wilderness Areas section to clarify differences between areas that meet Forest Service definitions as Potential Wilderness Areas (FSH 1909.12(70)) ,and areas proposed for wilderness by environmental organizations. The potential impacts to both of these areas are disclosed. Because of this only Potential Wilderness Areas 1, 4 and 5 remain in the analysis. Potential Wilderness Area 2 was combined with PWA 5. Areas proposed for wilderness (APW) will be identified separately.

Appendix A was created to contain the extensive responses to comments from the Draft Environmental Impact Statement (DEIS).

Where feasible throughout the FEIS, dates and analyses were updated to reflect the most current available data.

ENVIRONMENTAL SETTING

The D-Bug planning area is located near the crest of Cascades Mountains in southern Oregon, on the Diamond Lake Ranger District of the Umpqua National Forest. The planning area is within a high-use recreation destination, centrally located roughly 90 miles from the cities of Bend, Klamath Falls, Roseburg, and Medford, Oregon. Primary access corridors to this recreation area are the Rogue-Umpqua Scenic Byway, which

includes State highways 138 and 230. The 42,000-acre planning area is bordered on the south by Crater Lake National Park, on the north by Lemolo Lake Recreation Area, on the east by Mt. Thielsen Wilderness and Oregon Cascades Recreation Area, and on the west by the Mt. Bailey Inventoried Roadless Area.

Dominant landscape features of the area are the broad pumice flats covered in ash from the volcanic eruption that formed Crater Lake more than 7,000 years ago. Cold air settling onto these flats creates large frost pockets favoring lodgepole pine. Other conifers in the planning area represent a unique blend of tree species from both the east and west sides of the Cascade Mountains.

Most of the lodgepole pine forests in the area are now mature stands ranging from 80 to 150 years old; the result of large fires in the late 19th and early 20th centuries. The high incidence of fire during this period may be partly the result of stockmen setting fires intended to create open conditions for livestock. The pioneering lodgepole that reseeded the burned areas resulted in the vast acreages of stands that are mature today. Since the mid-1900s, Forest Service policies to suppress fire have resulted in artificially small fires that have done little to break up the homogeneous stands in the area (USDA, Umpqua National Forest, 1998). This historic increase in large-scale burning, followed by a dramatic cessation of fire, has set the stage for a landscape-scale mountain pine beetle outbreak and large wildfire events.

Both low-intensity and stand-replacement fire are historically common in pure lodgepole stands in the planning area. In the past, these fires burned in a mosaic pattern, creating patches of different age classes over the landscape (Arno, 2000; Agee, 1993) with different degrees of susceptibility to insects and stand-replacing wildfire. The fire return interval for lodgepole pine in this area is thought to be about 60 to 80 years (Agee, 1993; USDA, Umpqua National Forest, 2008). Low-intensity fires likely also occurred in lodgepole pine forests of the Pacific Northwest; often spreading slowly from log-to-log. Prior to fire exclusion, these low-intensity fires reduced surface fuel loads, which minimized fire severity to soil during the larger stand replacement events. The Forest Service assessed the dramatic difference in fuel conditions in the 1998 Diamond Lake/Lemolo Lake Watershed Analysis (Appendix B) (USDA, Umpqua National Forest, 1998); prior to fire exclusion, most fuel conditions consisted of light fuels in low quantities, while the vast majority of current conditions consist of heavy fuels in higher concentrations.

Dense stands of lodgepole pine (either in pure lodgepole stands or in mixed-conifer stands) that are at least 80 years of age with trees at least eight inches in diameter are highly susceptible to mountain pine beetle attack. Mountain pine beetle attacks seldom occur in younger stands, particularly those stands with trees less than four inches in diameter. Because of the very large amount of the landscape having mature, older pine in and around the planning area, the risk of a landscape-scale outbreak is considered high (Goheen and Bridgewater, 2007).

A mountain pine beetle outbreak along the east shore of Diamond Lake and in Crater Lake National Park was noted in 2004. This is now recognized as an infestation which extends in and beyond the D-Bug planning area. It is probable that this infestation will continue to spread through a high proportion of these lodgepole pine stands within the next few years (Goheen, 2008). As much as 90 percent mortality of the lodgepole pine overstory in the affected stands will likely occur and much of the ponderosa and western white pine may be adversely affected.

The mixed conifer stands in the planning area avoided the large stand-replacement fires of the late 19th and early 20th centuries that resulted in lodgepole pine dominance elsewhere. Now, due to fire exclusion, these stands are exhibiting a change from their historic composition and structure. Many of the mixed-conifer stands currently consist primarily of large mountain hemlock, ponderosa pine, Shasta red fir and Douglas-fir with substantial in-growth of white fir developing underneath. Under reference conditions, these areas typically experienced fire more frequently, so fire exclusion has had a greater ecological impact here than in other planning area stands. Ponderosa pine is not able to withstand very much vegetative competition from understory species, so it eventually will die out in the absence of fire. Stand replacement fire in mixed-conifer stands is now more likely due to the uncharacteristic buildup of live and dead vegetation (due to a lack of frequent fire) in most mixed-conifer forest types in the planning area.

DESIRED CONDITION

The Forest Service initiated the D-Bug project to move current conditions in pine-dominated landscapes in the general vicinity of high-use recreation areas toward landscape and stand conditions more resilient to infestation from pine beetle. The project also will reduce hazardous fuel conditions and create open-stand conditions more representative of the natural fire regime both inside and outside areas designated as wildland-urban interface areas (WUIs). Commercial timber harvest can be used to remove larger host lodgepole pine trees before the beetles infest an area (Fettig, et al., 2007). This reduction in the number of potential host trees and creation of a sunny micro-climate can reduce beetle-caused tree mortality, thus decreasing the future accumulation of fuel and hazard trees. Similarly, commercial and non-commercial tree removal opens up uncharacteristically dense stands in order to modify fire behavior, lower the risk of stand replacement fire, improve stand vigor and resistance to insects, and allow fire-fighting crews safe access for the control and potential use of fire in the future.

The Healthy Forest Restoration Act and Community Wildfire Protection Plans

Congress enacted the Healthy Forest Restoration Act of 2003 (HFRA) to expedite hazardous fuels reduction and forest restoration projects on specific types of Federal lands that are at risk of wildland fire or insect epidemics. This law encourages the development of Community Wildfire Protection Plans under which communities designate their wildland-urban interface areas where expedited projects under HFRA may take place. In 2006, the Umpqua National Forest collaborated with Douglas County and other entities to finalize the Douglas County Community Wildfire Protection Plans. These Plans include the designation of the Diamond Lake and Lemolo Lake WUIs. The Community Wildfire Protection Plans for Diamond and Lemolo Lake list hazardous fuel reduction treatments and methods to protect these at-risk communities.

The HFRA includes ways to streamline the planning process for projects such as D-Bug that qualify as authorized hazardous fuels reduction projects. D-Bug is an authorized hazardous fuels reduction project under section 102 of this act because:

- The project includes the Lemolo Lake and Diamond Lake WUIs and surrounding high-use recreation areas in an area with high fuel loads and an insect epidemic that is adding to the fuel loads.
- Based on an assessment of the mountain pine beetle epidemic by a Forest Service entomologist, the Forest Supervisor of the Umpqua National Forest determined that the mountain pine beetle epidemic in the planning area and

surrounding areas poses a significant threat to recreation resources and wildland-urban interface values.

- The methods proposed to implement this project, which include harvesting, thinning, and fuel treatments, will suppress the further spread of mountain pine beetle in areas already affected and help prevent the further spread of infestations by changing the conditions that presently render the forest susceptible to epidemics. Methods also are included to restore ecological integrity to uncharacteristically dense stands so that ecosystem components are functioning and more capable of self-renewal in the event of a wildfire.

PURPOSE AND NEED FOR ACTION

The purpose of this project is to lessen the fuel and safety hazards associated with the ongoing outbreak of mountain pine beetles and the ongoing impacts from fire exclusion by the timely implementation of commercial harvest and non-commercial treatments in strategic locations. The difference between the existing condition and the desired condition defines the need for action. The four elements of the D-Bug purpose and need are:

Element 1: The need for modifying mountain pine beetle habitat conditions in stands containing lodgepole to reduce potential infestation.

Element 2: The need to reduce existing and predicted fuel loads in areas identified as high fire hazard within the Diamond and Lemolo Lake WUIs and their evacuation routes identified in the 2006 Douglas County Wildfire Protection Plans.

Element 3: The need for removing existing dead and imminently dying pine and other hazard trees where human use is high in order to protect the recreating public.

Element 4: The need for increasing stand vigor in densely stocked mixed conifer stands containing older, large ponderosa pine, western white pine, Shasta red fir, and Pacific silver fir in order to improve stand resiliency.

PROPOSED ACTION

The proposed action was developed to meet the purpose and need. It includes the following:

- Variable-density commercial thinning of 3,165 acres in lodgepole pine stands (leaving 20-70 TPA); thinning 1,145 acres of lodgepole and mixed conifer (leaving 50-200 TPA); and thinning of 2,247 acres in mixed conifer stands (leaving 50-90 TPA). The lodgepole variable-density thinning would not generate any openings greater than 40 acres in size. These commercial thinnings include 620 acres within the outer edges of the Mt. Bailey and Thirsty Creek Appendage inventoried roadless areas (IRAs), and 318 acres along the edge of the Oregon Cascades Recreation Area (OCRA).
- Overstory removal in two lodgepole pine stands on 59 acres, leaving 20 overstory TPA. These overstory removals would not generate any openings greater than 40 acres.
- Salvage of 375 acres of dead and dying lodgepole.

- The commercial harvest would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations (*see* NWFP) to generate an estimated 44.8 million board feet of timber.
- Non-commercial removal of fuels on about 2,026 acres by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash. This includes treatment on about 344 acres of stands along the edges of the Mt. Bailey and Thirsty Creek Appendage IRAs and 15 acres in the OCRA.
- Re-using about 25.6 miles of existing spur roads to access thinning areas, then obliterating about 11.1 miles after use.
- Building a total of about 15.5 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for non-commercial treatments, then obliterating them after use.
- Amending the following sections of the 1990 Umpqua National Forest Land and Resource Management Plan (LRMP): scenery standards; timber harvest in MA-1; and opening size limitations in MA 2.

DECISION TO BE MADE

Based on the analysis documented in this Environmental Impact Statement, the Forest Supervisor of the Umpqua National Forest will decide the following:

- To implement the project as proposed; to implement a modified version of the project (an alternative) that addresses unresolved issues; or not to implement the project at this time (no action).
- If the project is implemented, which mitigation measures, project design features, monitoring, and water quality best management practices are necessary to achieve resource goals, objectives, and the desired future condition.
- If the project is implemented, whether to amend the LRMP, as proposed.

SCOPING

Under the direction of the HFRA, the Forest used a collaborative process during the development of the proposed action, which included several newspaper articles and announcements; mailings to over 350 potentially interested people and groups; a public meeting in Roseburg, Oregon, on September 27, 2007; a public field trip to the project area on November 3, 2007; and various one-on-one discussions with groups and individuals from September through December of 2007.

Formal scoping (a process used to ascertain issues) began when the Forest published the proposed action in the Federal Register on January 22, 2008. The Forest sent a scoping notice to the public on January 10, 2008, detailing the proposed action and soliciting comments. On February 8, 2008, the Roseburg News-Review published a front-page article describing the D-Bug proposed action and announced the opportunity to submit scoping comments to the Forest Service.

The Forest received 37 scoping comments, including letters, e-mails, face-to-face conversations at meetings, and phone conversations. The D-Bug project record contains a scoping summary that details the scoping comments received for the project.

ISSUES

The scoping process generated a number of issues related to the proposed action. An issue is a point of disagreement, debate, or dispute about the proposed action based on effects identified through scoping. The Forest used the following significant issues to develop alternatives to the proposed action:

Issue 1--Amendments to the Forest Plan

The proposed Forest Plan amendments that would amend scenery standards and include the harvest of lodgepole pine, which is normally excluded from the timber harvest base, would be harmful to the ecosystem and scenic quality of the area.

Issue 2--Treatments in Inventoried Roadless Areas/Oregon Cascades Recreation Area, and other Potential Wilderness Areas

Conservation groups state that scheduled timber harvest activities on a programmed basis are not permitted in the OCRA; creating fuelbreaks (which require periodic maintenance) along the Thirsty Creek Road and Kelsey Point Road at the edge of the Thirsty Creek Appendage IRAs violates the 2001 Roadless Area Conservation Rule, which states that any cutting of timber in IRA must be infrequent; and harvest activities in potential wilderness areas could severely degrade the rare features and the potential wilderness characteristics of these important areas.

Issue 3--New Road Building

Several conservation groups are concerned that the proposed 15.5 miles of temporary road building and subsequent obliteration would cause ecological damage.

Issue 4--Trails

Some conservation groups are concerned that impacts from logging and other fuel reduction treatments next to existing trails will negatively affect the trails and the recreation experience.

Issue 5--Fuelbreaks

Multiple commenters expressed concerns about the location, width, and thinning techniques proposed on some of the fuelbreaks, questioning their effectiveness and the possible impacts of such fuelbreaks. In particular, the fuelbreaks along Thirsty Creek and Kelsey Point roads are thought to be redundant because the proposal also includes a fuelbreak on the Windigo Pass Road, located directly to the northwest. Moreover, these fuelbreaks enter the Thirsty Creek IRA and are outside the WUIs.

Issue 6--Extent and Intensity of Treatments in Lodgepole Pine and Project Economics

Several conservation groups are concerned that the proposed action includes too much harvest, resulting in impacts in the lodgepole pine ecosystem.

Several other commenters stated that the proposed action is not doing enough removal to achieve project needs in terms of treatment intensity, treatment extent, and economic returns.

Chapter 2 –Alternatives Including the Proposed Action

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no thinning, fuel treatment, biomass utilization, temporary road construction, road reconstruction and maintenance, or other similar or connected

activities such as pre-commercial thinning, subsoiling, weed control, or road decommissioning would occur. No ground-disturbing activities would take place and no timber would be offered for sale. On-going activities, including road maintenance, recreation use, and noxious weed control would continue to occur (Table 3-2). Future activities would also occur (Table 3-3).

ALTERNATIVE 2 - PROPOSED ACTION

This alternative is the proposed action used in the scoping process. The Forest developed the proposed action to meet the purpose and need. It includes the following:

- Variable-density commercial thinning of 3,165 acres in lodgepole pine stands (leaving 20-70 TPA); thinning 1,145 acres of lodgepole and mixed-conifer (leaving 50-200 TPA); and thinning of 2,247 acres in mixed-conifer stands (leaving 50-90 TPA). The lodgepole variable-density thinning would not generate any openings greater than 40 acres in size. These commercial thinnings include 620 acres within the outer edges of the Mt. Bailey and Thirsty Creek Appendage IRAs, and 318 acres along the edge of the OCRA.
- Overstory removal in two lodgepole pine stands on 59 acres, leaving 20 overstory TPA. These overstory removals would not generate any openings greater than 40 acres.
- Salvage of 375 acres of dead and dying lodgepole.
- The commercial harvest would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations to generate an estimated 44.8 million board feet of timber.
- Non-commercial removal of fuels on about 2,026 acres by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash. This includes treatment on about 344 acres of stands along the edges of the Mt. Bailey and Thirsty Creek Appendage IRAs and 15 acres in the OCRA.
- Re-using about 25.6 miles of existing spur roads to access thinning areas, then obliterating about 11.1 miles after use.
- Building a total of about 15.5 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for non-commercial treatments, then obliterating them after use.
- Reconstructing portions of 11 sections of existing system roads (totalling 4.7 miles of road), including road re-alignment, intersection improvement, widening, continuous placement or replacement of surface rock and rock armoring, reshaping road beds, replacing culverts, adding culverts, and hazard tree felling.
- Maintaining about 67 miles of existing system roads (approximately nine miles are currently closed), including grading and shaping existing road surfaces, dust abatement, blading road beds and ditches, hazard tree felling, cleaning/maintaining ditches and culverts as needed, isolated placement or replacement of surface rock and rock armoring, opening and re-closing existing closed roads, removing debris from the roadway, and cutting intruding vegetation along roadsides.
- Utilizing the existing Lemolo Dam rock pit and the Boundary rock pit as rock sources for the road work.

- Amending the following sections of the LRMP: scenery standards; timber harvest in MA 1; and opening size limitations and firewood cutting in MA 2.

ALTERNATIVE 5 – PREFERRED ALTERNATIVE

The Forest developed Alternative 5 to respond to comments received from the public on the DEIS, and further refined the alternative following an additional collaboration period with the public. This alternative is similar to Alternative 3 from the Draft Environmental Impact Statement, but focuses treatments on critical fuelbreaks and evacuation routes. It includes the following:

- Variable-density commercial thinning of 3,634 acres in lodgepole pine stands, leaving 20-70 TPA interspersed with 10 percent of the area with no treatment; commercial thinning of 1,332 acres of lodgepole-mixed conifer (leaving 50-200 TPA); and commercial thinning of 1,500 acres in mixed-conifer stands (leaving 50-200 TPA). These commercial thinnings include 42 acres along the outer edges of the Mt. Bailey IRA. The lodgepole variable-density thinning would not generate any openings greater than 40 acres in size.
- Salvage of 285 acres of dead and dying lodgepole.
- The thinnings would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations to generate between 29.8 to 32.5 million board feet of timber.
- Non-commercial removal of fuels on about 2,069 acres by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash. This includes treatment on about 297 acres of stands along the edge of the Mt. Bailey IRA, and 32 acres along the edge of the Thirsty Creek Appendage IRA.
- Re-using about 16 miles of existing spur roads to access thinning areas, then obliterating about 7.4 miles after use.
- Building about 8.1 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for commercial treatments, then obliterating them after use.
- Reconstructing portions of 11 sections of existing system roads (totalling 4.7 miles of road), including road re-alignment, intersection improvement, widening, continuous placement or replacement of surface rock and rock armoring, reshaping road beds, replacing culverts, adding culverts, and hazard tree felling.
- Maintaining about 62 miles of existing system roads (approximately nine miles are currently closed), including the grading and shaping of existing road surfaces, dust abatement, blading road beds and ditches, hazard tree felling, cleaning/maintaining ditches and culverts as needed, isolated placement or replacement of surface rock and rock armoring, opening and re-closing existing closed roads, removing debris from the roadway, and the cutting of intruding vegetation along roadsides.
- Utilizing the existing Lemolo Dam rock pit and the Boundary pit as the rock sources for the road work.
- Amending the following sections of the LRMP: scenery standards; timber harvest in MA 1; and opening size limitations and firewood cutting in MA 2.

ALTERNATIVES 3 AND 4

In addition to the two alternatives above, two more alternatives were eliminated after publication of the DEIS: alternatives 3 and 4. Alternative 3 was developed to address Issues 2 through 6. Alternative 3 was eliminated in the FEIS because Alternative 5 makes greater progress towards reaching common ground with the public and better responds to issues. It was very similar to Alternative 5 in concept and treatments, as well as the issues it responded to.

Alternative 4 was developed to respond specifically to Issue 6. It was identified as the preferred alternative in the DEIS, but it received a great deal of opposition. Many comments received stated the alternative went too far into undeveloped areas and would cause considerable ecological impacts. Additional collaborative public meetings held after the DEIS comment period indicated more support for a new alternative. Thus, Alternative 4 was eliminated.

Chapter 3—Affected Environment and Environmental Effects

Affected environments and environmental effects discussed in the EIS include Forest Vegetation, Fire and Fuels, Coarse Woody Debris, Wildlife, Unique Habitats, Noxious Weeds, Botany, Soils and Site Productivity, Air Quality, Economics, Recreation, OCRA, IRA, Potential Wilderness and Potential Wilderness Areas, Wilderness, Water Quality, Stream Flows, Erosion and Sedimentation, Riparian Reserves, Stream Channels, Fish, and numerous Specifically Required Disclosures.

The alternatives vary in terms of the degree to which they meet the various elements of the purpose and need (Table S-1).

Table S-1. Alternative Comparison for the Elements of the Purpose and Need.

Purpose and Need	Alt. 1	Alternative 2	Alternative 5
Element 1 – Pine Beetle Habitat Modification • Acres of susceptible lodgepole treated.	0	4,743	3,634
Element 2 – Fuel loading in WUIs and along WUI Evacuation Routes. • Acres treated within the WUIs. • Acres of treatment along designated evacuation routes.	0 0	3,781 4,242	3,890 5,913
Element 3 – Hazard Tree Reduction • Acres of commercial harvest within developed recreation sites and by private dwellings/businesses.	0	199	199
Element 4 – Improved Fire Resiliency & Stand Vigor • Acres of mixed conifer stands thinned.	0	2,247	1,500

The alternatives also differ in terms of how they respond to the issues raised during scoping (Table S-2).

Table S-2. Response to Significant Issues by Alternative.

Significant Issues	Alt. 1	Alternative 2	Alternative 5
Issue 1 – Plan Amendments			
• Acres of lodgepole harvested.	0	4,743	3,633
• Acres of Retention VQO along Highways 138 and 230 moved to:			
○ Partial Retention	0	220	220
○ Modification		265	265
• Acres of Partial Retention VQO along Highways 138 and 230 moved to:			
○ Modification	0	164	164
Issue 2 – IRA/OCRA/Potential Wilderness Areas			
• Acres of commercial thinning in the OCRA.	0	318	0
• Acres of forest treated in the IRAs.			
○ Commercial treatment	0	620	78
○ Non-Commercial treatment	0	345	329
• Acres of treatment Potential Wilderness Areas (excluding overlap with IRA and OCRA acres)	0	1,515	1,041
Issue 3 – Road Building			
• Miles of temporary roads constructed and subsequently obliterated.	0	15.4	8.1
Issue 4 –Impacts of Thinning/Haul on Trails			
• Miles of existing trail used for logging access.	0	8.2	4.9
• Acres of commercial & non-commercial treatment within 200 feet of trails.	0	2,253	2,229
Issue 5 – Fuelbreaks – Effectiveness, Redundancy and Extent.			
• Acres of commercial/non-commercial treatments along Thirsty Creek and Kelsay Point fuelbreaks.	0	970	0
• Total acres in roadside fuelbreaks	0	7,347	6,627
Issue 6 – Lodgepole Pine Prescriptions, Extent of Lodgepole Treatment and Project Economics			
• Acres of lodgepole pine regenerated	0	59	0
• Acres of lodgepole pine and lodgepole-mixed conifer commercially thinned	0	4,685	3,634
Extent of Lodgepole Pine Treatment			
• Acres harvested south of Hwy. 230 toward Crater Lake National Park.	0	1,660	668
Economic Efficiency			

Significant Issues	Alt. 1	Alternative 2	Alternative 5
• Net Present Value • Least Cost to Government (Total Cost/Total Acres Treated)	0 0	-$239,396 $1,367	-$947,272 $1,121

Chapter 4—List of Preparers

This chapter lists the members of the interdisciplinary team (IDT) who contributed to the preparation of the EIS.

Chapter 5—List of Participants and Public Involvement.

Chapter 5 documents the public involvement process and who participated. Initial contact with the public for the D-Bug project began in August of 2007, when the IDT started field reconnaissance to develop a proposed action. At that time, the Forest identified a need to collaborate. The Forest made numerous contacts with interested individuals, homeowners, special use permittees, conservation groups, industry representatives, and other agencies over a six-month period of time with the goal of collaborating on the development of the proposed action. This collaboration also included newspaper articles, an advertised public meeting at the Douglas County Library and a follow-up field trip. The feedback received during the development of the proposed action is summarized in notes, conversation records, and in a 'pre-scoping summary' document. The project was also listed in the October 2007 Schedule of Proposed Actions (SOPA), which let interested people know the project was in development.

Formal scoping began in January of 2008, when a scoping packet, including maps and details of the proposed action, was sent to more than 350 individuals and groups. The packet invited people to document their concerns regarding the proposal. In addition, the Forest published a Notice of Intent to prepare an Environmental Impact Statement in the January 22, 2008, Federal Register. The Roseburg News-Review also published a front-page story describing the details of the proposed action on February 8, 2008.

The Forest consulted the U.S. Fish and Wildlife Service (USFWS), the regulatory agency charged with overseeing the Endangered Species Act, extensively throughout the planning process. Consultation with this agency will be finalized before the Record of Decision is signed.

The Forest sent the tribal governments (Cow Creek Band of Umpqua Indians, Confederated Tribe of the Grand Ronde Indians, and the Confederated Tribe of the Siletz Indians) a letter describing the project, with a request to contact the Forest for further information. To date, no responses have been received. The Forest also consulted the tribes for the purposes of the National Historic Preservation Act.

During the scoping period, the Forest received letters, face-to-face discussions, e-mails, and phone calls regarding the D-bug Hazard Reduction Timber Sale Project Proposed Action from 37 individuals or groups. The D-Bug analysis file contains a detailed scoping summary of all scoping comments. The Forest developed an extensive mailing list for the D-Bug project, which it used to inform the public of the opportunity for early involvement, public meetings, and field trips and the start of the formal scoping process.

The public comment period for the D-Bug project DEIS began on March 14, 2009, with publication of the Notice of Availability in the Federal Register and closed on April 27,

2009. Requests for extension of the comment period prompted the Responsible Official to extend the comment period until June 8, 2009, totaling 87 days for public comment. The public was asked to comment on Alternative 4 as described in the Chapter 2. A field trip to the planning area was held on June 4, 2009, to take additional comments and give people the opportunity to visit the planning area with members of the Interdisciplinary Team.

The Forest received 428 timely comment letters, emails or phone calls. An additional 634 comments, primarily in the form of emails, were received after the close of the extended comment period. The majority of these comments resemble the timely comments received and are on file (electronically) at the Umpqua National Forest Supervisor's Office.

In response to the comments received from the DEIS, the Forest prepared a "working alternative" that was shared via public collaboration meetings on March 18-19, 2010, in Roseburg. After those meetings, the working alternative was refined to become what is now Alternative 5. Input received via this collaborative meeting is not considered a comment sufficient to establish standing to object under the regulations at 36 CFR 218.7.

CHAPTER 1

PURPOSE AND NEED FOR ACTION

Introduction and Environmental Setting

Chapter 1 describes the purpose and need for action and the proposed action for the D-Bug Hazard Reduction Timber Sale Project (D-Bug). The chapter also briefly characterizes the project area and its setting, outlines applicable management direction, addresses the scope of the decision, summarizes the scoping process, and lists the issues identified during scoping.

The 42,000-acre planning area is located within the Diamond Lake, Lemolo Lake, and Clearwater fifth-field watersheds on the Diamond Lake Ranger District of the Umpqua National Forest (Forest). The planning area contains areas of concentrated human use centered around Diamond and Lemolo lakes. Crater Lake National Park is located just south of the planning area. These high-use recreation lakes are approximately 90 miles from the cities of Bend and Klamath Falls, Oregon, to the east and Medford and Roseburg, Oregon, to the west (Figure 1-1).

The planning area includes all or portions of: T26S, R5E, Sections 10, 11, 13-15, 23-26, 34-36; T26S, R6E, Sections 16-21, 28-33; T27S, R5E, Sections 1-5, 25, 36; T27S, R6E, Sections 5-8, 17, 20, 29-32; T28S, R5.5E, Sections 4, 9, 16, 18-21, 28-30, 33-35; T28S, R6E, Sections 1, 12, 13, 22-26, 35; and T29S, R5.5E, Sections 2-4.

LODGEPOLE PINE, MOUNTAIN PINE BEETLE, AND FIRE HAZARD

There is widespread agreement that wildfires are becoming larger with more expansive areas burned under higher severity than experienced in the recent past in western United States. Alarmingly, in the Pacific Northwest, losses of key habitat on public lands from wildfire often exceed losses from timber harvest. Fires on the Umpqua National Forest clearly follow this trend, growing substantially larger in recent history than those experienced in the past five decades. These fires force evacuations, endangere the public and firefighters, close a major highways, and cause major losses of revenue for utility companies, local businesses, as well as resource damage to recreation facilities, wildlife habitat, and timber and water resources. The fires also cost millions of dollars to suppress.

Fire managers agree that a substantial fire hazard exists within the D-Bug planning area. They have expressed concern at public meetings that some structures, including the Diamond Lake recreation residences on the west shore, would not be defensible if a large fire approached, given the adjacent vegetation and fuel conditions. Furthermore, currently there are no treatments of evacuation routes designed for protecting evacuees or ingress/egress of firefighters and no availability of adequate fuel breaks to manage underisreable fire that threatens human safety, structures, and resource values.

Mountain pine beetles (*Dendroctonus ponderosae*) also contribute to dangerous conditions in the area. Dense stands of lodgepole pine are highly susceptible to mountain pine beetle attack. The life history of lodgepole pine lends itself particularly well to mountain pine beetle attack, but all pines, including ponderosa pine, western white pine, and whitebark pine, are susceptible to attack during an outbreak. The risk of

a landscape-scale outbreak in the planning area is high because of the very large amount of area covered by mature pine (Goheen and Bridgewater, 2007).

A mountain pine beetle outbreak has been ongoing around Diamond Lake since 2004 (Figure 1-2). Forest Service entomologists predict that the present infestation on the north and west shores of Diamond Lake will spread to other areas, perhaps quickly. Infested stands will likely suffer as much as 90 percent mortality of overstory lodgepole pines and may also lose large proportions of any ponderosa, western white, or white bark pines that they contain (Goheen and Bridgewater, 2007). Prior to the present epidemic, a mountain pine beetle outbreak occurred at the south end of Diamond Lake during the late 1970s and early 1980s.

Mountain pine beetle outbreaks create landscape-level mortality that increases fire hazard (Parker, et al., 2006; Lynch, et al., 2006). In pure lodgepole stands, fire hazard is typically high during the years immediately following an outbreak before dead needles fall. During this period, fire can spread through the abundant aerial fine fuels (Stuart, et al., 1998). In pure stands, the hazard typically subsides a few years after the outbreak during the period after the red needles fall but before snags begin to fall. During this period, the threat of crown fire is usually low because there are fewer fine fuels in the canopy. Fire hazard again increases as snags fall and branchwood accumulates on the forest floor. This increase can be rapid and drastic when blowdown results in “jack-strawed” conditions in which dead and downed trees loosely pile atop one another, forming a continuous jumble of logs several feet high. Jack-strawed conditions can create very high-intensity and high-severity fires (Page and Jenkins, 2007) that are difficult and dangerous for firefighters to suppress and can damage natural resources.

Fire hazard also increases in stands where dead lodgepole and other pines exist amongst live hemlock, true firs, and Douglas-fir. The threat of crown fire continues in these stands even after needles fall from the beetle-killed trees because a live overstory remains. The beetle-killed trees contribute to surface fuel loadings and ladder fuels, increasing the intensity and severity of fire when it occurs.

Both low-intensity and stand-replacement fires were historically common in pure lodgepole stands in the planning area. In the past, these fires burned in a patchy mosaic, creating different age classes across the landscape (Arno, 2000; Agee, 1993) with different degrees of susceptibility to future insect outbreaks and stand-replacing wildfire. The fire-return interval for lodgepole pine stands in this area is thought to be about 60 to 80 years (Agee, 1993; USDA, Umpqua National Forest, 2008). Low-intensity fires also occurred in lodgepole pine forests of the Pacific Northwest. These fires often spread slowly from log-to-log in what is referred to as “cigarette burns.” Prior to fire exclusion, these low-intensity fires effectively reduced surface fuel loads between stand-replacement fire events and consequently minimized fire severity to soil. The Forest assessed the dramatic difference in fuels conditions in the 1998 Diamond Lake/Lemolo Lake Watershed Analysis (App. B, USDA, Umpqua National Forest, 1998). It shows that, prior to fire exclusion, most fuel conditions consisted of light fuels in low quantities, while the vast majority of current conditions consist of heavy fuels in higher concentrations.

The mountain pine beetle/wildfire cycle in lodgepole pine forests is a natural process that has been repeated for centuries. However, decades of fire suppression following what appears to be an unnaturally high occurrence of fire in the late 19th and early 20th centuries resulted in unusually homogenous tracts of mature lodgepole forest. This condition leaves the landscape with a high fire hazard in a location where summer

lightning is common and high human use and occupancy increases the risk of fire starts. This could lead to an extensive wildfire that could be difficult and dangerous to manage in the heavily-used recreation sites around Diamond and Lemolo lakes.

MIXED CONIFER AND FIRE EXCLUSION

The mixed-conifer stands in the planning area have avoided the large stand-replacement fires of the late 19th and early 20th centuries that resulted in lodgepole pine dominance elsewhere. Now, due to fire exclusion, the stands in the white fir series are exhibiting a change from their historic composition and structure. These stands currently consist primarily of an overstory of very large Douglas-fir and ponderosa pine with substantial in-growth of white fir developing underneath. Much of the white fir is already mature and forms a sub-canopy below the Douglas-fir and ponderosa pine and occupies gaps generated by the dying overstory trees. Under reference (i.e., historic) conditions, these areas typically experienced fire more frequently, so fire exclusion has had a greater ecological impact here than in other planning area stands. Ponderosa pine is able to withstand less vegetative competition than white fir and eventually will be replaced in the absence of disturbance. Stand-replacement fire in mixed-conifer stands is now more probable due to the uncharacteristic buildup of live and dead vegetation in most mixed-conifer forest types.

The effects of fire exclusion are less pronounced in the mountain hemlock and Shasta red fir stands that are less prone to regular fire. However, even these vegetation types are likely comprised of reduced age and structural diversity at the landscape scale.

RECREATIONAL USE AND VALUES AT RISK

The Diamond Lake area has about 450 campsites, numerous picnic sites, several boat ramps and docks, a visitor information center, and miles of trails for hiking, equestrian, bicycle, all-terrain vehicle and winter snow use. The Diamond Lake Improvement Company runs a resort, lodge, horse-rental corral, two grocery stores, a gas station, a pizza parlor, and several permanent residences associated with the resort under a special use permit. Also under permit are 102 privately owned recreation residences, an RV park, and a state-owned cabin for water-level and fishery management.

The Lemolo Lake area contains another 95 campsites, and many more miles of trails. The Lemolo Lake Resort runs a year-round lodge and restaurant, a seasonal boat dock, an RV park, and permanent residences associated with the resort under a special use permit.

In total, these two areas receive more than 700,000 visitor days each year. On any given mid-summer weekend, thousands of visitors and employees are likely to be in the area at any one time. A large fire in this area could have catastrophic consequences.

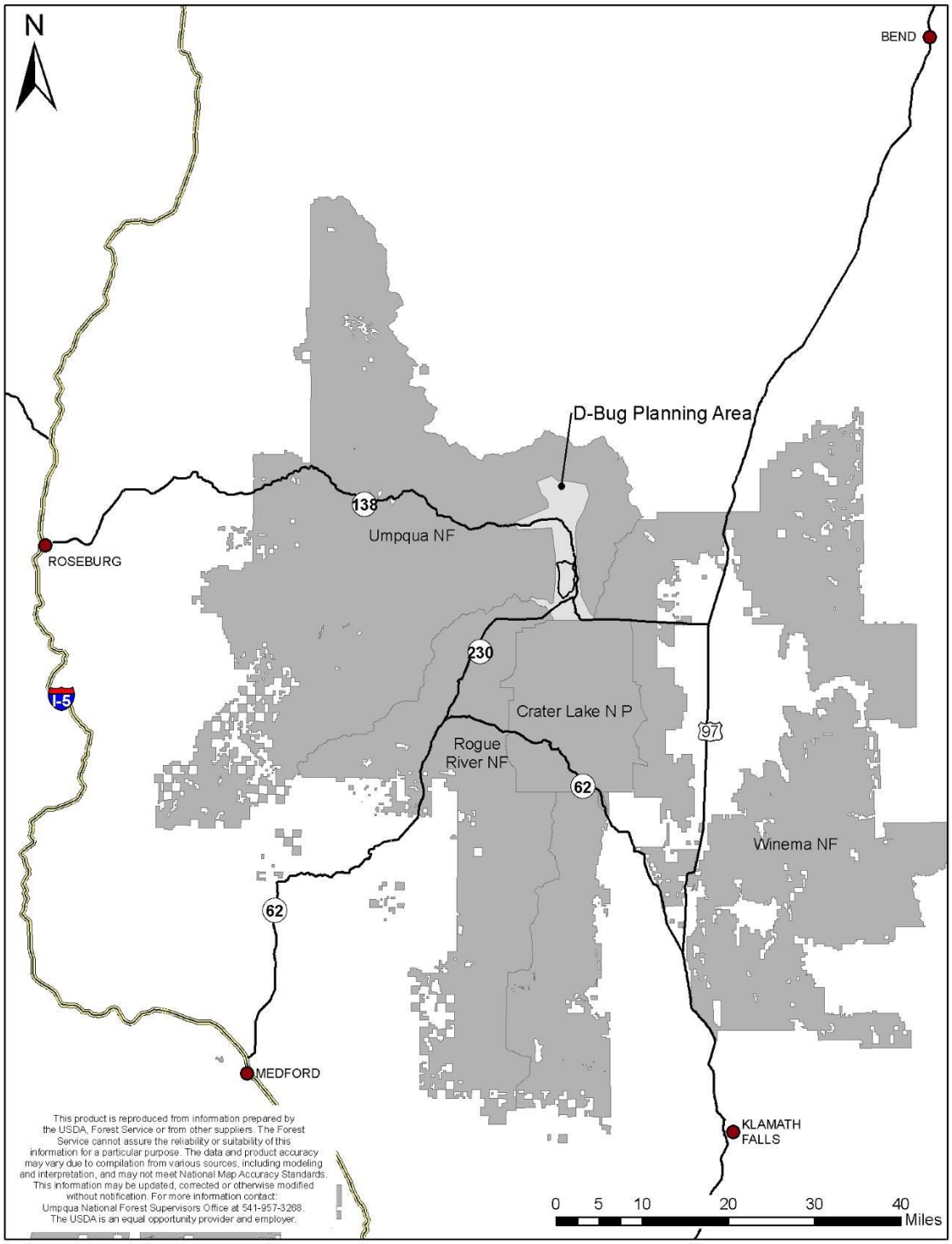

Figure 1-1. Vicinity of the D-Bug Hazard Reduction Timber Sale Project.

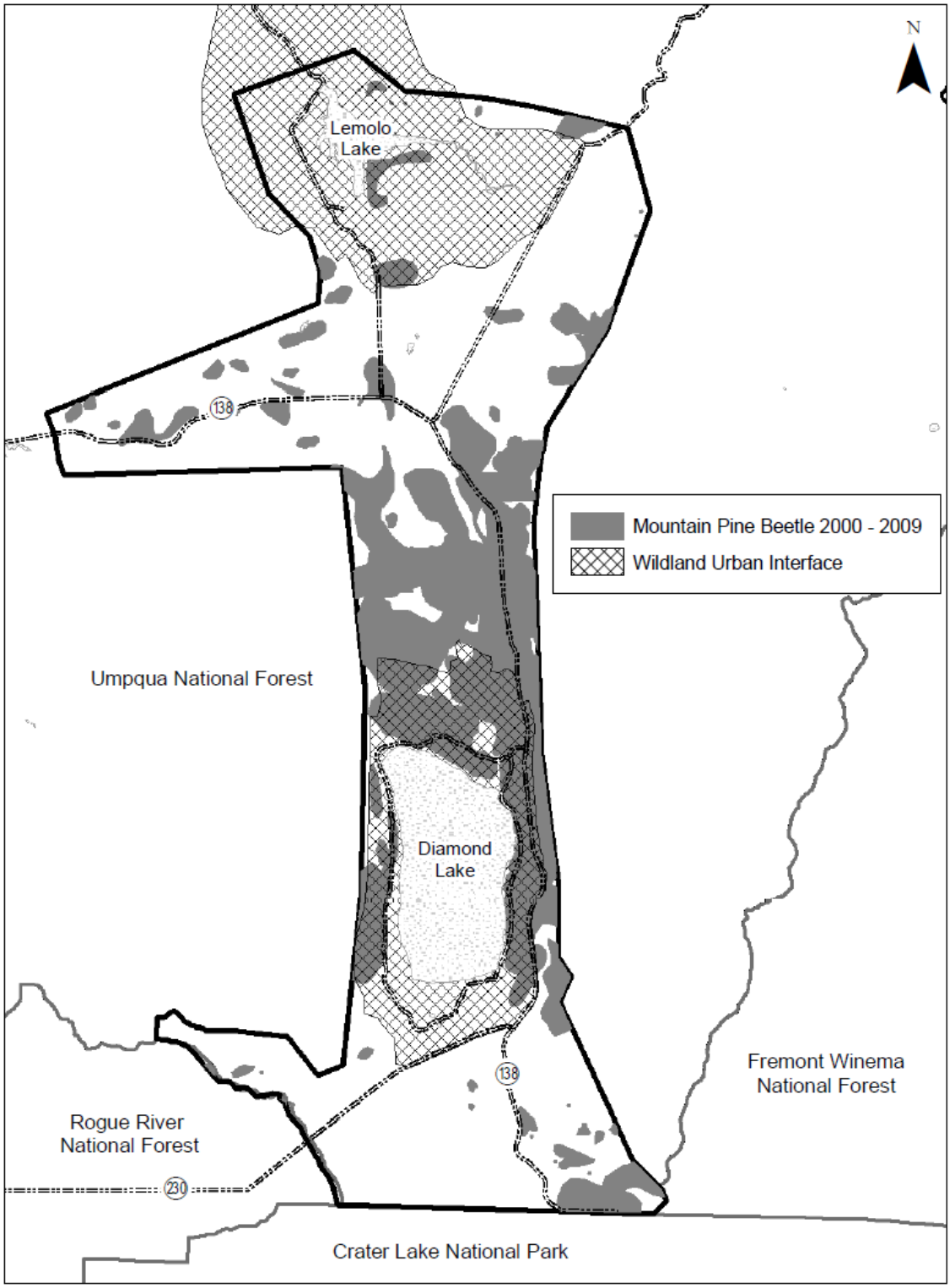

Figure 1-2. Mountain Pine Beetle Outbreak Areas (mapped from aerial surveys 2000-2009) and Wildland Urban Interfaces Areas.

FOREST CONDITION

The D-Bug planning area lies near the crest of the Cascade Mountains, where both eastside and westside forest types are represented. As such, the D-Bug planning area contains a diverse array of tree species. The dominant feature of the Diamond and Lemolo lakes area is the vast, contiguous stands of 80- to 150-year-old lodgepole pine. These stands carpet the pumice flat area by Lemolo Lake, sweep up the flanks of Mt. Thielsen, and extend seamlessly south into Crater Lake National Park.

In much of the planning area, lodgepole pine is the "pioneer" that establishes following disturbances such as fire or clearcut harvest. This is particularly true in flat terrain with pumice soils, where cold air drainage forms frost pockets. In such cold, unproductive environments, lodgepole pine dominates both the overstory and understory in pure stands. In less harsh locations, the pioneering lodgepole is succeeded by other conifers that eventually come in under the lodgepole canopy, which provides frost protection. These stands eventually succeed to mixed-conifer stands that can include Shasta red fir, Pacific silver fir, white fir, Douglas-fir, mountain hemlock, Engelmann spruce, and western white pine. Ponderosa pine is present in some of these mixed-conifer stands on southerly aspects.

Mature natural lodgepole pine stands on the landscape today are the result of the large fires in the late 19th and early 20th centuries. At least three different large conflagrations can be documented between 1880 and 1910 in the Diamond Lake and Lemolo Lake watersheds. One historic account described a number of fires spreading over the area started by an electrical storm on July 5, 1910. Most fires were not extinguished until autumn rains in September (Perkins, 1938). Diary accounts during the late 1800s included many references to fire and thick, smoky conditions that often obscured views of Mt. Thielsen from Diamond Lake (Waldo, 1880). As a result, large areas of the landscape in the vicinity of the D-Bug planning area are now covered by mature lodgepole pine stands. The high incidence of fire during this period may be partly the result of stockmen setting fires intended to create open conditions for livestock. The pioneering lodgepole that reseeded into the burned areas resulted in the vast acreage of stands that are mature today. Forest Service policies to suppress fire have resulted in artificially small fires that do little to break up the homogeneous stands in the area (USDA, Umpqua National Forest, 1998), setting the stage for a landscape-scale mountain pine beetle outbreak and/or large wildfire events.

DESIRED CONDITION

The Forest initiated the D-Bug project to move current conditions in pine-dominated landscapes in the general vicinity of high-use recreation areas toward landscape and stand conditions more resilient to infestation from mountain pine beetle, with lower fuel profiles, and more open-stand conditions representative of the natural fire regime both inside and outside WUIs. Commercial timber harvest can be used to remove the larger host lodgepole pine trees before the beetles infest an area (Fettig, et al., 2007). With fewer host trees and a sunny microclimate, beetle-caused mortality can be decreased, thus reducing the future accumulation of fuel and hazard trees. Similarly, commercial and non-commercial tree removal can open up uncharacteristically dense stands in order to modify fire behavior, lower the risk of stand-replacement fire, improve stand vigor and resistance to insects, and allow fire-fighting crews safe access for fire control and potential use of fire in the future.

RELEVANT LAWS, OTHER PLANNING DOCUMENTS AND OTHER ANALYSES

The LRMP and its amendments established Management Areas (MAs) to emphasize different land uses. Laws and administrative rules also have been promulgated that affect land use in the vicinity of the planning area (Table 1-1, figures 1-3 and 1-4).

In addition to MAs established by the LRMP and land allocations created by the Northwest Forest Plan, Inventoried Roadless Areas (IRAs) also exist in the planning area. IRAs are not a recognized MA, but are lands identified in the 2001 Roadless Area Conservation Rule. Generally, small-diameter timber may still be cut while maintaining the areas roadless characteristics.

Table 1-1. Summary of Land Use Allocations in the D-Bug Vicinity.

Designation	Focus	Requirements
Management Area 1	Unroaded recreation primarily in a semi-primitive environment.	Insect control practices as approved in a vegetative management plan; otherwise, no timber harvest.*
Management Area 2	Concentrated Developed Recreation immediately around Diamond and Lemolo lakes.	Timber management designed to complement the recreation resource. Harvest is limited to ½ acre in size*. Insect control practices allowed, as approved in a vegetative management plan.
Management Area 5	Congressionally designated Oregon Cascades Recreation Area with a focus on dispersed recreation opportunities in predominately natural settings.	Timber harvest is allowed to prevent and control insects, disease, and other damaging agents and to prevent catastrophic mortality from these agents, or when the overall protection of the forest inside or outside the recreation area might be adversely affected by failure to remove dead or damaged timber. No new permanent road construction.
Management Area 10	Produce timber in a cost-effective, sustainable basis consistent with other resource objectives.	Road construction/reconstruction is necessary to access land for timber harvest. A variety of silvicultural practices can be used.
Management Area 11	Provide big-game winter range habitat production consistent with other resource objectives.	Road construction/reconstruction is necessary to access land for timber harvest. A variety of silvicultural practices can be used.
Matrix and Riparian Reserve (Northwest Forest Plan)	MAs 10 and 11 were revised with additional standards and guidelines in 1994 emphasizing more retention of green tree, dead, and down wood habitat and emphasizing riparian dependant resources along streams and other water bodies.	Timber harvest and road construction is allowed following standards and guidelines.

*A site-specific Forest Plan amendment is proposed to address this requirement.

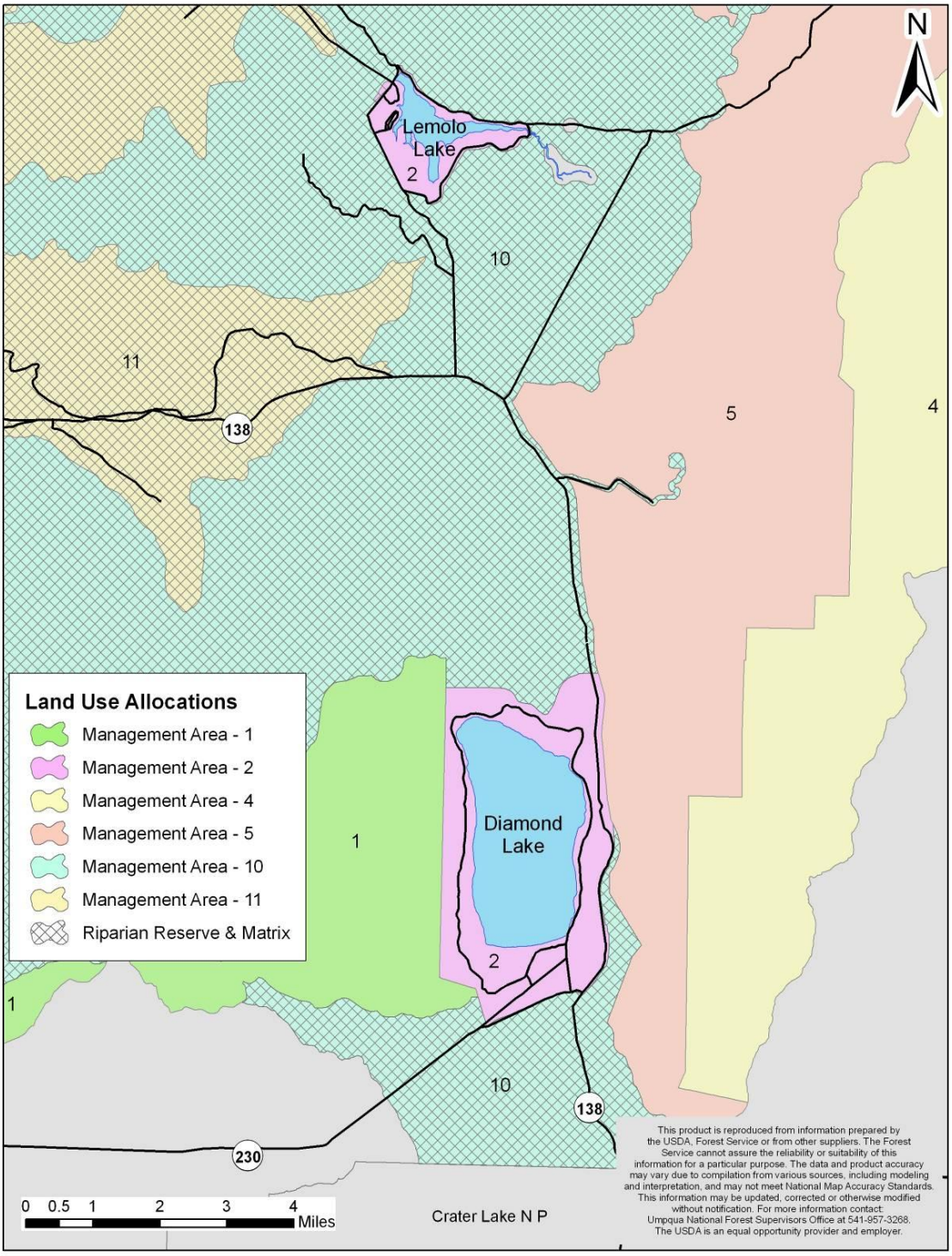

Figure 1-3. Management Areas Designated by the Umpqua NF Land and Resource Management Plan and as Established by Law.

This analysis tiers to the Final Environmental Impact Statement (FEIS) of the 1990 Umpqua National Forest Land and Resource Management Plan (LRMP), as amended, and the 2005 Final Environmental Impact Statement for the Pacific Northwest Region Invasive Plant Program. It also incorporates by reference the recommendations and analysis in the 1998 Diamond Lake/Lemolo Lake Watershed Analysis (WA), the 2003 Community Wildfire Protection Plans (CWPP), the 2008 Vegetation Management Plan and Watershed Analysis Iteration, and the 2003 Umpqua National Forest Roads Analysis.

The Healthy Forest Restoration Act and Community Wildfire Protection Plans

Congress enacted HFRA to expedite hazardous fuels reduction and forest restoration projects on specific types of Federal lands that are at risk of wildland fire or insect epidemics. This act encourages the development of Community Wildfire Protection Plans under which communities designate their wildland-urban interface (WUI) areas where expedited projects may take place. In 2006, the Umpqua National Forest collaborated with Douglas County and other entities to finalize the Douglas County Community Wildfire Protection Plans. These plans include the designation of the Diamond Lake and Lemolo Lake WUIs. The protection plans for Diamond Lake and Lemolo Lake list hazardous fuel reduction treatments and methods to protect these at-risk communities:

- Thin 300 feet around structures and critical infrastructure.
- Clear and thin evacuation routes for homes and areas of recreation.
- Fuel reduction treatments include mechanical clearing and thinning in the WUIs by harvesting, thinning, mowing, chipping, cutting, and piling.
- Use prescribed burning as a method of fuels reduction, where appropriate.

The Healthy Forest Restoration Act also includes ways to streamline the planning process for projects such as D-Bug that qualify as authorized hazardous fuels reduction projects. D-Bug is an authorized hazardous fuels reduction project under Section 102 this Act and utilizes two specific authorities under HFRA:

- Under Sec. 102(a)(1), the Act authorizes projects in wildland-urban interface areas. The project includes the Lemolo Lake and Diamond Lake WUIs and surrounding high-use recreation areas in an area with presently high fuel loads and an insect epidemic that is adding to the fuel loads.
- Under Sec. 102(a)(4), the Act authorizes projects on lands with the “existence of an epidemic of disease or insects, or the presence of such an epidemic on immediately adjacent lands…” Based on an assessment of the mountain pine beetle epidemic by a Forest Service entomologist, the Forest Supervisor of the Umpqua National Forest determined that the mountain pine beetle epidemic in the planning area and surrounding areas poses a significant threat to recreation resources and wildland-urban interface values.

For activities in WUIs, HFRA states that treatments are to focus “largely on small diameter trees, thinning, strategic fuel breaks, and prescribed fire” and “maximize the retention of large trees, as appropriate for the forest type, to the extent that the trees promote fire-resilient stands.” Activities proposed to reduce insect and disease outbreaks outside of WUIs do not need to comply with the large-tree component of HFRA. The methods proposed to implement this project, which include harvesting,

thinning, and fuel treatments, will suppress the further spread of mountain pine beetle in areas already affected and help prevent the further spread of infestations by changing the conditions that presently render the forest susceptible to epidemics. Methods also are included to restore ecological integrity to uncharacteristically dense stands so that ecosystem components are functioning and more capable of self-renewal in the event of a wildfire.

Inventoried Roadless Areas

Roadless area management became a national issue in 1972 when the Forest Service initiated a review of certain areas of National Forest System (NFS) lands greater than 5,000 acres to determine their suitability for inclusion in the National Wilderness Preservation System. This planning process was called Roadless Area Review and Evaluation (RARE). This initial process (sometimes referred to as RARE I) identified lands meeting certain criteria for wilderness lands. The second and final review process, the Roadless Area Review and Evaluation II (RARE II), resulted in a nationwide inventory of roadless areas.

In 2001, the Roadless Area Conservation Rule (36 CFR Part 294.) was developed which provides direction for management within Inventoried Roadless Areas (IRAs). In this Rule, inventoried roadless areas were identified based on areas analyzed in the Land and Resource Management Plans (LRMPs).

The RACR generally prohibits road construction and reconstruction and the timber cutting, sale or removal in IRAs. One exception (§294.13(b)(1)(ii) to this is when "the cutting, sale, or removal of generally small diameter timber is needed [for a specific purpose] and will maintain or improve one or more of the roadless area characteristics."

The legal status of the 2001 Roadless Area Conservation Rule (RACR) continues to be uncertain. Throughout D-Bug project scoping, public involvement, and project design and analysis, the RACR was in force. This regulation prohibited the construction or reconstruction of roads and prohibited the cutting, sale, or removal of timber in IRAs identified in the map set for the FEIS for that rule, dated November, 2000. The prohibitions on road construction and timber harvest also included a limited set of exceptions that would allow otherwise prohibited activities to take place.

Soon after its issuance in January, 2001, the RACR triggered litigation that led to a complex history of injunctions, reinstatements, replacement regulations, state-specific rulemaking, and Forest Service interim directives. This FEIS will not trace that legal history. However, two court decisions heavily influence this analysis:

- In February, 2007, in the Federal District Court for the Northern District of California, Judge Laporte struck down the 2005 State Petitions Roadless Rule as unlawful, reinstated the 2001 Roadless Area Conservation Rule, and enjoined the Forest Service from taking any actions contrary to that rule. The essence of this ruling is that the roadless rule must be implemented.
- In August, 2008, in the Federal District Court for the District of Wyoming, Judge Brimmer found the 2001 Roadless Area Conservation Rule to be unlawfully promulgated and ordered that it be permanently enjoined. The essence of this ruling is that the roadless rule must not be implemented.

These two contradictory rulings from separate federal district courts create a situation where this Forest may potentially be in conflict with either ruling, regardless of what is proposed. Nationally, the USDA has filed motions with both courts seeking relief. Judge

Laporte further clarified her ruling to apply to the 9th Circuit Court of Appeals (Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, Guam and the Northern Marianas Islands) and New Mexico. No clarifications have been issued by Judge Brimmer. At this time, the Forest will proceed with release of the FEIS. When the Record of Decision for this project is signed, the project will comply with all relevant court orders.

Rationale for Compliance with the 2001 Roadless Rule and Judge Brimmer's Ruling

The D-Bug project implements the Umpqua National Forest LRMP. It was developed while the 2001 RACR was in force and is consistent with the requirements of that rule. As outlined in the Purpose and Need section of this document (FEIS, pp. 17-19), this project responds to a critical need to reduce hazardous fuels in a wildland-urban interface. The fuels situation is compounded by an ongoing insect epidemic that continues to kill trees and create more hazardous fuels (FEIS, pp. 1-3, Figure 1-3). This situation prompted the need to proceed with this project in full recognition of the special values of roadless areas and the requirements of the RACR.

The D-Bug proposed action and alternatives are consistent with RACR, as documented in Chapter 3 of the FEIS. There is no road construction or reconstruction in IRAs. The timber harvest and other tree cutting in IRAs is allowed under one of the exceptions to the general prohibition on harvesting contained in 36 CFR §294.13(b)(1)(ii): 1) the trees to be cut are generally small diameter; 2) the cutting is done to maintain or restore characteristics of ecosystem composition and structure within the range of variability that would occur under natural disturbance regimes; and 3) the cutting will maintain one or more of the roadless area characteristics as defined in 36 CFR 294.11. See the OCRA, IRA and Potential Wilderness Area discussion in Chapter 3 for roadless rule considerations.

Because the proposed action involves no road construction or reconstruction in IRAs, and the limited timber harvest is consistent with a RACR exception, the proposed action is consistent with the RACR and in compliance with Judge Laporte's order.

Because the D-Bug project design began prior to Judge Brimmer's order enjoining the roadless rule, the FEIS and project record include analysis of project's consistency with that rule. However, regardless of the outcome of the on-going litigation, the project still complies with the spirit of Judge Brimmer's ruling in the following ways:

1. Project design features that make the proposed action and alternatives consistent with the RACR are equally appropriate in the absence of that rule.

The lack of road construction or reconstruction in IRAs is also influenced by:

- The fact that these RACR IRAs are also designated Appendix C IRAs in the LRMP. The LRMP prohibits road construction in the eastern portion of the Mt. Bailey IRA (LRMP, p. IV-107). LRMP direction is not changed by Judge Brimmer's injunction.
- Treatment areas sufficient to meet the project purpose and need can be adequately accessed from existing roads. Thus, road construction in IRAs is not necessary, even if the RACR or the LRMP allowed for it.
- Low product values of trees identified for harvest require that road construction costs be held to a minimum in order for this project to be economically viable.

The silvicultural prescription for the treatment areas would be appropriate in the presence or absence of the RACR. The removal of generally small diameter trees is the best way to shift the fuels profile to reduce potential for catastrophic wildfire in and adjacent to the wildland-urban interface, to slow the future tree mortality due to insect infestation, and to restore desirable ecosystem characteristics (see discussion of silvicultural prescription, pp. 94-98). That these silvicultural treatments are appropriate even in the absence of the RACR is reinforced by the fact that silvicultural prescriptions outside of IRAs are the same as prescriptions inside of IRAs.

2. Although designed to be consistent with the RACR, the D-Bug project is also consistent with the spirit of Judge Brimmer's injunction of that rule. It does not treat these IRAs as de facto wilderness areas as discussed in Judge Brimmer's order, but instead proposes timber harvest and fuel reduction activities within them. It enters the IRAs for the purpose of ecosystem restoration and reduction of hazardous fuels in and adjacent to a wildland-urban interface, the prohibition of which was one of the 'injuries in fact' discussed in his order. Issuance of the FEIS at this time facilitates the public's ability to be informed of and to influence agency decisions, and continues with collaboration as required by the HFRA.

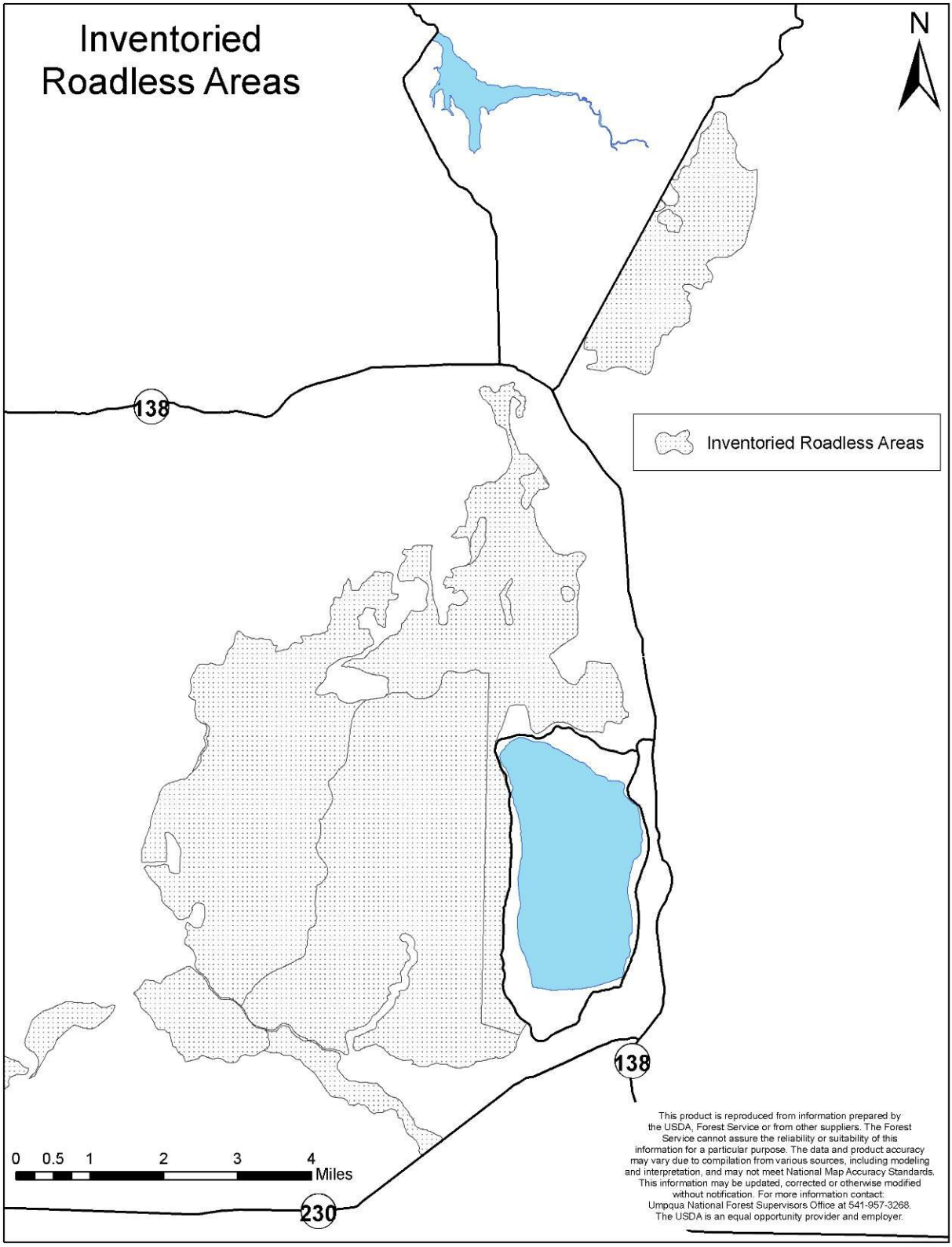

Figure 1-4. Inventoried Roadless Areas in the Vicinity of the D-Bug Project.

The 1998 Diamond Lake-Lemolo Lake Watershed Analysis (WA)

A watershed analysis is a compilation of information used to understand ecological processes and trends operating over large landscapes. Watershed analyses help to set the context for appropriate management actions. Several overarching WA recommendations are relevant to the D-Bug project. More specific WA recommendations are discussed in Chapter 3.

Mountain Pine Beetle:

- Lodgepole pine stands older than 70 years should be targeted for harvest to reduce the potential for mountain pine beetle epidemics. Treatments to remove large trees and regenerate lodgepole pine that are done in the near future will capture mortality, reduce fire risk, and create a mosaic of lodgepole pine stands of various ages that will respond differently to future mountain pine beetle outbreaks. Young lodgepole pine stands should be thinned to increase vigor in order to suppress future mortality caused by mountain pine beetles.

Restoring the Fire Regime:

- In order to maintain the older scattered ponderosa pine and western white pine, thin or clear around these trees to simulate the natural fire regime that has been excluded.
- Use prescribed fire as a tool to return the area to a moderate severity fire regime.

Riparian Reserves

- An accepted approach to minimizing wildfire size and the impacts of fire suppression is reducing the amount or continuity of ground and ladder fuels prior to the start of a wildfire in riparian reserves (p. 216).
- Active silvicultural programs will be necessary to restore large conifers in riparian reserves.
- Prescribed fire for ecosystem maintenance and restoration should be allowed to burn within riparian reserves as fire did historically. These fires will be utilized to restore function and diversity to the system (p. 220).
- Hazard reduction is recommended along the north shore of Diamond Lake due to high fuel loading, heavy public use, and the existing fire hazard. Hazard reduction treatments also should include the riparian reserve.
- The fire hazard around existing buildings in the Diamond Lake composite cannot be alleviated without treatment in riparian reserves due to the proximity of the buildings to the reserves or the buildings actually being in the reserves. Areas of riparian reserve with high fuel loading on the west (near the summer homes) and south sides of Diamond Lake (around Teal Lake) should be treated. These areas have high public use and, due to improvements (summer homes and other developments/facilities), values at risk are high.

The 2008 Vegetation Management Plan and Watershed Analysis Iteration

In 2008, the Forest Service completed a vegetation management plan and WA iteration to further compile and refine information in the vicinity of the D-Bug project. The following recommendations apply:

Pure Lodgepole Pine

- In mature stands (80 years old or older) that are susceptible to infestation from mountain pine beetle (dense stands with lodgepole eight inches and greater), commercial timber harvest should be employed to remove host trees before the beetles infest an area. Where healthy lodgepole exist with adequate crowns, either heavy thinning (with trees spaced 25-30 feet apart, ranging from 50-70 leave trees/acre) or an overstory removal (with sufficient numbers of leave trees to meet standards and guidelines), or a mosaic of these prescriptions resulting in variable-density thinning is recommended. These prescriptions would meet LRMP tree retention standards. With fewer host trees and an increased sunny microclimate, beetle-caused mortality of host trees can be decreased (Fettig, et al., 2007). Where healthy lodgepole are not present, the overstory removal prescription is recommended because unhealthy, failing lodgepole leave trees would eventually add to the fuel accumulation.
- In younger stem exclusion lodgepole pine, apply cost-effective-density-management techniques, such as mastication[1], in order to accomplish a maximum amount of acreage in a cost-effective manner to lower the potential fire intensity in the WUIs.

Mixed Conifer and Lodgepole/Mixed Conifer

- In stands where the older, larger lodgepole pine have mostly all died, remove some of the dead and dying trees as economically feasible during the thinning operation. Seek funding sources to burn or otherwise dispose of excessive fuel loads determined to be not merchantable. Biomass utilization should be explored.
- In older mixed-conifer timber stands, thinning from below would reduce stand density to the approximate conditions that would occur under the natural fire regime. The objective is to improve the resiliency of stands to withstand the effects of fire, insect outbreaks and other uncharacteristic conditions that occur under excessive tree densities. In the older lodgepole/mixed-conifer stands not yet affected by the beetle infestation, thinning should remove or lower the density of susceptible pines from the overstory and release understories.
- Stands containing ponderosa and western white pine would particularly benefit from reduction in competition through thinning of subordinate trees. These pines are also susceptible to mortality from mountain pine beetle, especially under dense conditions created by fire exclusion. Western white pine is more susceptible to white pine blister rust under unnaturally dense conditions. Ponderosa pine also is weakened by other diseases under excessively dense conditions increasing the likelihood of beetle mortality. Underburning is recommended, where feasible, in the stands containing ponderosa pine, as long as duff mounds are pulled away from the base of the legacy pines two years in advance of the underburn. Underburning is not recommended in the stands containing western white pine.

Management Areas 1 and 2

- The LRMP does not permit timber harvest in Management Area 1, except in the event of catastrophic damage. In order to lower the effects of the ongoing mountain pine beetle outbreak and reduce fuels in the vicinity of the wildland-urban interface,

[1] Mastication is the grinding of woody vegetation using equipment.

the LRMP should be amended during site-specific NEPA to allow timber harvest to help reduce the fire risk within and adjacent to MA-1 west of Diamond Lake.

- The LRMP places a size limitation on timber harvest openings (units) that can be created within Management Area 2, the Lemolo Lake and Diamond Lake Recreation composites. In order to allow for removal of beetle-killed trees and to allow for the lodgepole pine to be removed, the LRMP should be amended during site-specific NEPA to allow for timber harvest units greater than one-half acre in size.

Scenery Management

- Site-specific forest plan amendments should be pursued, where necessary, to achieve a desired scenic character that is compatible with desired conditions for vegetation and fuel management and to lower the fire hazard in the WUIs and along evacuation routes.
- The LRMP suggests opening sizes of one-quarter acre to 1.5 acres in the foreground areas of retention and one-half acre to 1.5 acres in the foreground areas of partial retention. Larger openings are suggested in middle ground areas of retention and partial retention areas. Where lodgepole stands are susceptible to beetle mortality, the opening size limitations should be amended during site-specific NEPA analysis to meet the overarching objective of hazard management in high-use recreation areas and WUIs.

Roads Analyses

An Umpqua Forest-Scale Roads Analysis (USDA, Umpqua National Forest, 2003) evaluated access issues for key road systems across the Forest and recommended further evaluations at the watershed and project scale, as needed. Roads analysis below the Forest scale is not automatically required, but may be undertaken at the discretion of the Responsible Official (FSM 7710).

Former District Ranger John Ouimet determined that a roads analysis below the Forest scale was not needed to support the D-Bug project. This is because no road management activities (road construction, reconstruction, and decommissioning) under the D-Bug project would result in any changes to access, changes to current use, or changes in traffic patterns or road standards. All new road building proposed under the project would be temporary roads that would be obliterated and blocked following use. The road reconstruction on existing roads and existing snow trails would not change any road management levels or standards nor affect any traffic patterns. The small segment of road proposed for decommissioning with D-Bug involves an abandoned segment of road that has not been open or used for years. Because the new road construction is temporary, followed by obliteration, impacts to soils and ecological processes are minimized.

PROJECT RECORD

This Environmental Impact Statement incorporates by reference the project record (40 CFR 1502.21). Chapter 3 provides a summary of the specialists' input in adequate detail to support the rationale for the decisions and the project record provides supporting documentation. The project record contains supplemental information and other technical documentation used to support the analysis and conclusions in this EIS. This information includes summaries or reports for Silviculture, Hydrology, Fish, Wildlife, Botany, Scenery Management, Logging Systems, Economics, Soils, and Cultural

Resources. Incorporating this information implements the CEQ regulations, which instruct agencies to reduce NEPA paperwork (40 CFR 1500.4), keep environmental documents "analytic rather than encyclopedic, and…concise and no longer than absolutely necessary" (40 CFR 1502.2). The objective is to furnish adequate site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated, without repeating detailed analysis and background information available elsewhere. The project record is available for review at Umpqua National Forest Headquarters, 2900 NW Stewart Parkway, Roseburg, OR, 97471.

PURPOSE AND NEED FOR ACTION

The purpose of this project is to lessen the fuel and safety hazards associated with the ongoing outbreak of mountain pine beetles and the ongoing impacts from fire exclusion through timely implementation of commercial treatments[2] and non-commercial treatments[3] in strategic locations. The difference between the existing condition and the desired condition defines the need for action in terms of elements that can be measured. The four elements of the D-Bug purpose and need are:

Element 1: The need to modify mountain pine beetle habitat conditions in stands containing lodgepole pine in order to reduce potential infestation.

Existing dense timber stands containing mature lodgepole pines have an abundance of host trees that allow the spread of mountain pine beetles, resulting in overstory tree mortality and fuel accumulations over landscape areas.

In pure stands of lodgepole pine, the removal of overstory host trees, or the heavy thinning of such host trees (20-50 feet of spacing between host leave trees), would remove the trees needed by beetles for population expansion. This also would increase the vigor of the residual trees, increasing the likelihood they would survive an infestation. This desired type of habitat modification also would alter the microclimate by removing the shady conditions preferred by beetles and interrupt the beetles' tree-to-tree spread. A literature review that examined the effectiveness of such beetle prevention treatments concluded that the various treatments studied are effective tools for suppressing mountain pine beetle infestations (Fettig, et al., 2007).

In mixed-conifer stands containing mature lodgepole in the overstory, harvest of the lodgepole overstory and retention of the other non-host conifers can prevent stand infestation. The remaining mixed conifer understory can be cultured once the host lodgepoles are removed.

Although no treatment can guarantee complete protection of mature residual pine species, the expansion of beetles into pure blocks of mature, contiguous lodgepole pine may be interrupted by harvest treatments that result in breaking up the existing homogenous landscape pattern (Fettig, et al., 2007; Goheen and Bridgewater, 2007).

[2] Commercial treatments, as defined for the purposes of this project, are the extraction of trees from a forested stand using various harvest systems, processing them at a landing, loading the logs onto trucks, and transporting them to a facility for further processing into products. This definition is generally limited to material of merchantable dimensions and includes fuel wood harvest.

[3] Non-commercial treatments are mechanical treatments that are not expected to produce a traditional wood product, such as thinning or mastication of small-diameter trees and brush.

Element 1 is measured by:

- Acres of susceptible lodgepole pine treated.

Element 2:

The need to reduce existing and predicted fuel loads in areas identified as high fire hazard within the Diamond and Lemolo Lake WUI and their evacuation routes.

The 2006 Douglas County Wildfire Protection Plans for Lemolo and Diamond Lake WUIs identified the need for fuel reduction treatments around homes and recreation areas in these "at-risk" communities, such as "mechanical clearing and thinning, including harvesting, thinning, mowing, chipping, cutting, and piling… and prescribed burning where appropriate." Such treatments would reduce wildland fire hazard and improve the ability to suppress fires and protect both public lands and developments and homes on leased public land. Beetle-caused mortality within these WUI areas has created and will continue to create additional fuel loadings. Proactive commercial and non-commercial thinning in stands within the WUI that are susceptible to mountain pine beetle attack would result in the desired condition of removing fuels that would otherwise accumulate following an attack and reduce fuel loads to desired levels. Treatments within the WUIs also would treat existing fuel loads, independent of mountain pine beetle activity.

Element 2 is measured by:

- Acres treated within the WUIs.
- Acres treated along designated evacuation routes.
- Acres of fuelbreak protecting Diamond Lake and Lemolo Lake WUIs from wilderness/roadless area wildfires.

Element 3:

The need to remove existing dead and imminently dying pine and other hazard trees in areas already infested where human use is high in order to protect the recreating public.

Mountain pine beetle hot spots exist on the east and north sides of Diamond Lake. Since 2004, these areas are experiencing increased annual mortality. In some stands within campgrounds and other concentrated use areas such as trails, snow parks, developed facilities and homes, most of the lodgepole host trees are now snags that are hazard trees. Portions of the Diamond Lake campground were not safe enough to open in 2007 because hazard tree felling could not keep up with the rapid and progressive mortality. Removing imminently dying trees and salvaging dead trees would result in the desired condition of reduced human exposure to hazard trees.

Element 3 is measured by:

- Acres of commercial harvest within developed recreation sites and by permitted dwellings/businesses.

Element 4:

The need for increasing stand vigor in order to improve stand resiliency in densely-stocked mixed conifer stands containing older, large ponderosa pine, western white pine, Shasta red fir, and Pacific silver fir.

Competition from excessive vegetation has reduced existing stand vigor in older mixed conifer stands containing ponderosa pine, western white pine, and Shasta red fir. This condition has developed in the absence of natural surface fires over many years. In the stands containing ponderosa and western white pine, the dense stocking has increased the pine's susceptibility to mortality from mountain pine beetle and other pathogens and has increased the risk of stand replacement fire. Reducing stand density by thinning would result in the desired condition of improved resiliency of older mixed conifer timber stands to the effects of fire and potential insects and disease outbreaks.

Element 4 is measured by:

- Acres of mixed conifer stands thinned.

PROPOSED ACTION

The Forest Service developed the proposed action to address the elements of the purpose and need. In stands containing pine, timely thinning in advance of beetle outbreaks would lessen the fuel accumulation that naturally follows behind pine beetle outbreaks. In stands already infested by mountain pine beetles and located near high use recreation areas, the dead trees would be salvaged to lower safety hazards and fuel accumulations. Fuel treatments within WUIs and the installation of fuelbreaks along evacuation routes (highways 138 and 230, and roads leading away from both WUIs) would implement recommendations of the Douglas County Community Wildfire Protection Plans. Additional fuelbreaks also are included in the proposed action to help slow down potential wildfires between the Mt. Thielsen Wilderness and the Lemolo Lake WUI. Finally, reducing stand density would approximate more natural stand conditions and potentially increase the survival of older fire-tolerant trees following future fires.

The proposed action includes:

- Variable-density commercial thinning of 3,165 acres in lodgepole pine stands leaving 20-70 TPA interspersed with 10 percent of the area with no treatment; commercial thinning 1,145 acres of lodgepole-mixed conifer from below (leaving 50-200 TPA); and commercial thinning of 2,247 acres in mixed-conifer stands (leaving 50-200 TPA). The lodgepole variable-density thinning would not generate any openings greater than 40 acres in size. These commercial thinnings include 620 acres within outer edges of the Mt. Bailey and Thirsty Creek Appendage IRAs, and 318 acres along the edge of the Oregon Cascades Recreation Area (OCRA).
- Overstory removal (leaving 20 overstory TPA) in two lodgepole pine stands on 59 acres. These overstory removals would not generate any openings greater than 40 acres.
- The commercial harvest would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations to generate an estimated 44.8 million board feet of timber.
- Non-commercial removal of fuels on about 2,026 acres by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash. This

includes treatment on about 344 acres of stands along the edges of the Mt. Bailey and Thirsty Creek Appendage Inventoried Roadless Areas and 15 acres in the OCRA.

- Biomass[4] utilization could occur on about 2,003 acres, depending on the market at the time operations occur. The Forest would create 21 one-acre landings to process the biomass material.
- Treating activity-created fuels (slash) on all acres commercially thinned by underburning (195 acres), handpile burning along roads in combination with crushing slash on skid roads (1,009 acres), machine piling (964 acres), masticating (1,162 acres), or yarding tops attached (3,224 acres).
- Re-using about 25.6 miles of existing spur roads to access thinning areas, then obliterating about 11.1 miles after use.
- Building a total of about 15.5 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for commercial treatments, then obliterating them after use.
- Reconstructing portions of 11 sections of existing system roads (totaling 4.7 miles of road), including road re-alignment, intersection improvement, widening, continuous placement or replacement of surface rock and rock armoring, reshaping road beds, replacing culverts, adding culverts, and hazard tree felling.
- Maintaining about 67 miles of existing system roads (approximately 9 miles are currently closed), including the grading and shaping of existing road surfaces, dust abatement, blading road beds and ditches, hazard tree felling, cleaning/maintaining ditches and culverts as needed, isolated placement or replacement of surface rock and rock armoring, opening and re-closing existing closed roads, removing debris from the roadway, and the cutting of intruding vegetation along roadsides.
- Amending the following sections of the 1990 Umpqua National Forest Land and Resource Management Plan (LRMP): scenery standards; timber harvest in MA 1; and opening size limitations in MA 2.

DECISION TO BE MADE

Based on the analysis documented in this Environmental Impact Statement, the Forest Supervisor of the Umpqua National Forest will decide the following:

- To implement the project as proposed; to implement a modified version of the project (an alternative) that addresses unresolved issues; or to not implement the project at this time (no action).
- If the project is implemented, which mitigation measures, project design features, monitoring, and water quality best management practices are necessary to achieve resource goals, objectives, and the desired future condition.
- If the project is implemented, whether to amend the Forest Plan as proposed.

[4] Biomass is generally non-merchantable materials or pre-commercial thinnings that are by-products of preventative treatments. This includes trees, wood, brush, thinnings, chips, and slash that are removed to reduce hazardous fuels, to reduce or contain disease or insect infestations, or to restore forest health.

SCOPING

Under the direction of the Healthy Forest Restoration Act (HFRA), a collaborative process was used during the development of the proposed action which included several newspaper articles and announcements, mailings to over 350 potentially interested people and groups, a public meeting in Roseburg on September 27, 2007, a public field trip to the project area on November 3, 2007, and various one-on-one discussions with groups and individuals from September 2007 through December 2007.

Formal scoping (a process used to surface issues) began when the proposed action was published in the federal register on January 22, 2008. A scoping notice was sent to the public on January 10, 2008 detailing the proposed action and soliciting comments. On February 8, 2008, The Roseburg News-Review published a front-page article describing the D-Bug proposed action and announced the opportunity to submit scoping comments to the Forest Service.

Thirty-seven scoping comments were received which included letters, e-mails, face-to-face conversations and meetings, and phone conversations. The D-Bug project record contains a scoping summary that details the scoping comments received for the project.

ISSUES

The scoping process generated a number of issues related to the proposed action. Significant issues associated with a proposed action are the focus of an environmental impact statement because they provide the basis for formulating and comparing alternatives to the proposed action (40 CFR 1502.14). Significant issues also may be used to prescribe mitigation and monitoring measures, or they may be used for analyzing environmental effects. Significant issues are based on unresolved conflicts concerning alternative uses of available resources. An issue is a point of disagreement, debate, or dispute about the proposed action based on effects identified through scoping. The following issues were used to develop alternatives to the proposed action:

<u>Issue 1--Amendments to the Forest Plan</u>

Umpqua Watersheds and Klamath-Siskiyou Wildlands Center are concerned that two of the proposed Forest Plan amendments would be harmful to the ecosystem and scenic quality of the area:

a) They state that, based on data from past lodgepole clearcuts in the planning area, the proposed D-Bug harvest in the lodgepole pine ecosystem does not conform with long-term sustained yield capacity or the sustained logging assumptions of the 1990 LRMP.

The following indicator quantifies and tracks this issue:

- Acres of lodgepole pine harvested.

b) They also state that the proposed activities along highways 138 and 230 would degrade the scenic drives, and that the visual quality objectives of retention and partial retention should be retained instead of amending the visual quality objectives along those routes.

The following indicator quantifies and tracks this issue:

- Acres treated along highways 138 and 230 that currently have retention or partial retention visual standards that would be moved into a lower visual level.

Issue 2--Treatments in Inventoried Roadless Areas/Oregon Cascades Recreation Area, and other Areas Without Roads (Potential Wilderness Areas)

Umpqua Watersheds, Klamath-Siskiyou Wildlands Center, Oregon Wild, and Cascadia Wildlands Project are concerned that the proposed thinning would impact the ecological importance and roadless characteristics in Inventoried Roadless Area (IRA), Oregon Cascades Recreation Area (OCRA), Potential Wilderness Areas, and areas proposed as wilderness by environmental organizations.

a) Cascadia Wildlands Project states that in the OCRA, scheduled timber harvest activities on a programmed basis are not permitted. They state that the fuelbreaks located in the OCRA will require additional maintenance treatments that represent programmed harvest, which is in violation of direction in the 1984 Act creating the OCRA.

Legislation which established the OCRA allows for activities "necessary to prevent and control wildfire, insects, disease, soil erosion, and other damaging agents including timber harvesting activities necessary to prevent catastrophic mortality from insects, diseases, or fire." Additionally, the goals in the OCRA Management Plan for the two zones affected allows for harvest and salvage consistent with the actions proposed in this FEIS. Furthermore, the proposed timber harvest for this project is not occurring on lands determined suitable for timber harvest in the Umpqua NF LRMP; therefore, this action is not considered programmable timber harvest.

Fuelbreak maintenance is anticipated to be infrequent; maintenance activities could occur every 10 to 30 years, depending on the site conditions. Maintenance activities would involve cutting small trees and shrubs. When the maintenance is needed in the future, the objective would be to prevent or control future wildfires and reducing the threat to health and safety; thus meeting the intent of the OCRA legislation.

While the management actions proposed in this FEIS are in compliant with the OCRA laws and regulations, because of the public's interest in management in this area, this will be tracked as an issue. The following indicator quantifies and tracks this issue:

- Acres of commercial thinning in the OCRA.

b) Umpqua Watersheds and Klamath-Siskiyou Wildlands Center state that putting fuelbreaks along the Thirsty Creek Road and Kelsey Point Road along the edge of the Inventoried Roadless Areas (IRAs) violates the 2001 Roadless Area Conservation Rule (RACR). Tim Ballard, Kim Treadwell, Randall Ballard, and Linda Quintero are concerned over the precedent that active management within IRAs would establish.

The Roadless Area Conservation Rule sets forth particular requirements when timber may be cut, sold, or removed within Inventoried Roadless Areas. Following are the requirements which apply to this project and will be used as indicators of compliance with the 2001 RACR. They are further explained below.

- The purpose is to maintain or restore the characteristics of ecosystem composition or structure, such as to reduce the risk of uncharacteristic wildfire effects, within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period. 36 CFR 294.13 (b)(1)(ii)
- The timber is generally small diameter. 36 CFR 294.13 (b)(1)

- Timber cutting, sale and/or removal are needed to maintain or improve one or more of the roadless area characteristics. 36 CFR 294.13 (b)(1)
- The cutting, sale, or removal of timber is incidental to the implementation of a management activity not otherwise prohibited. 36 CFR 294.13 (b)(2) This criteria will be only applied to cutting and removal of roadside danger trees.
- The cutting and sale of timber is expected to be infrequent. 36 CFR 294.13 (b)

These criteria only apply to the management within IRAs. To track the extent of the effects the following indicator will be used:

- Acres of forest treated within Inventoried Roadless Areas.

c) Several members of the public noted concern that management was proposed within Potential Wilderness Areas as identified by the criteria in FSH 1909.12 Chapter 70.

The following indicator quantifies and tracks this issue:

- Acres within the Potential Wilderness Area which would continue to qualify under FSH 1909.12 Chapter 70.

d) Umpqua Watersheds, Oregon Wild and Klamath-Siskiyou Wildlands Center state that thinning is proposed in areas they have proposed as wilderness areas and that the proposed treatments could degrade the rare features and potential wilderness characteristics of these areas.

The following indicator quantifies and tracks this issue:

- Acres within affected within areas proposed for wilderness (APW)

Issue 3--New Road Building

Several conservation groups are concerned that the proposed 15.5 miles of temporary road building and subsequent obliteration would cause ecological damage.

Cascadia Wildlands stated that fewer miles of road could be built and that other logging systems could be used, resulting in less temporary road building. Umpqua Watersheds and Klamath-Siskiyou Wildlands Center requested that the EIS consider an alternative to the 15.5 miles of temporary road building. Oregon Wild also requested that new temporary road segments be ranked according to their impacts relative to the benefits of access, dropping the roads with the lowest ratio of benefits to costs.

The following indicator quantifies and tracks this issue:

- Miles of temporary road constructed and subsequently obliterated.

Issue 4--Trails

Some conservation groups are concerned that log haul on top of existing trails and thinning next to existing trails will negatively affect the trails and the recreation experience due to the impacts from logging and other fuel reduction treatments. See Chapter 2 “Best Management Practices, Mitigation Measures, Project Design Features, and Monitoring” on pages 53-54 (for roads) and 59-60 (for recreation/scenery) for information on how the recreation experience will be maintained.

Umpqua Watersheds and Klamath-Siskiyou Wildlands Center state that log haul on snowmobile trail #1457 (a segment of the Crater Trail) and thinning in the vicinity of cross-country ski trail #1410 (a segment of the North Crater Trail) would affect the recreation users and that off-road vehicle use would increase as a result of the thinning and log haul. Further, Oregon Wild states that use of trail #1457 as a haul road would degrade the roadless characteristics in the vicinity.

The following indicators quantify and track this issue:

- Miles of trail used for logging access.
- Acres of commercial and non-commercial treatment within 200 feet of affected trails.

Issue 5--Fuelbreaks

Multiple commenters expressed various concerns over the location, width, and thinning technique proposed on some of the fuelbreaks, questioning their effectiveness and the possible impacts of such fuelbreaks.

Conservationists state that the fuelbreaks along the Thirsty Creek and Kelsey Point roads are redundant because the proposal also includes a fuelbreak on the Windigo Pass Road, which is located directly to the northwest. Oregon Wild states that there are much higher priorities for modifying fuel structure, such as in dense plantations. Cascadia Wildlands Project states that these fuelbreaks are outside the WUI and that it is not clear how they would meet the stated purpose. Tim Ballard, Kim Treadwell, Randall Ballard, and Linda Quintero also question the effectiveness of these fuelbreaks and suggest that non-commercial removal of fuels is preferred. Oregon Wild also questioned the general effectiveness of the fuelbreaks, citing studies that cast doubt on their effectiveness. On the other hand, other members of the public question whether the fuelbreaks are large enough to be effective.

The following indicators will quantify and track this issue:

- Acres of commercial and non-commercial treatments along the Thirsty Creek and Kelsey Point fuelbreaks.
- Acres of improved resiliency to stand replacement fire within and adjacent to fuelbreaks.
- Total acres in roadside fuelbreaks (measured as 400 meters in total width).

Issue 6--Extent and Intensity of Treatments in Lodgepole Pine and Project Economics

Several conservation groups are concerned that the proposed action includes too much harvest, resulting in impacts in the lodgepole pine ecosystem.

a) Umpqua Watersheds, Klamath-Siskiyou Wildlands Center, and Oregon Wild state that the areas receiving only 20 trees per acre of retention, up to 40 acres in size, represents too much regeneration harvest and promotes the spread of wildfire due to dense understory regeneration. They also state that such a heavy harvest in lodgepole pine would result in impacts to habitat quality. Umpqua Watersheds and Klamath-Siskiyou Wildlands Center asked that an alternative be considered that makes smaller openings and includes no regeneration harvest.

The following indicators will quantify and track this issue:

- Acres of lodgepole pine regenerated.
- Acres of lodgepole pine and lodgepole/mixed conifer commercially thinned.

b) Several other commenters state that the proposed action is not doing enough removal to achieve project needs in terms of treatment intensity, treatment extent, and economic returns. Douglas Timber Operators, Swanson Group, Don Wilson, Communities for Healthy Forests, Monett Logging Inc., and Rick Abbott are concerned that thinning lodgepole pine from below, leaving 20-70 trees per acre may not meet the project's purpose because the leave trees may die anyway, adding to fuel loads, and result in lost economic opportunities. American Forest Resource Council and Larry and Roberta Hall asked for economically viable timber sales with increased revenues to the government.

The following indicators quantify and track this issue:

- Net Present Value
- Least Cost to Government (total cost per acre treated)

c) Mark Boyer stated that more areas need to be treated to more aggressively stem the spread of the mountain pine beetle and lower the associated fire hazard that would threaten improvements.

The following indicator will quantify and track this issue:

- Total acres of commercial lodgepole pine treated south of Hwy. 230

ISSUES THAT DID NOT DRIVE ALTERNATIVES

Several other issues or concerns raised by the public were resolved by clarifying the existing details of the proposed action. Other issues raised were resolved by describing mitigation measures to address them. Other points of debate raised by the public requested full disclosure of the effects of the actions described under the alternatives so that they could fully understand the impacts of the proposal; these points are fully disclosed in Chapter 3. As such, these issues did not drive the development of an alternative to the proposed action. These are discussed below by category:

Issue resolved through the development of mitigation measures or project design features:

Site Disturbance

Numerous commenters, including some Diamond Lake cabin owners, the U.S. Environmental Protection Agency, and conservationists, are concerned that commercial logging and associated road building and slash disposal would result in soil disturbance, loss of ground cover, and canopy reductions. Commenters are concerned that these activities could ultimately lead to weed infestations, loss of soil productivity, and impacts to the aquatic environment, including the aquifer, and increased susceptibility of stands to insect attack.

These concerns are addressed, in part, by a variety of mitigation measures (detailed at the end of Chapter 2), such as: use of native seed to revegetate areas of bare soil; minimizing and/or avoiding any operations in areas of existing weed infestation; installation of waterbars on roads/skid trails in sloping terrain; subsoiling some of the skid trails and temporary roads following logging, as appropriate; retaining green trees and snags in the overstory of all stands to help reduce microclimate changes; and

restricting the timing of logging operations during relatively dry soil and weather conditions.

Impacts to Scenery and Land Usability after Harvest

Conservation groups, the Diamond Lake Homeowners Association, and some individual Diamond Lake cabin owners are concerned about the impacts of fuel mastication and the impacts of thinning and associated skid trails, slash piles, and log landings on the usability of the treated areas, and overall visual quality, including the loss of screening vegetation that provides privacy for cabin owners.

These concerns are addressed, in part, by a suite of mitigation measures such as: thorough and timely slash disposal, when feasible; removal of mastication slash from cabin driveways; revegetation of certain disturbed areas with native shrubs; subsoiling certain disturbed areas to speed revegetation; a no-cut buffer along the shoreline of Diamond Lake; returning any cabin driveways used for the timber sale operations to pre-logging conditions; and various project design features to lower visual impacts, when economically feasible.

Impacts to Customers of Private Businesses.

Steve Koch, owner of the Diamond Lake Improvement Company, is concerned that noisy logging operations will disturb his customers and cause a loss of customer enjoyment and loss of business during operations.

This concern is addressed by limiting the logging operations in the near vicinity of private businesses (in special use permit areas) to before Memorial Day and after Labor Day and prior to the winter sports season.

Impacts to Bald Eagles and Ospreys

Oregon Department of Fish and Wildlife is concerned that logging operations and burning would impact raptors through disturbance and habitat changes. They advise seasonal restrictions around nests and avoidance of clearcutting or overstory harvest prescriptions within 330 feet of nests.

This concern is address by limiting operations in the near vicinity of raptor nests so that nesting and fledging is not disturbed. The silvicultural prescription involves light non-commercial thinning within the 330 foot nest buffer.

Impacts to Private-Use Roads

The Diamond Lake Homeowners Association and some individual cabin owners are concerned about logging impacts to their cabin access roads where they bear the cost of road maintenance under the terms of their special use permit.

This concern is addressed by mitigation measures detailed in Chapter 2 which requires that any cabin access roads used during project operations be returned to pre-logging conditions.

Impact to Streams and Lakes

The US Environmental Protection Agency (EPA), the Steamboaters, and some private cabin owners at Diamond Lake are concerned that thinning operations and associated slash burning and road building could impact riparian areas, that streams such as Lava Creek and the Clearwater River could be affected, and that water quality in Diamond Lake and Lemolo Lake could be impacted. EPA states that methods should be used around Lemolo and Diamond Lakes that reduce the likelihood of nutrient input.

These concerns are addressed by applying appropriate no-cut stream buffers on all perennial streams; applying a no-cut buffer along both lakeshores; avoiding perennial streams during ground-based logging operations; and the use of best management practices (design criteria) for the two new intermittent stream crossings by new temporary roads and road reconstruction and maintenance.

Issues resolved through disclosure of effects:

Impacts to Certain Wildlife

Conservation groups are concerned about important habitat for wolverines, fishers, and, at one time, lynx, stating that the EIS should consider the impacts on these species, and other remote and rare wildlife that depend on large expanses of roadless areas or areas without roads. They state that logging and the associated increase in snowmobile and OHV use will increase hunting, noise, and exhaust pollution, negatively impacting wildlife.

These comments are addressed by fully disclosing the impacts to wildlife that are potentially present in the planning area. Lynx are not on the Regional Forester's special status species list (Jan. 21, 2008) for the Umpqua National Forest, nor are they a Management Indicator Species on the Umpqua National Forest. Only species on the list determined by the Regional Forester for each individual Forest, or identified within land and resource management plans as management indicator species are required to be analyzed in a biological evaluation. Therefore, lynx were not considered in the biological evaluation for the D-Bug project.

Impacts of Roadside Thinning to Deer and Elk Cover

Oregon Department of Fish and Wildlife is concerned about the thinning of fuelbreaks along roads where deer and elk become too vulnerable to roadside shooting. They suggest reduced thinning intensity to provide visual screens (cover) for these animals.

These comments are addressed by fully disclosing the impacts to deer and elk hiding cover.

Increased Off-Highway Vehicle Use

The Diamond Lake Homeowners Association and Oregon Wild expressed concerns about off-highway vehicle use of new skid trails and roads, suggesting that all such roads be properly blocked. Oregon Department of Fish and Wildlife is concerned that new logging roads would impact elk calving grounds, wintering areas, or other sites where elk normally congregate and requested that roads be closed following use and that off-road vehicles be prohibited. Umpqua Watersheds and Klamath Siskiyou Wildlands Center state that any alternative that logs and builds roads in roadless areas must consider the increased use of off road vehicles, including snowmobiles and the decreased quality of non-motorized recreation, such as equestrian or hiking use. Oregon Wild is concerned about immediate obliteration of such roads in order to prevent OHV trespass.

This concern is addressed in the proposed action where all new road building would consist of temporary roads, which will be obliterated following use and would include the installation of effective barriers at the road initiation points, if needed. The impacts to non-motorized recreation and to wildlife from increased snowmobile use (where road obliteration and road blocks do not prevent use) are addressed by full disclosure.

Smoke Management

Oregon DEQ requested that the EIS provide an overview of the smoke management program that will be followed to avoid public health impacts and potential ambient air quality exceedances.

These comments are addressed by the inclusion of mitigation measures to protect air quality and by fully disclosing the impacts to air quality.

Impacts of Rock Pit Use/Development

Conservation groups request that the EIS clearly describe the location of the rock pits that will be used to build new roads, and the impacts to wildlife and recreation in the rock pit areas.

These comments are addressed by fully disclosing the impacts from rock pit use to recreationists and wildlife. A map disclosing the location of the two rock pits appear in Figure 1-5.

Legality of Treatments in the OCRA and Inventoried Roadless Areas

Several conservation groups question the legality of entry into the OCRA and IRAs. Cascadia Wildlands requests that the EIS disclose how the 2001 Roadless Area Conservation Rule is not violated and how the proposed OCRA entry does not violate the regulation of no programmed harvest.

These comments are addressed by disclosing the aspects of the 1984 law that created the OCRA and regulations associated with the Roadless Rule in the context of what is proposed in D-Bug.

Rationale Behind Non-significant Forest Plan Amendments

Cascadia Wildlands Project requested that the EIS disclose the criteria and analyses used to reach a non-significant conclusion on the various proposed Forest Plan amendments.

This comment is addressed by disclosing the four criteria described in Forest Service Handbook 1926.51 regarding changes to a land management plan that are not significant.

Scientific Controversy

Cascadia Wildlands Project states that there is scientific controversy surrounding the use of logging to prevent future outbreaks of mountain pine beetle, and they requested consideration and disclosure of this controversy.

This comment is addressed in chapters 1 and 3 of the EIS.

Impacts to the Aquifer

Conservation groups are concerned about impacts to the aquifer under the fragile pumice soils in the planning area.

This comment is addressed by disclosing the impacts of soil compaction from ground based logging on the underground aquifer.

Non-significant issues

Three issues raised during scoping were dismissed as non-significant. Non-significant issues include those that are outside the scope of the proposed action, are already

decided by law, regulation, Forest Plan, or other higher-level decision, or by previous decision.

Road Decommissioning

Some Diamond Lake cabin owners are concerned about the decommissioning of the existing system road that parallels the lakeshore (4795-400) near their homes, stating that it will be important for fire suppression activities. Generally, the American Forest Resource Council is not in favor of system road decommissioning, stating that road decommissioning is careless in a landscape prone to catastrophic wildfires.

This issue was determined to be non-significant (outside the scope of the project) because the decommissioning of a portion of existing system road 4795-400 was covered under a separate decision made by former District Ranger John Ouimet in 2006. The actual decommissioning included under this EIS only includes an abandoned section of old Highway 230 that has been closed for many years and is not presently functioning as a system road.

Forage Creation

Oregon Department of Fish and Wildlife suggests that efforts be made to reclaim meadows and openings in order to improve forage opportunities for elk that have been encroached upon by trees.

This issue was determined to be non-significant (outside the scope of the project) because creating forage is not part of the stated purpose and need.

Staged Timber Harvest over Multiple Years

Don Wilson suggested NEPA planning to allow two to three harvest entries over 15 to 20 years that would stage the removal of lodgepole along with associated precommercial thinning in order to help manage the overstocked and stagnated understories that he predicts will gradually develop after lodgepole thinning overstory treatments.

Under NEPA, discrete projects need to be implemented within reasonably definable timeframes. Typically, a NEPA analysis would be required for each timber sale entry over the course of 20 years time. Because future harvest over time is outside the scope of the project, this issue was determined to be non-significant.

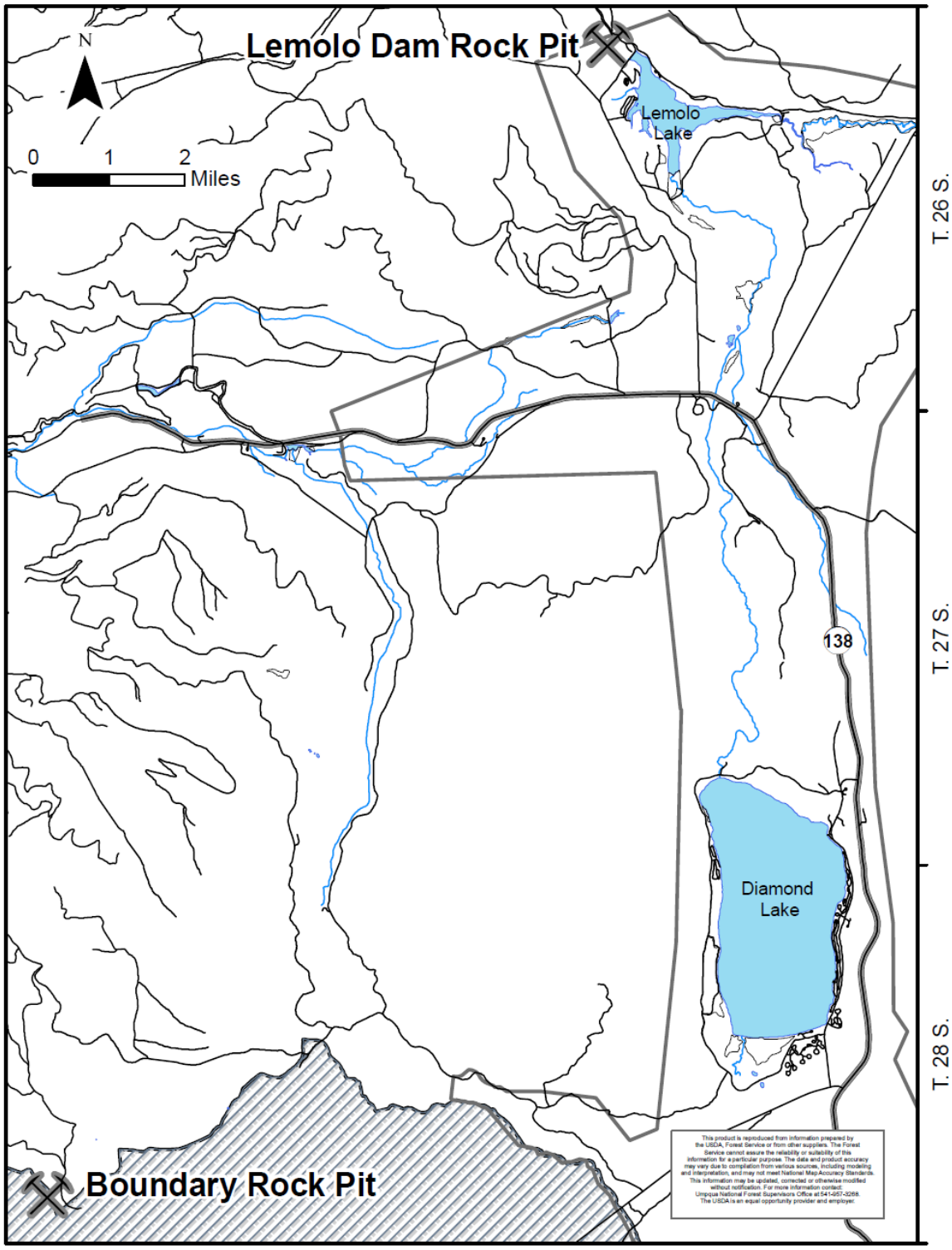

Figure 1-5. Locations of Lemolo Dam and Boundary rock pits.

PROJECT IMPLEMENTATION

Should an action alternative be selected as a result of this NEPA process, the Forest Service would implement most of the timber harvest, road construction, and road reconstruction through timber sale contracts. All action alternatives would likely result in multiple separate timber sale contracts.

The Forest Service may also choose to use a contracting tool called stewardship contracting, authorized by Congress and described under the January 28, 2004, Forest Service Washington Office Interim Directive (FSH 2409.19, Ch. 60). Stewardship contracting is a tool used where goods are exchanged for services to accomplish resource management projects, in collaboration with interested publics. Service contracts or construction contracts also can be used to accomplish some of the connected actions or similar actions, which can be funded by other sources.

In the course of implementing complex projects with many acres of harvest, fuel treatment, and several connected actions, minor changes may be needed during implementation to better meet on-site resource management and protection objectives. For example, fuels prescriptions may be modified if site conditions dictate and if other resource objectives can be met. Minor adjustments to unit boundaries may be needed during final layout for resource protection, to improve logging system efficiency, or to better meet the intent of the resource prescriptions. Changes in aspects of logging systems, including locations of temporary spur roads, may be required to better facilitate logging systems and provide for resource protection. Many of these minor changes would not present sufficient potential impacts to require any specific documentation or action to comply with applicable laws.

In determining whether and what kind of further NEPA action is required to document any changes, the criteria for whether to supplement an existing environmental impact statement (FSH 1909.15, Sec. 18) will be followed.

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CHAPTER 2

ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

The National Environmental Policy Act (NEPA) requires analysis of a proposed action and other reasonable alternatives, including no action. The no action alternative provides a baseline for estimating environmental effects. Two alternatives, including no action, for the D-Bug Project are considered in detail in this FEIS. The Forest developed the proposed action to meet the purpose and need established by the District Ranger. The Forest developed Alternative 5 after publishing the DEIS to respond better to the issues, and to work towards common ground with the public. In addition, four other alternatives were considered, but eliminated from detailed study.

Changes Between Draft and Final

This FEIS contains a number of refinements and clarifications received during the public comment period. A new alternative (Alternative 5) was developed in response to public comments and further refined based on input received during a collaborative meeting with the public. Details on Alternative 5 appear in this chapter. Alternative 3 was eliminated because Alternative 5, which is similar in concept and treatments, makes greater progress towards reaching common ground with the public and better responds to issues. Alternative 4 was eliminated because of opposition to the extent of treatments into undeveloped areas.

The Forest Plan amendment for timber harvest in the lodgepole pine climax ecoclasses was eliminated from both action alternatives. On further examination, it was determined that National Forest Management Act (NFMA) supported activity in these areas in order to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area to meet overall multiple-use objectives” (16 USC 1604(g)(3)(B)). Futhermore, regulations at 36 CFR 219.27(c)(1-2) support activity in these areas, precluding the need for an amendment. The regulations state that “sales necessary to protect other multiple-use values or activities that meet other objectives” may occur on lands not suitable for timber production if the Forest Plan supports the action. Furthermore, stands that are in “imminent danger of insect or disease attack” may count towards planned volume, so long as the harvest is consistent with silvicultural and environmental standards. The Forest Plan Standards and Guidelines for Timber/Vegetation Management support harvest on unsuitable lands when needed to enhance other resource objectives, so long as activities are documented in the environmental analysis.

Alternatives Considered, But Eliminated From Detailed Study

Based on scoping comments, two alternatives were considered but eliminated from detailed study as described below.

An alternative was suggested that would use helicopter logging to lower the amount of ground disturbance associated with ground-based logging in areas of pumice soil. Helicopter logging is prohibitively expensive because the predicted revenue generated by the various timber sales located in the lodgepole areas would be less than the cost to

log them using helicopters. The Contracting Officer states that no bids would be received if helicopter logging was included. If no bids are received, the project cannot be implemented, thus the purpose and need would not be met. Therefore, this alternative was eliminated from detailed study.

Another alternative was suggested that would manage lodgepole pine stands more extensively and intensively by increasing the amount of treatment acres in lodgepole pine and by using regeneration harvest instead of the variable density thinning prescribed under Alternative 2.

This alternative, as considered, included a 36 percent increase in the amount of lodgepole pine stands proposed for commercial treatment, equating to an additional 2,072 acres over that of Alternative 2. The majority of the commercial lodgepole stands under this alternative (76 percent) would have received overstory removal (leaving 20 of the largest overstory lodgepole pine per acre), while only applying variable density thinning of lodgepole (leaving 20-70 overstory trees per acre intermixed with no-cut leave areas) on 23 percent of the area, where scenic sensitivity is high. This alternative, which also included all of the same mixed conifer harvest as Alternative 2, would have generated 67.7 million board feet of timber and generated an estimated 1.2 million dollars of revenue to the national treasury.

Due to available revenue associated with the higher harvest levels, this alternative also included a 17 percent increase in non-commercial fuel treatments, equating to an additional 305 acres over that of Alternative 2. Most of the additional non-commercial fuel treatments in this alternative would have been located west of the Lemolo Lake Resort which also would have boosted the amount of woody biomass available to that market.

The alternative included the following activities:

- Overstory removal of 4,048 acres in lodgepole pine stands leaving 20 large overstory trees per acre; variable density thinning of 1,248 acres of lodgepole pine leaving 20-70 TPA interspersed with 10 percent of the area with no treatment; and commercial thinning of 2,247 acres in mixed conifer stands (leaving 50-200 overstory trees per acre). The various harvest treatments would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations to generate an estimated 67.7 million board feet of timber. These commercial treatments include 620 acres along the outer edges of the Mt. Bailey and Thirsty Creek Appendage Inventoried Roadless Areas (IRAs), and 318 acres along the edge of the Oregon Cascades Recreation Area (OCRA).
- Non-commercial removal of fuels on about 2,318 acres by pre-commercial thinning, mastication, whip felling[5], chipping, and piling and burning of slash. This includes treatment on about 345 acres of stands along the edges of the Mt. Bailey and Thirsty Creek Appendage IRAs, and 15 acres along the edge of the OCRA.
- Treating activity-created fuels (slash) on all acres commercially thinned using a variety of methods, including underburning, crushing, machine piling, handpile burning along roads, whole tree yarding, or mastication.
- Re-using about 25.6 miles of existing, spur roads to access thinning areas, then obliterating about 3.8 miles after use.

[5] Whip felling is the hand cutting of small understory trees.

- Building a total of about 25.4 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for non-commercial treatments, then obliterating them after use.
- Forest Plan amendments as described under Alternative 2, and conducting road maintenance and road reconstruction similar to that in Alternative 2.

An assessment was done on this alternative's ability to meet the requirements of the National Forest Management Act (NFMA). This law requires that openings created as individual cut blocks have a maximum size limit of 40 acres in lodgepole pine forest types (36 CFR 219.27(d)(2)). The alternative's emphasis on regeneration harvest rather than variable density thinning caused it to deviate substantially from the size limitation under this law. The law permits exceptions, based on specific rationales, after a 60-day public notice and review by the Regional Forester.

Based on the collaborative process used to develop Alternative 2 and comments received during scoping, a NFMA exemption process would generate much opposition. Conservation groups and other members of the public, including some of the local residents who reside in the planning area, have already expressed concerns over the impacts of thinning to scenery, spread of noxious weeds, effects to certain wildlife species, and increased off-road vehicle access. The extensive amount of regeneration harvest in this alternative would heighten concerns and likely stall the exemption process, thus delaying project implementation.

Moreover, the use of variable-density thinning has been shown in the scientific literature to achieve the various objectives outlined in the purpose and need while treating broad landscape areas and not creating openings that would deviate from NFMA. Also, similar thinning prescriptions have been successfully used and found to be economically viable on the nearby Chemult and Crescent ranger districts, on the Fremont-Winema and Deschutes national forests, respectively. As such, compelling reasons to pursue an exception to NFMA do not exist. For the above reasons, this alternative was eliminated from detailed study.

In addition to the two alternatives above, two more alternatives were eliminated after publication of the DEIS: alternatives 3 and 4. Alternative 3 was developed to address Issues 2 through 6. Under this alternative, commercial harvest in the IRAs, the OCRA, and in potential wilderness areas was reduced by 65, 64 and 52 percents, respectively, compared to Alternative 2. The construction of new temporary roads under Alternative 3 was lowered by 35 percent compared to Alternative 2. The use of existing trails for timber haul was lowered from 8.2 miles in Alternative 2 to 4.8 miles in this alternative. The Thirsty Creek and Kelsey Point fuelbreaks were dropped where they overlapped the Thirsty Creek Appendage IRA, totaling a reduction of 420 acres of commercial harvest and 109 acres of non-commercial fuel treatments. Also, this alternative decreased the amount of commercial harvest in lodgepole pine by 26 percent relative to Alternative 2. This alternative would have generated 33.8 million board feet of timber. Alternative 3 was eliminated in the FEIS because Alternative 5 makes greater progress towards reaching common ground with the public and better responds to issues. It was very similar to Alternative 5 in concept and treatments, as well as the issues it responded to.

Alternative 4 was developed to respond specifically to Issue 6. Several commenters responded to the proposed action, stating that not enough lodgepole pine would be treated in terms of total area or intensity. This alternative included a nearly 50 percent increase in the amount of lodgepole pine stands proposed for commercial treatment, totaling 2,219 more acres than that of Alternative 2. It also increased the amount of

lodgepole pine regeneration harvest by applying the overstory removal prescription to an additional 182 acres. Alternative 4 required building an additional 9.7 miles of temporary roads over Alternative 2. This alternative also treated 187 more acres of non-commercial fuel, mostly west of the Lemolo Lake Resort. This alternative would have generated 55.3 million board feet of timber. Alternative 4 was identified as the preferred alternative in the DEIS, but it received a great deal of opposition. Many comments received stated the alternative went too far into undeveloped areas and would cause considerable ecological impacts. Additional collaborative public meetings held after the DEIS comment period indicated more support for a new alternative. Thus, Alternative 4 was eliminated. HFRA only requires the Responsible Official to consider one additional action alternative besides the proposed action. Alternative 5 was selected for the reasons described above.

Alternatives Considered In Detail

ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no thinning, fuel treatment, biomass utilization, temporary road construction, road reconstruction and maintenance, or other similar or connected activities, such as pre-commercial thinning, subsoiling, weed control, or road decommissioning would occur. No ground-disturbing activities would take place and no timber would be offered for sale. Ongoing activities, including road maintenance, recreation use, and noxious weed control, would continue to occur (Table 3-2). Future activities would also occur (Table 3-3).

ALTERNATIVE 2 - PROPOSED ACTION (TABLE 2-1, FIGURES 2-1 & 2-2)

This alternative is the proposed action used in the scoping process. The Forest developed the proposed action to meet the purpose and need. It includes the following:

- Variable density commercial thinning of 3,165 acres in lodgepole pine stands leaving 20-70 TPA interspersed with 10 percent of the area with no treatment; commercial thining 1,145 acres of lodgepole-mixed conifer (leaving 50-200 TPA); and commercial thinning of 2,247 acres in mixed-conifer stands (leaving 50-200 TPA). The lodgepole variable-density thinning would not generate any openings greater than 40 acres in size. These commercial thinnings include 620 acres along the outer edges of the Mt. Bailey and Thirsty Creek Appendage IRAs, and 318 acres along the edge of the OCRA.
- Overstory removal (leaving 20 overstory TPA) in two lodgepole pine stands on 59 acres. These overstory removals would not generate any openings greater than 40 acres.
- Salvage of 375 acres of dead and dying lodgepole.
- The commercial harvest would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations to generate an estimated 44.8 million board feet of timber.
- Non-commercial removal of fuels on about 2,026 acres by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash. This includes treatment on about 344 acres of stands along the edges of the Mt. Bailey and Thirsty Creek Appendage IRAs and 15 acres in the OCRA.

- Biomass utilization could occur on as much as 2,003 acres, depending on the market at the time operations occur. Nine one-to-five-acre landings would be created to process the biomass.
- Treating activity-created fuels (slash) on all acres commercially thinned by underburning, handpile burning along roads in combination with crushing slash on skid roads, machine piling, masticating, or yarding tops attached.
- Re-using about 25.6 miles of existing spur roads to access thinning areas, then obliterating about 11.1 miles after use.
- Building about 15.4 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for commercial treatments, then obliterating them after use.
- Reconstructing portions of 11 sections of existing system roads (totaling 4.7 miles of road), including road re-alignment, intersection improvement, widening, continuous placement or replacement of surface rock and rock armoring, reshaping road beds, replacing culverts, adding culverts, and hazard tree felling.
- Maintaining about 67 miles of existing system roads (approximately 9 miles are currently closed), including the grading and shaping of existing road surfaces, dust abatement, blading road beds and ditches, hazard tree felling, cleaning/maintaining ditches and culverts as needed, isolated placement or replacement of surface rock and rock armoring, opening and re-closing existing closed roads, removing debris from the roadway, and the cutting of intruding vegetation along roadsides.
- Utilizing the existing Lemolo Dam rock pit and the Boundary rock pit as rock sources for the road work.
- Amending the 1990 Umpqua National Forest Land and Resource Management Plan (LRMP) in the following areas:
    1. The LRMP assigned Visual Quality Objectives of Retention and Partial Retention along highways 138 and 230, and areas surrounding Diamond Lake and Lemolo Lakes. The LRMP would be amended for this project to modify these objectives in the short term in order to meet the purpose and need.
    2. The LRMP does not permit timber harvest in Management Area 1, except in the event of catastrophic damage and as approved in a vegetation management plan. The Forest Plan would be amended for this project to include commercial timber harvest in MA-1 in order to lower the effects of the ongoing mountain pine beetle outbreak and reduce fuels in the vicinity of the wildland-urban interface area, as recommended in the 2008 Vegetation Management Plan (USDA, Umpqua National Forest, 2008).
    3. The LRMP places a size limitation on timber harvest openings (units) that can be created within Management Area 2 surrounding Diamond and Lemolo lakes. In addition, prescription A4-I for this Management Area, does not allow for commercial or personal-use firewood cutting. In order to accomplish effective treatments of adequate size, the LRMP would be amended for this project to allow for timber harvest units greater than one-half acre in size. Also, to allow for the economic removal of dead

and dying lodgepole pine, the LRMP would be amended to allow for commercial and personal-use firewood cutting.

Thirteen different silvicultural prescriptions are included in Alternative 2. Prescriptions 1-4 and 9-13 include removal of a commercial product, while prescriptions 5-8 include non-commercial treatments (Table 2-1):

Table 2-1. Alternative 2 silvicultural prescriptions by individual treatment unit.

Prescription #[6]	Units assigned to prescription	Com-mercially treated acres	Non-comm. treatment acres	Volume Removed (thousand board feet)
1 – Overstory removal of lodgepole forests using mechanical harvest, retaining about 20 TPA, 5" and greater; yard tops attached.	29, 30	59	0	472
2 – Variable density thinning of lodgepole pine stands leaving 20-70 TPA, 5" and greater, interspersed with 10 percent of the area with no treatment, using mechanical harvest, yard tops attached, and masticate fuels.	18, 22, 32, 42, 44, 46, 60, 61, 62, 63, 64, 65, 66, 67, 68, 72, 73, 106, 108, 121, 133, 135, 136, 139, 140, 141, 147, 149, 152, 156, 164, 180, 181, 182, 184	3,165	0	15,823
3 – Thinning in stands of lodgepole overstory and mixed conifer understory leaving 50-200 TPA, 5" and greater; yard tops attached and masticate fuels. This prescription includes post and pole size stands to produce biomass.	4, 5, 9, 10, 11, 12, 19, 23, 24, 28, 34, 36, 37, 39, 41, 48, 76, 77, 84, 85, 94, 116, 120, 134, 137, 138, 143, 146, 151, 155, 171, 177, 185, 189, 195, 200, 201, 203	1,145	0	2,290
4 – Salvage of dead/dying lodgepole pine, retaining 50-200 TPA of the residual green trees; yard tops attached and masticate fuels.	1, 56, 59, 75, 79, 80, 93, 95, 97, 112, 130, 204	375	0	1,875
5 – Understory thinning with fuel mastication or handpiling along roadway.	55, 109, 163, 198, 199	0	347	0
6 – Understory precommercial thinning and masticating fuels along roadways.	13, 14, 16, 17, 20, 21, 25, 26, 27, 31, 33, 40, 74, 125, 127, 128, 131, 142, 148, 150, 153, 154, 165, 166, 167, 168, 169, 172, 173, 175, 179, 186, 187, 188, 190, 191, 192, 196, 197	0	622	0
7 – Understory treatment along highways and escape routes, masticating fuels or handpiling along	35, 45, 47, 49, 50, 51, 52, 57, 58, 69, 71, 78, 92, 99, 101, 103, 110, 111, 119,	0	1,043	0

[6] Firewood sales would be considered in prescriptions 1, 2, 3, and 4 depending on the amount of mortality that develops as the mountain pine beetle infestation progresses.

Prescription #[6]	Units assigned to prescription	Com-mercially treated acres	Non-comm. treatment acres	Volume Removed (thousand board feet)
roadway.	170, 174, 178, 205			
8 – Understory thinning of small trees (whips), pulling slash from around residual ponderosa pine, and underburning.	53	0	14	0
9 – Thin from below in small diameter mixed conifer stands using a mechanical harvester, retaining 50-90 TPA, and grapple piling/burning slash.	2, 7, 8, 15, 86, 89, 113, 118, 144, 160	546	0	5,456
10 – Thin from below in mixed conifer stands dominated by small diameter red and white fir, using cut-to-length harvester retaining 50-90 TPA; masticating or handpiling slash along roadway.	3, 6, 38, 54, 81, 90, 91, 96, 98, 100, 102, 104, 105, 107, 114, 115, 117, 157, 176, 202	1,011	0	10,112
11 – Thin from below in mixed conifer stands with a Douglas-fir and ponderosa pine component using a mechanical harvester retaining 50-90 TPA, and grapple piling/burning slash.	83, 122, 123, 126, 129, 132, 162	418	0	5,440
12 – Thin from below in mixed conifer stands with a ponderosa pine component using skyline yarding retaining 50-90 TPA, and handpiling/burning along roadways at a depth of 2 chains.	158, 161, 193	77	0	771
13 – Thin from below in mixed conifer stands with a ponderosa pine component, using skyline yarding and a mechanical harvester, retaining 50-90 TPA and underburning.	82, 124, 145, 194	195	0	2,529
Totals		**6,990**	**2,026**	**44,771**

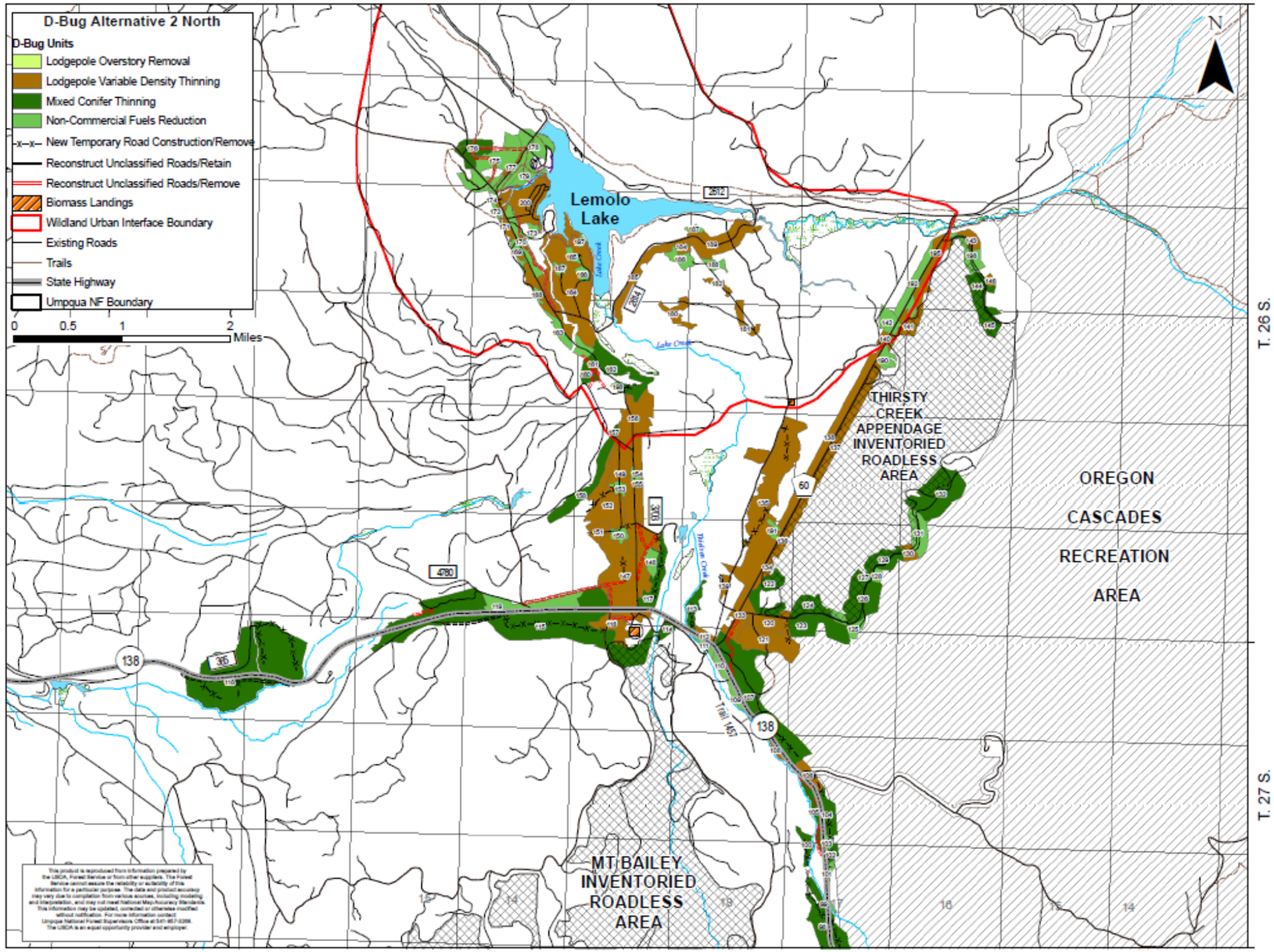


Figure 2-1. Alternative 2 – Proposed Action North Half.

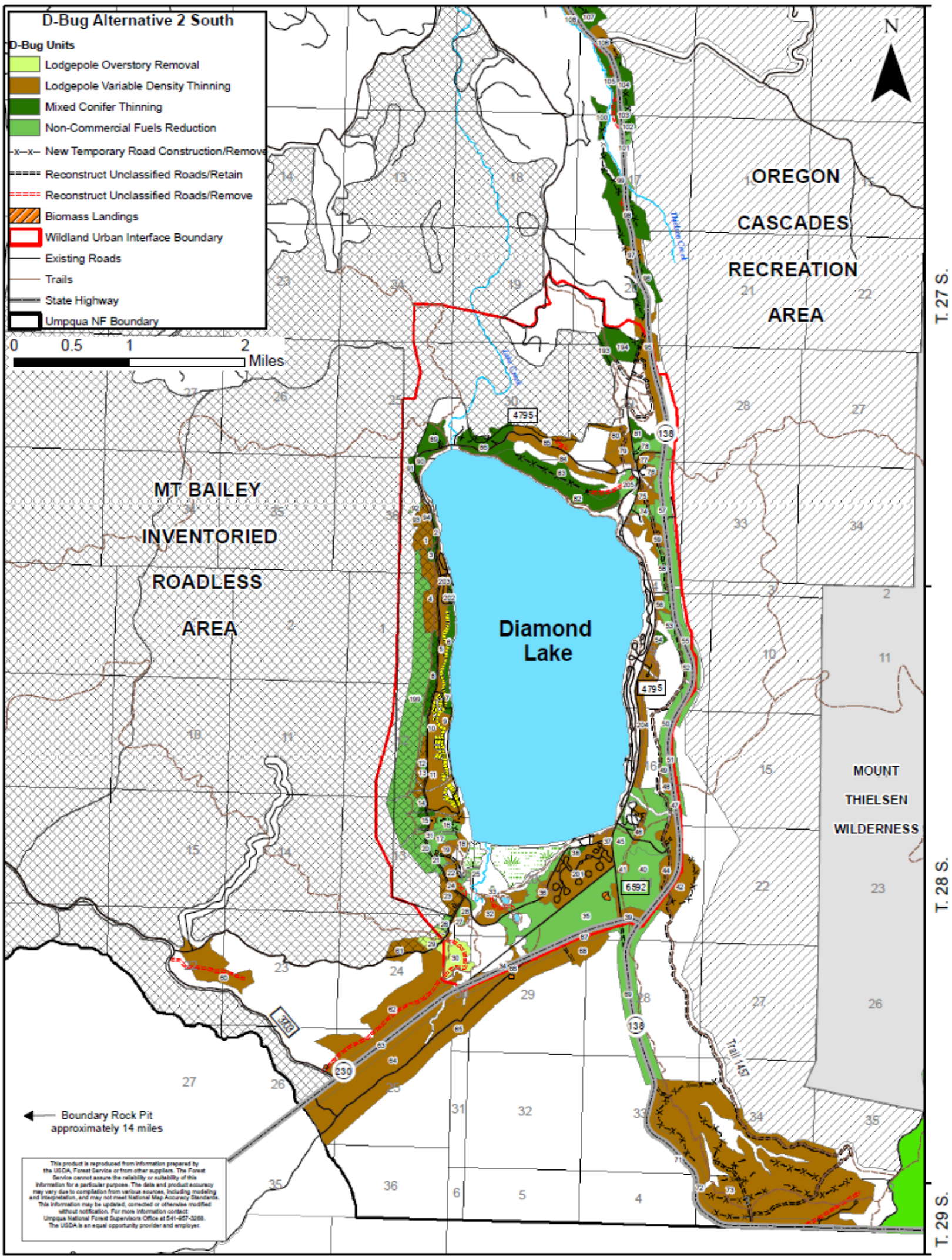


Figure 2-2. Alternative 2 – Proposed Action South Half.

New Temporary Road Construction/Obliteration

The 15.4 miles of new temporary road to be constructed under Alternative 2 would be native surface roads, with rock added at limited locations where soil moisture requires the use of rock to effectively pass log trucks. Temporary roads are typically constructed with a tractor. After logging they would be obliterated with an excavator or bulldozer appropriately equipped to decompact soil, as needed. Any excavated material, including soil and woody material, would be pulled back over the road to re-establish the original contour, as much as possible.

Re-Use of Existing Unclassified Roads and Trails

The 25.6 miles of unclassified roads and trails found in and adjacent to the treatment units were initially built for access into the area and are used as winter snow trails today. Some of these old roads were rocked when they were originally built and are in good condition today with little to no erosion potential or rutting. Most are native (dirt) surface that can become rutted if driven on during wet conditions. These existing roads would be re-used because they would provide cost-effective logging access and because the impacts to the site from road building have already occurred. An estimated 11.1 miles of these existing roads would be obliterated following the stand treatments. In all cases, these roads slated for obliteration are not presently open roads. An excavator would be used to modify the existing road beds to remove any potential erosion problems and, in some cases, to decompact soil in the road beds.

The remaining 14.6 miles of existing roads used for this project are designated either for winter snow-trail use, are a part of the old North Umpqua Highway, or are used for access to other sites. These roads would not be obliterated after use in order to maintain the existing use or the historical values.

System Road Reconstruction

Alternative 2 would include the reconstruction of about 4.7 miles of existing system roads to meet standards and guidelines of the Northwest Forest Plan to minimize the disruption of natural water-flow pathways, and lessen risk of erosion (ROD, C 32-33), while providing for safe, cost-effective timber haul. The reconstruction would be done using heavy equipment such as an excavator, bulldozer, backhoe, road grader, dump truck, and a water truck. Reconstruction would include the following work, listed by road number and mile post (MP):

- 2610-571 (MP 0.0): 0.1 mile, improve intersection with Poole Creek Campground road 2610-570;
- 2614-410 (various locations along route): 0.7 miles, improve alignment;
- 2614-411 (various locations along route): 0.5 miles, improve alignment;
- 4791 - Thielsen Forest Camp (various locations along route): 0.1 miles, fell trees for alignment;
- 4795-300 (various locations along route): 1.4 miles, improve drainage, add/replace culverts;
- 4795-400 – Summer Home Road (various locations along route): 1.2 miles, widen traveled way, place pit run rock at MP 0.35;
- 6000-430 (MP 0.54): 0.1 miles, widen;
- 6000-455 (various locations along route): 0.3 miles, improve alignment;
- 6530-100 (various locations along route): 0.3 miles, improve alignment.

Rock for these reconstruction activities would be generated from the existing Boundary and Lemolo Dam rock quarries. Work at these existing quarries would include drilling, blasting, rock crushing, and hauling of materials. Existing stockpiled material within the pits also would be used.

Excess excavated materials generated by reconstruction would be hauled and dumped at the Oregon Department of Transportation (ODOT) Sand Shed site on road 4700-700.

System Road Maintenance

Alternative 2 would include road maintenance on about 67 miles of existing system roads where timber haul would occur. Maintenance differs from reconstruction in that it consists of more routine work with less site-specific contract requirements. It would be accomplished using a variety of equipment such as a road grader, small bulldozer, dump truck, backhoe, water truck, and a tractor-mounted brusher. The road maintenance under Alternative 2 would include:

- Re-opening and closing (upon completion of haul) currently closed system roads;
- Logging out (removing downed trees, large rocks, slides, etc.) such roads;
- Brushing roads and roadsides;
- Blading road beds, including ditches where needed;
- Cleaning existing culverts at ditch relief and stream crossing locations as needed for proper drainage;
- Hazard tree felling to meet OSHA requirements;
- Applying dust-abatement materials to road surfaces.

Connected Actions

Connected actions are those actions that depend on the proposed action to be implemented, are mitigation or management requirements that may be required to implement the proposed action, and/or are located within the sale area boundary. The connected actions, and how they contribute to meeting the purpose and need, would include:

Table 2-2. Connected Actions Under Alternative 2.

Type of Action	*Element of Purpose and Need Met*
Reforestation: Includes 200 acres of planting sugar/white pine for stand diversity.	Element 1 – Modifying beetle habitat.
Precommercial thinning: Includes pre-commercial thinning 300 acres in the sale area boundaries.	Element 1 – Modifying future mountain pine beetle habitat; Element 2 – Reduce fuel loads
Visual Management: Seeding, planting shrubs and stump flush cutting where needed.	Lowers the short-term impacts to high profile recreation areas.
Noxious Weed Treatment: Includes seeding along roadsides (49 acres), seeding temporary roads and landings (119.7 acres), and managing weeds on acres after project implementation.	Required to meet Standards and Guidelines.
Education: Install interpretive panels to inform forest visitors about the fire risk and bark beetle outbreak in the area.	Located in geographic area.

Similar Actions

Similar actions are located in the general vicinity of the timber sale area (Table 2-3). These actions may or may not contribute to meeting the overall purpose and need, but are actions that are located in the sale area boundary or are in a geographically similar area. Under Alternative 2, the first two similar actions involving road decommissioning have decisions previously made under NEPA in 2006; the D-Bug project may potentially fund these two actions. The third decommissioning project is fully incorporated into this D-Bug NEPA analysis since it is not previously covered under NEPA.

Table 2-3. Similar Actions Under Alternative 2.

Type of Action	Rationale
Road Decommissioning: Includes decommissioning about one mile of road 4795-400 in the summer home tract, south of the Noble Fir picnic area.	Located in geographic area.
Road Decommissioning: Includes decommissioning a stream crossing in the summer home area.	Located in geographic area.
Road Decommissioning: Includes decommissioning 0.8 miles of road 6592-100 (the abandoned segment of the old Highway 230). The crushed aggregate and asphalt would be salvaged and stored in an existing stockpile location south of this road segment for use in future projects.	Located in geographic area.

ALTERNATIVE 5 (TABLE 2-4, FIGURES 2-3 & 2-4)

The Forest developed Alternative 5 to respond to comments received from the public on the DEIS, and further refined the alternative following an additional collaboration period with the public. This alternative is similar to Alternative 3 from the Draft Environmental Impact Statement, but focuses treatments on critical fuelbreaks and evacuation routes.

Under Alternative 5, commercial harvest in the IRAs, the OCRA, and in Potential Wilderness Areas is lowered by 88, 100, and 44 percents, respectively, compared to Alternative 2. New temporary road construction is reduced by 63 percent. In this alternative, the Thirsty Creek and Kelsey Point fuelbreaks are dropped, equating to a reduction of 524 acres of commercial harvest and 92 acres of non-commercial fuel treatments. Also under Alternative 5, the amount of commercial harvest in lodgepole pine is decreased by 36 percent (1,149 acres) relative to Alternative 2.

Specifically, Alternative 5 differs from Alternative 2 by eliminating the lodgepole pine overstory removal prescriptions and adding a hazardous tree removal prescription. Scaling back these commercial treatments reduces the amount and intensity of harvest in lodgepole pine stands, reduces temporary road construction, reduces the use of existing snow-trails for timber haul, and reduces impacts to potential wilderness areas. Alternative 5 also decreases the size of unit 115 to avoid thinning a mixed-conifer area within a narrow, northern finger of the Mt. Bailey IRA near Highway 138. When coupled with the dropped fuelbreaks, these changes would result in 1,670 fewer acres of commercial harvest compared with Alternative 2. The Windigo Pass fuelbreak was expanded in order to provide an effective fuelbreak for Lemolo Lake because the Kelsey Point and Thirsty Creek fuelbreaks were eliminated. Alternative 5 would generate an estimated 29 to 32. million board feet of timber.

Alternative 5 includes the following activities:

- Variable-density commercial thinning of 3,634 acres in lodgepole pine stands, leaving 20-70 TPA interspersed with 10 percent of the area with no treatment; commercial thinning of 1,332 acres of lodgepole-mixed conifer (leaving 50-200 TPA); and commercial thinning of 1,500 acres in mixed-conifer stands (leaving 50-200 TPA). These commercial thinnings include 42 acres along the outer edges of the Mt. Bailey IRA. The lodgepole variable-density thinning would not generate any openings greater than 40 acres in size.
- Salvage of 285 acres of dead and dying lodgepole.
- The thinnings would use ground-based and skyline logging systems in both the matrix and riparian reserve land allocations to generate between 29.8 to 32.5 million board feet of timber.
- Non-commercial removal of fuels on about 2,069 acres by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash. This includes treatment on about 297 acres of stands along the edge of the Mt. Bailey IRA, and 32 acres along the edge of the Thirsty Creek Appendage IRA.
- Biomass utilization could occur on as many as 2,022, depending on the market at the time operations occur. Nine one-to-five-acre landings would be created to process the biomass, if needed.
- Treating activity-created fuels (slash) on all acres commercially thinned by underburning, crushing, machine piling, masticating, or yarding tops attached.
- Re-using about 16 miles of existing spur roads to access thinning areas, then obliterating about 7.4 miles after use.
- Building about 8.1 miles of new temporary spur roads to provide access for logging machinery and for accessing stands for commercial treatments, then obliterating them after use.
- Reconstructing portions of 11 sections of existing system roads (totalling 4.7 miles of road), including road re-alignment, intersection improvement, widening, continuous placement or replacement of surface rock and rock armoring, reshaping road beds, replacing culverts, adding culverts, and hazard tree felling.
- Maintaining about 62 miles of existing system roads (approximately nine miles are currently closed), including the grading and shaping of existing road surfaces, dust abatement, blading road beds and ditches, hazard tree felling, cleaning/maintaining ditches and culverts as needed, isolated placement or replacement of surface rock and rock armoring, opening and re-closing existing closed roads, removing debris from the roadway, and the cutting of intruding vegetation along roadsides.
- Utilizing the existing Lemolo Dam rock pit and the Boundary pit as the rock sources for the road work.
- Amending the 1990 Umpqua National Forest Land and Resource Management Plan (LRMP) in the following areas:
    1. The LRMP assigned Visual Quality Objectives of Retention and Partial Retention along highways 138 and 230, and areas surrounding Diamond Lake and Lemolo Lakes. The LRMP would be amended for this project to

modify these objectives in the short term in order to meet the purpose and need.

2. The LRMP does not permit timber harvest in Management Area 1, except in the event of catastrophic damage and as approved in a vegetation management plan. The Forest Plan would be amended for this project to include commercial timber harvest in MA-1 in order to lower the effects of the ongoing mountain pine beetle outbreak and reduce fuels in the vicinity of the wildland-urban interface area, as recommended in the 2008 Vegetation Management Plan (USDA, Umpqua National Forest, 2008).
3. The LRMP places a size limitation on timber harvest openings (units) that can be created within Management Area 2 around Diamond and Lemolo Lakes. In addition, prescription A4-I for this Management Area does not allow for commercial or personal-use firewood cutting. In order to accomplish effective treatments of adequate size, the LRMP would be amended for this project to allow for timber harvest units greater than one-half acre in size. Also, in order to allow for the removal of dead and dying lodgepole pine, the LRMP would be amended to allow for commercial and personal-use firewood cutting.

Thirteen different silvicultural prescriptions are proposed for Alternative 5. Prescriptions 2-4 and 9-14 include removal of a commercial product, while prescriptions 5-8 include non-commercial treatments. Prescription 1 is not used in Alternative 5. Specific prescriptions, along with the unit numbers and total acreage assigned to those prescriptions, are as follows (Table 2-4):

Table 2-4. Alternative 5 silvicultural prescriptions by individual treatment unit.

Prescription #[7]	Units assigned to prescription	Commercially treated acres	Non-commercially treated acres	Volume Removed (thousand board feet)
2 – Variable density thinning in pure lodgepole pine stands leaving 20-70 TPA, 5" and greater, interspersed with 10 percent of the area with no treatment using mechanical harvest, yard tops attached and masticate fuels.	18, 22, 30, 32, 44, 46, 62, 63, 64, 65, 66, 67, 68, 106, 108, 133, 135, 140, 141, 147, 149, 152, 156, 164, 184, 210, 239, 240, 244, 245 and 246.	2,016	0	10,080
3 – Thin from below, retaining 50-200 TPA in forests with a lodgepole overstory and mixed conifer understory; yard tops attached and masticate fuels. This prescription includes post and pole size stands to produce biomass.	5, 9, 10, 11, 19, 24, 28, 34, 36, 37, 39, 41, 48, 76, 77, 84, 85, 116, 138, 151, 155, 171, 177, 185, 189, 195, 200, 201, 203, 216 and 999.	1,332	0	2,664
4 – Salvage of dead/dying lodgepole pine, retaining 50-	56, 59, 75, 79, 80, 95, 97, 112, and 204.	285	0	1,425

[7] Firewood sales would be considered in prescriptions 2, 3, and 4 depending on the amount of mortality that develops as the infestation progresses.

Prescription #[7]	Units assigned to prescription	Commercially treated acres	Non-commercially treated acres	Volume Removed (thousand board feet)
200 TPA of the residual green trees; yard tops attached, and masticate fuels.				
5 – Understory thinning with fuel mastication or handpiling along roadways.	1, 3, 4, 12, 55, 109, 134, 136, 137, 163, 198, 199, 215, 300, 997, 998, and 999.	0	655	0
6 – Understory precommercial thinning and masticating fuels along roadways.	13, 14, 16, 17, 20, 21, 25, 27, 31, 33, 40, 74, 88, 142, 148, 150, 153, 154, 159, 165, 166, 167, 168, 169, 172, 173, 175, 179, 186, 187, 188, 190, 191, 197, 207, 211, 220, 221, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, and 237.	0	714	0
7 – Understory treatment along highways and escape routes, masticating fuels and handpiling along roadways.	35, 45, 47, 49, 50, 51, 52, 57, 58, 71, 78, 92, 93, 99, 101, 103, 110, 111, 119, 120, 170, 174, 178, and 205.	0	699	0
8 – Understory thinning of small trees (whips), pulling slash from around residual ponderosa pine, and underburning.	53	0	14	0
9 – Thin from below in small diameter mixed conifer stands using a mechanical harvester, retaining 50-90 TPA, and grapple piling/burning slash.	2, 7, 8, 15, 86, 89, 94, 113, 118, and 160.	432	0	4,320
10 – Thin from below in mixed conifer stands dominated by small diameter red and white fir, using cut-to-length harvester retaining 50-90 TPA; mastication of fuels or handpiling along roadways.	6, 38, 54, 81, 90, 91, 96, 98, 102, 104, 105, 107, 114, 115, 117, 157, 176, and 202.	802	0	8,020
11 – Thin from below in mixed conifer stands with Douglas-fir and ponderosa pine components using a mechanical harvester retaining 50-90 TPA, and grapple piling/burning slash.	83, 122, and 162.	101	0	1,313

Prescription #[7]	Units assigned to prescription	Commercially treated acres	Non-commercially treated acres	Volume Removed (thousand board feet)
12 – Thin from below in mixed conifer stands with a ponderosa pine component using skyline yarding retaining 50-90 TPA, and handpiling/burning along roadways at a depth of 2 chains.	158 and 161.	37	0	370
13 – Thin from below in mixed conifer stands with a ponderosa pine component, using skyline yarding and a mechanical harvester, retaining 50-90 TPA and underburning.	82 and 194.	125	0	1,625
14 – Decrease the immediate and likely safety hazards from tree toppling or branch fall from either dead or live trees of all species across roads or trails. Activity fuels will be treated using mastication or handpiling following hazard tree removal.	1, 3, 4, 12, 13, 14, 20, 35, 42, 45, 69, 72, 183, and 199.	0-556*	556	0-2,715*
Totals		**5,130-5,673**	**2,625**	**29,817-32,532**

* The possibility of trees >7” dbh to be decked and sold or fallen, bucked and left on-site for coarse wood. An on-the-ground determination of hazard trees will occur during implementation.

New Temporary Road Construction/Obliteration

The 8.1 miles of new temporary road to be constructed under Alternative 5 would be native surface roads, with rock added at limited locations where soil moisture requires the use of rock to effectively pass log trucks. Temporary roads are typically constructed with a tractor. After logging, they would be obliterated with an excavator or bulldozer appropriately equipped to decompact soil, as needed. Any excavated material, including soil and woody material, would be pulled back over the road to re-establish the original contour, as much as possible.

Re-use of Existing Unclassified Roads and Trails

The 16 miles of unclassified roads and trails found in and adjacent to the treatment units were initially built for access into the area and are used as winter snow trails today. Some of these old roads were rocked when they were originally built and are in good condition today with little to no erosion potential or rutting. Most are native (dirt) surface that can become rutted if driven on during wet conditions. These existing roads and snowmobile routes would be re-used because they would provide cost-effective logging access and because the impacts to the site from road building have already occurred. An estimated 7.4 miles of these existing roads would be obliterated following the stand treatments. In all cases, these roads slated for obliteration are presently closed. An excavator would be used to modify the existing road beds to remove any potential erosion problems and, in some cases, to decompact soil in the road beds.

The remaining 8.7 miles of existing roads used for this project are designated either for winter snow-trail use, are a part of the old North Umpqua Highway, or are used for access for other sites. These roads would not be obliterated after use in order to maintain the existing uses or the historical values.

System Road Reconstruction

Alternative 5 would include the reconstruction of about 6 miles of existing system roads to meet standards and guidelines of the Northwest Forest Plan to accommodate flood flows, minimize the disruption of natural water-flow pathways, and lessen risk of erosion (ROD C-32 & 33), while providing for safe, cost-effective timber haul. The reconstruction would be done using heavy equipment such as an excavator, bulldozer, backhoe, road grader, dump truck, and a water truck. Reconstruction would include the following work, listed by road number and mile post (MP):

- 2614-410 (various locations along route): 0.2 miles, improve alignment, remove northern 0.5 miles of road for access to non-commercial unit;
- 2614-411 (various locations along route): 0.5 miles, improve alignment;
- 4791- Thielsen Forest Camp (various locations along route): 0.1 miles, fell trees for alignment;
- 4795-400 – Summer Home Road (various locations along route): 1.2 miles, widen traveled way, place pit run rock at MP 0.35;
- 6000-430 (MP 0.54): 0.1 miles, widen;
- 6000-455 (various locations along route): 0.15 miles, improve alignment, remove northern 0.15 miles of road for access to non-commercial unit;
- 6530-100 (various locations along route): 0.3 miles, improve alignment.

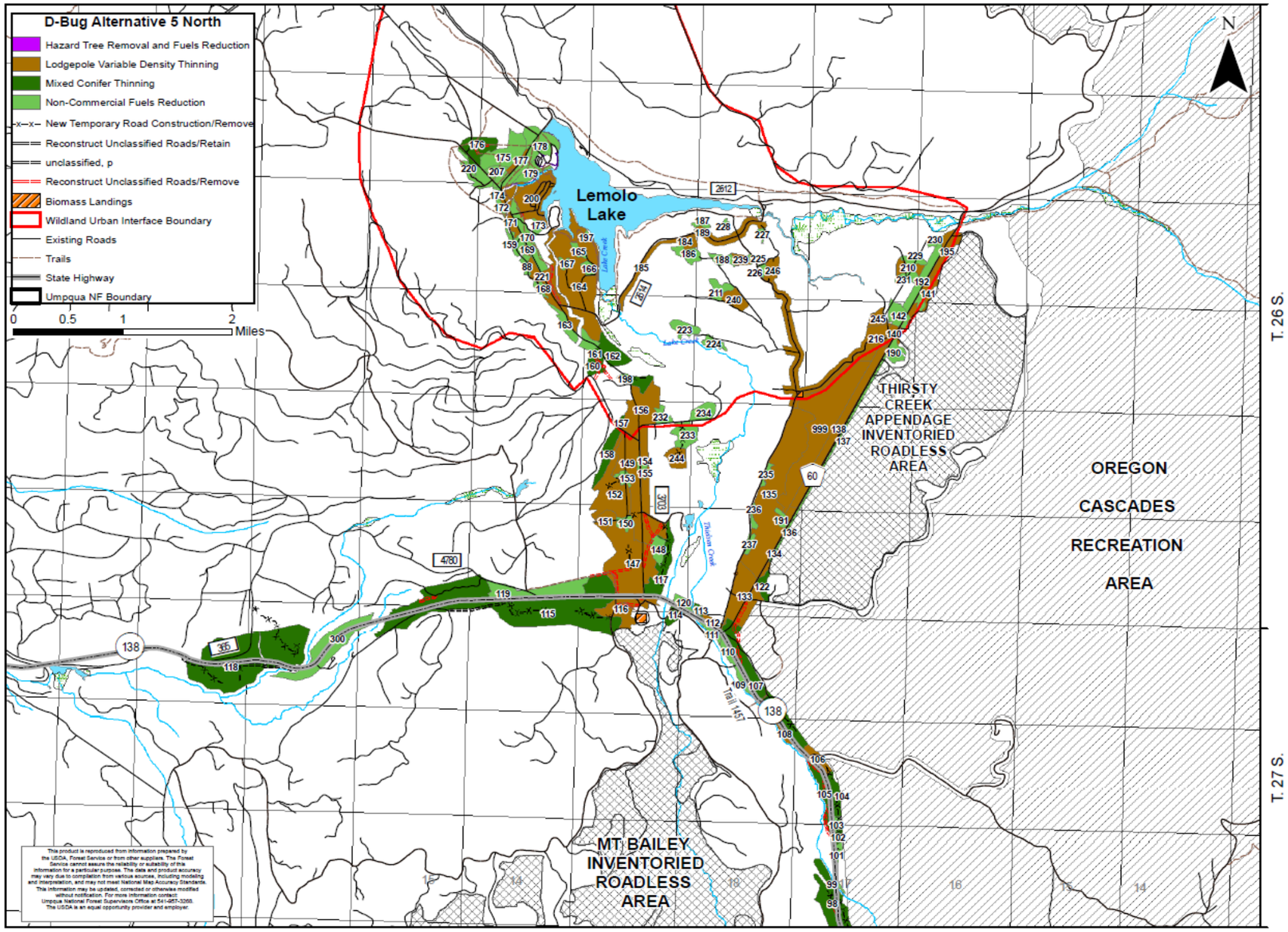


Figure 2-3. Alternative 5 – North Half.

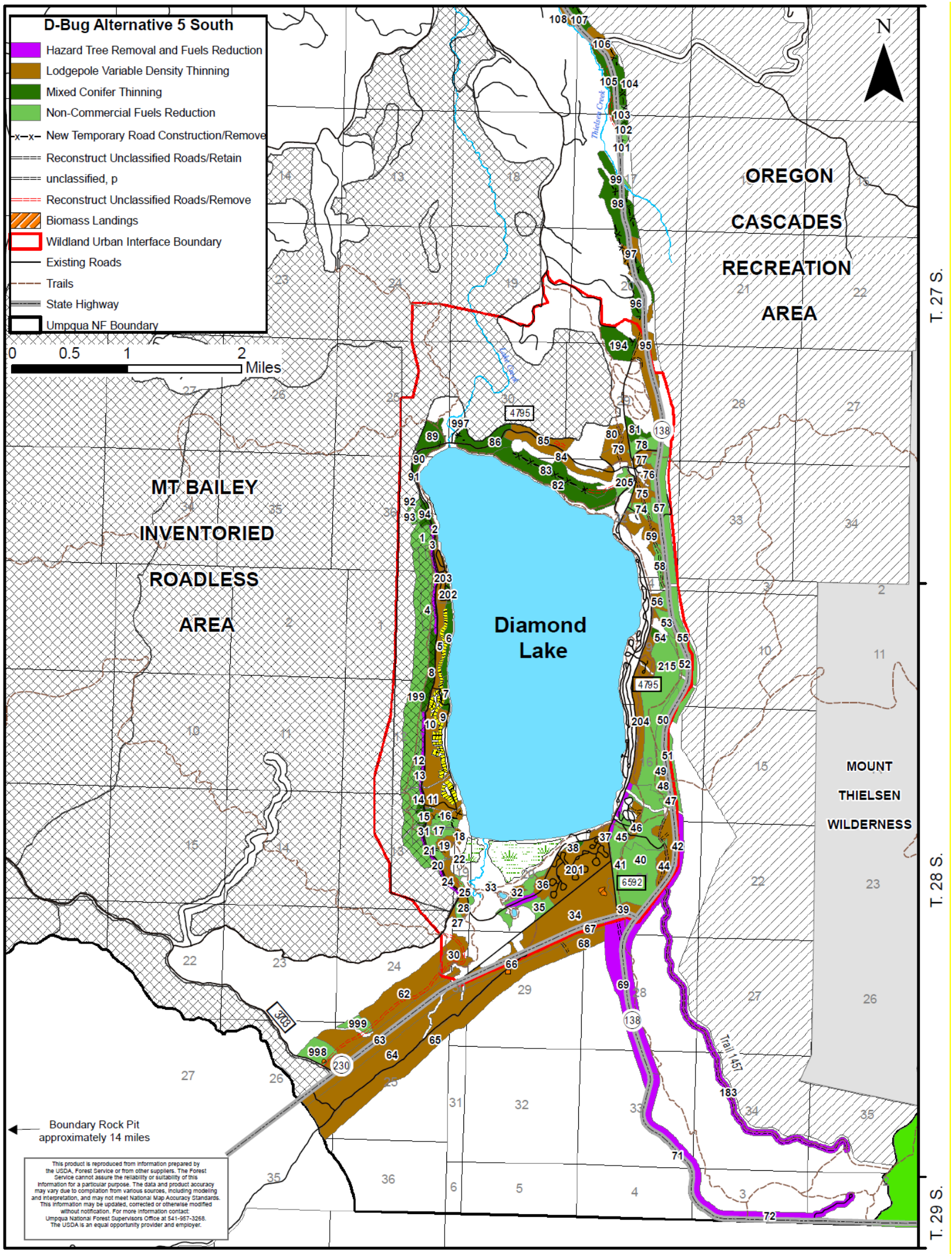


Figure 2-4. Alternative 5 – South Half.

Rock for these reconstruction activities would be generated from the existing Boundary and Lemolo Dam rock quarries. Work at the Lemolo quarry would include drilling, blasting, rock crushing, and hauling of materials, while only hauling would occur out of the Boundary quarry.

Excess excavated materials generated by reconstruction and any slide material removed as part of maintenance would be hauled and dumped at the Oregon Department of Transportation (ODOT) Sand Shed site on road 4700-700.

System Road Maintenance

Alternative 5 would include road maintenance on about 54 miles of existing system roads where timber haul would occur. Maintenance differs from reconstruction in that it consists of more routine work with less site-specific contract requirements. It would be accomplished using a variety of equipment, such as a road grader, small bulldozer, dump truck, backhoe, water truck, and a tractor-mounted brusher. The road maintenance under Alternative 5 would include:

- Re-opening and closing (upon completion of haul) currently closed roads;
- Logging out (removing downed trees, large rocks, slides, etc.) roads;
- Brushing roads and roadsides;
- Blading road beds, including ditches where needed;
- Cleaning existing culverts at ditch relief and stream crossing locations as needed for proper drainage;
- Hazard tree felling to meet OSHA requirements;
- Applying dust-abatement materials to road surfaces.

Connected Actions

Connected actions are those actions that depend on the proposed action to be implemented, are mitigation or management requirements that may be required to implement the proposed action, and are located within the sale area boundary. The connected actions, and how they contribute to meeting the purpose and need, would include:

Table 2-5. Connected Actions Under Alternative 5.

Type of Action	Element of Purpose and Need Met
Precommercial thinning: Includes pre-commercial thinning 300 acres in the sale area boundaries.	Element 1 – Modifying future mountain pine beetle habitat; Element 2 – Reduce fuel loads.
Noxious Weed Treatment: Includes seeding along roadsides (49 acres), seeding temporary roads and landings (105.7 acres) and managing weeds on acres after project implementation.	Required to meet Standards and Guidelines.
Visual Management: Seeding, planting shrubs and stump flush cutting where needed.	Lowers the short-term impacts to high profile recreation areas.
Education: Install three interpretive panels to inform forest visitors about the fire risk and bark beetle outbreak in the area.	Located in geographic area.

Similar Actions

Similar actions are located in the general vicinity of the timber sale area (Table 2-6). These actions may or may not contribute to meeting the overall purpose and need, but are actions that are located in the sale area boundary or are in a geographically similar area. Under Alternative 5, the first two similar actions involving road decommissioning have decisions previously made under NEPA in 2006; the D-Bug project may potentially fund these two actions. The third decommissioning project is fully incorporated into this D-Bug NEPA analysis, because it is not previously covered under NEPA.

Table 2-6. Similar Actions Under Alternative 5.

Type of Action	Rationale
Road Decommissioning: Includes decommissioning about one mile of road 4795-400 in the summer home tract, south of the Noble Fir picnic area.	Located in geographic area.
Road Decommissioning: Includes decommissioning a stream crossing in the summer home area.	Located in geographic area.
Road Decommissioning: Includes decommissioning 0.8 miles of road 6592-100 (the abandoned segment of the old Highway 230). The crushed aggregate and asphalt would be salvaged and stored in an existing stockpile location south of this road segment.	Located in geographic area.

COMPARISON OF ALTERNATIVES

Table 2-7 compares the alternatives by the elements of the purpose and need, the issue indicators, and summarizes other activities and actions that would occur.

Table 2-7. Comparison of Alternatives.

	Alt. 1	Alternative 2	Alternative 5
Element 1 – Pine Beetle Habitat Modification • Acres of susceptible lodgepole treated.	0	4,743	3,634
Element 2 – Fuel loading in WUIs and along WUI Evacuation Routes. • Acres treated within the WUIs. • Acres of treatment along designated evacuation routes (400m).	0 0	3,781 6,225	3,890 5,913
Element 3 – Hazard Tree Reduction • Acres of commercial harvest within developed recreation sites and by private dwellings/businesses.	0	199	199
Element 4 – Improved Fire Resiliency & Stand Vigor • Acres of mixed conifer stands thinned.	0	2,247	1,500
Issue 1 – Plan Amendments • Acres of lodgepole harvested. • Acres of Retention VQO along	0	4,744	3,633

	Alt. 1	Alternative 2	Alternative 5
Highways 138 and 230 moved to:			
○ Partial Retention	0	220	220
○ Modification		265	265
• Acres of Partial Retention VQO along Highways 138 and 230 moved to:			
○ Modification	0	164	164
Issue 2 – IRA/OCRA/Potential Wilderness Areas			
• Acres of commercial thinning in the OCRA.	0	318	0
• Acres of forest treated in the IRAs.			
○ Commercial treatment	0	620	78
○ Non-Commercial treatment	0	345	329
• Acres of treatment in Potential Wilderness Areas (excluding overlap with IRA and OCRA acres)	0	1,515	1041
Issue 3 – Road Building			
• Miles of temporary roads constructed and subsequently obliterated.	0	15.4	8.1
Issue 4 – Impacts of Thinning/Haul on Trails			
• Miles of existing trail used for logging access.	0	8.2	4.9
• Acres of commercial & non-commercial treatment within 200 feet of trails.	0	2,253	2,229
Issue 5 – Fuelbreaks – Effectiveness, Redundancy and Extent			
• Acres of commercial/non-commercial treatments along Thirsty Creek and Kelsay Point fuelbreaks.	0	970	0
• Total acres in roadside fuelbreaks (400m)	0	7,347	6,627
Issue 6 – Lodgepole Pine Prescriptions, Extent of Lodgepole Treatment and Project Economics			
• Acres of lodgepole pine w/20 lg.trees per acre retained	0	59	0
• Acres of lodgepole pine w/40 lg. trees per acre retained	0	4,685	3,634
Extent of Lodgepole Pine Treatment			
• Acres harvested south of Hwy. 230 toward Crater Lake National Park	0	1,660	668
Economic Efficiency			
• Net Present Value	0	-$239,396	-$947,272
• Least Cost to Government (Total Cost/Total Acres Treated)	0	$1,367	$1,121

	Alt. 1	Alternative 2	Alternative 5
Comparison of Activities			
Treatment Types • Total Acres Commercially Harvested • Total acres non-commercial treatment • Acres potentially available for biomass utilization	 0 0 0	 6,991 2,026 2,201	 5,690 2,069 2,022
Estimated Timber Volume Removed (million board feet)	0	44.8	29.8 – 32.5

BEST MANAGEMENT PRACTICES, MITIGATION MEASURES, PROJECT DESIGN FEATURES, AND MONITORING

The following measures apply to all action alternatives unless otherwise stated. These requirements will be implemented in order to meet laws, regulations, and policies. In most cases these requirements have been designed to reduce potential environmental effects.

Mitigation measures are defined as actions that:

- Avoid the impact all together (such as avoiding harvest on unstable land);
- Minimize impacts by limiting the degree or magnitude of the action;
- Rectify the impact by repairing, rehabilitating, or restoring;
- Reduce the impact over time by applying maintenance operations (such as road maintenance).

General Water Quality Best Management Practices (BMPs), symbolized by a checkmark (✓), are mitigation measures prescribed to protect the beneficial uses of water and to address water quality objectives as required by the Federal Clean Water Act and the 1990 Umpqua National Forest LRMP, as amended. Each BMP is listed by the code used in the Pacific Northwest Regional Guide called General Best Management Practices (USDA Forest Service, 1988). A complete BMP checklist is included in the Project Record.

Other mitigations not related to compliance with the Clean Water Act, but required by the LRMP or to further reduce impacts, are indicated by a round bullet (•). Items included to track project design features or prescriptive details are noted with the symbol (**Rx**). Monitoring is delineated by a lightning bolt (⚡).

Contract provisions are noted in parentheses where they apply. Standards and Guidelines (S&Gs) from the Umpqua National Forest LRMP and Northwest Forest Plan are also listed.

CONTROL OF PURCHASER OPERATIONS

BMPs T-5, T-10, T-13, T-14, T-15, T-18, T-19, T-21, T-22, R-3, R-9, R-19, R-20, W-4. VM-2, Forest Plan S&Gs IV-83-3, IV-82-5, IV-61-9.

OBJECTIVE: Enable the Forest Service to exercise control of operations to prevent impacts which could have detrimental results to water quality.

ACTIONS:

✓ Contract preparation and administration will include operating periods, modification language, and control and acceptance of purchaser work (BT6.1 and BT6.35).

✓ The Normal Operating Season (May 1 to October 31) for the sale area will be identified and applied, unless otherwise agreed to by the Forest Service. To prevent damage to water quality during the operating period, restriction of equipment shall be enforced through the use of appropriate Timber Sale Contract (TSC) provisions when conditions for timber harvest, road construction, or road use are such that excessive damage will result. The Umpqua Road Rules, which calls for suspending work when either road or environmental damage such as stream turbidity is predicted, will be enforced. The kind and intensity of erosion control work done by the purchaser shall be adjusted to ground and weather conditions and the need for controlling runoff and soil compaction.

✓ Purchaser erosion control structures and maintenance work must be inspected prior to acceptance by the Forest Service (CT6.6#).

✓ Pollutants from logging or road reconstruction equipment will be kept from entering waterways during servicing or refueling by selecting areas at least 100 feet away from wet areas and surface water, and by using a berm around sites to contain spills. If the volume of fuel exceeds 660 gallons in a single container or a total on site storage of 1320 gallons, a Spill Prevention Control and Countermeasures (SPCC) Plan (BT6.341) is required and the necessary equipment will be on site during operations (BT6.34). The purchaser shall take appropriate preventative measures to ensure that any spill does not enter any stream. Any spill that occurs must be reported to the Contracting Officer.

✓ Roadwork contractors will have spill prevention and recovery equipment on site during all road construction operations as agreed to by the Forest Service.

✓ All landing locations will be approved by the Forest Service prior to landing construction and agreed upon plans for the landing shall insure water quality protection (BT6.422).

✓ Road construction operations and road reconstruction will occur during drier periods.

✓ Timely erosion control measures will be applied to incomplete road and stream crossing projects before the rainy season.

✓ Ground-based operations will be excluded from wetlands and meadows in or near units 18, 19, 22, 28, 32, 34, 95, 97, 162, 164, 185, and 189.

LOGGING PRACTICES

BMPs T-1, T-11, T-12, T-16; Forest Plan S&Gs IV-60-2, IV-60-5, IV-67-1, IV-68-2, IV-176, IV-188, IV-190.

OBJECTIVE: Minimize impacts to water quality and soil productivity from timber harvest to the extent practical through logging practices.

ACTIONS:

✓ To minimize the number of skyline corridors, skyline roads will be about 150 feet apart for the unit interior with the capability to lateral yard 75 feet, or as required in order to protect green trees prior to felling.

✓ Location of all skid trails will be agreed to prior to felling, unless otherwise agreed to in writing (BT6.422), at an average of 100 feet apart.

✓ Locate landings so that timber can be yarded with minimal disturbance to riparian reserves.

✓ Landing size should be no larger than needed for a safe, efficient yarding and loading operation (BT6.422).

• Units 82 and 86 require a 50-foot no cut buffer uphill from the Dellenback Trail to reduce the visual impact from the skyline corridors.

LOGGING EROSION CONTROL MEASURES

BMPs T-3, T-8, T-13, T-14, T-16; Forest Plan S&Gs IV-60-5; IV-65-3, IV-71-13, IV-72-16.

OBJECTIVE: Ensure that any increase in sedimentation is minimized during and after logging or associated activities. Logging methods are described in the project record.

ACTIONS:

✓ Stream course protection will be used on all stream classes (BT6.5).

✓ Erosion control measures will be identified where project areas have the potential to produce erosion/sedimentation that may affect water quality and beneficial uses in surface waters (CT6.6#). The installation/application of appropriate erosion control measures will be applied on designated soil gouges in skyline corridors and on ground based equipment skid trails that may reroute or concentrate runoff in order to spread water and allow for infiltration into the soil.

WATERSHED PLANNING AND MONITORING

BMP W-7.

OBJECTIVE: To monitor the long-term stream temperature trends in the Clearwater River and Diamond Lake watersheds and compare with State Water Quality Standards.

ACTIONS:

✓ Forest long-term stream temperature monitoring sites include Mowich Creek and Lake Creek which are applicable to the D-Bug planning area. The ongoing stream temperature monitoring at these sites is evaluated each year.

TEMPORARY ROAD CONSTRUCTION/OBLITERATION, SYSTEM ROAD RECONSTRUCTION, AND SYSTEM ROAD MAINTENANCE

BMPs R-2, R-3, R4, R5, R-6, R-7, R-9, R-15, R-23; Forest Plan S&G IV-83-6.

OBJECTIVE: To minimize sedimentation, the effects of water concentration on roadbeds, cut slopes or fill slopes, and subsequent production of sediment associated with temporary road construction and road reconstruction/maintenance.

ACTIONS:

✓ All work at stream crossings (on four intermittent channels) will be done during the dry season only.

✓All new temporary roads will be obliterated following use. This will include subsoiling and woody debris placement as feasible.

✓ All new temporary road construction on slopes will be done using outslope designs, with drain dips and grade sags as needed, so that no new ditchlines will be built.

• New temporary roads will be blocked immediately after completion of logging operations, or at the end of the logging season to prevent off -highway vehicle use.

✓ Level 1 aggregate-surfaced system roads to be closed following use will be barricaded and treated with water bars, if needed, to prevent drainage problems. Water bars and barricades will be in place annually prior to onset of the wet season, typically at the end of the Normal Operating Season.

✓ Avoid blading ditches that are functioning and effectively draining.

✓ Waste material generated by road reconstruction and road maintenance activities shall be placed in areas agreed to by the Forest Service. These areas shall generally avoid riparian reserves, and avoid affecting fish, wildlife, cultural, and botanical resources.

✓ Aggregate will be placed on access roads into water sources to reduce sedimentation to streams, as needed.

✓ Surface rock placement may be done outside the normal operating season as weather and road conditions permit, but no surface rock can be added to extend the season of haul on any of the unclassified roads that are to be obliterated after use.

✓ During road reconstruction, relief culvert locations will be located, flagged, and approved by the Forest Service before installation to ensure that water is routed only onto stable soil/vegetation.

✓ Cut-and-fill slopes will have required erosion control treatments completed the same year they are reconstructed, even if they are not completed to final acceptance specifications. If the same area requires further disturbance to complete the road reconstruction, it will be re-vegetated as needed to ensure surface soil protection.

RIPARIAN AREAS AND WETLANDS WITHIN OR ADJACENT TO CUTTING UNITS

BMPs T-4, T-7, T-8; Forest Plan S&Gs IV-60-1, IV-60-4, 5, 6; IV-61-11, IV-33-5.

OBJECTIVE: Establish riparian area protection zones to minimize stream temperature increases, protect channel bank structure, and provide a debris filter for sediment and debris which could enter the channels, and maintain a source of large woody debris for continued stream channel stability and structural diversity.

ACTIONS:

✓ Stream courses and wetlands will be identified on sale area maps.

✓ Wetlands will be protected from microclimate change or ground disturbance by applying no-cut buffers for commercial operations. No logging corridors will be put through wetlands.

✓During the decommissioning of the abandoned portion of old Highway 230, the fill that occurs in the wetland bisected by this road will be completely removed so that hydrologic exchange between the two portions of this wetland will be restored.

✓During ground-based logging, restrict equipment entry within 40 feet of streams and wet areas.

✓ Apply no-cut buffers around all identified water pipes and water lines in order to protect domestic water sources.

✓ Apply no-cut buffers to all perennial streams and lakes as described below:

Perennial Stream	No-cut buffer	Units	Description
Silent Creek	60 ft or slope-break greatest distance	30, 62	Initiation point downstream to tributary confluence
Silent Creek	80 ft or slope-break greatest distance	30	Tributary confluence downstream
Silent Creek	80 ft	25, 28, 32	Lower Silent Creek
Silent Creek Tributary	80 ft	62, 63	Hwy 230 downstream to Tributary confluence
Silent Creek Tributary, east	50 ft	64, 66	Perennial flow initiation to Hwy 230
Silent Creek Tributary, south	50 ft	63, 64	Perennial flow initiation to Hwy 230
Short Creek	60 ft or slope-break greatest distance	45	Initiation point downstream to Forest Rd 4795
Camp Creek	60 ft	44, 45, 47	Perennial flow initiation to Forest Rd 4795
Porcupine Creek	50 ft	51, 52, 204	Hwy 138 above & below; extent of unit 204 to Forest Rd 4795
Spruce Creek	60 ft	56, 57, 58	Extent of these units to Forest Rd 4795
Two Bear Creek	50 ft or to the parallel road; whichever is closest	75, 76, 205	Developed springs downstream to extent of unit 205
Thielsen Creek	60 ft or second slope-break; greatest distance	98*, 99, 100*, 105*, 108, 109, 111, 113	Extent of these units
Lake Creek	60 ft or at slope-break; greatest distance	114*	Near Forest Rd 4700-710 crossing
Lake Creek	100 ft above stream to include buffering ash bank	185	Upstream Forest Rd 2614 crossing
Battery Creek	100 ft	163, 164	Spring initiation to Forest Rd 2614
Battery Creek	50 ft	164	Forest Rd 2614 to channel widens
Battery Creek	60 ft	164	Wider channel segment
Battery Creek	50 ft	164	Narrower channel to Lemolo Lake
Pool Creek	60 ft or slope-break greatest distance	171, 174, 179, 200	Unit 174 extent to Lemolo Lake

Perennial Stream	No-cut buffer	Units	Description
North Umpqua River	300 ft (full Riparian Reserve)	143, 195, 196	Near Forest Rd 6000 crossing
North Umpqua River	300 ft (full Riparian Reserve)	189	Near Forest Rd 2614 crossing
Clearwater River	150 ft (full Riparian Reserve)	115	Spring initiation area
Clearwater River	300 ft (full Riparian Reserve)	115	Near Hwy 138
Clearwater River	Alt. 2: 75 ft or slope-break greatest distance Alt 5: 200 ft	118	Extent of unit (north side)
Lava Creek	Alt. 2: 75 ft or slope-break greatest distance Alt. 5: 200 ft	118	Extent of unit (north side)
Lake	**No-cut Buffer**	**Units**	**Description**
Diamond Lake	50 ft from lake bank or high water	2, 6, 7, 9, 11, 202, 203	Western lake shoreline
Lemolo Lake	50 ft from lake bank	164	Along southwestern shoreline; west of Lake Creek inflow
Horse and Teal lakes	150 ft from lake bank	34	Applies to commercial harvest prescriptions only

* Under Alternative 2, buffer prescriptions for units 98, 100, 105 and 114 include no removal of trees taller than 100 feet within 75 feet of the stream to protect stream shade. Alternative 5 does not include Unit 100.

✓Select intermittent streams will also receive no-cut buffers. No-cut buffers are designed for some intermittent channels where streambanks are susceptible to surface erosion or where commercial thinning is not necessary to meet riparian reserve objectives. Thinning will occur along intermittent channels where the benefits of thinning outweigh the long-term impacts of stand replacement fire. The individual buffer prescriptions for the intermittent channels are stored in the GIS files.

✓ Underburning of Unit 82 within the riparian reserve of Diamond Lake to reduce fuel hazard will be carefully managed to minimize fire intensity and mortality of low fire-resistant species such as hemlock and the younger true fir species. This needs to be balanced with wildlife protection measures in the vicinity of this same unit.

WILDLIFE

• To protect nesting Northern Spotted Owls, prohibit timber harvesting and road construction operations from March 1 to July 15 in mixed conifer stands that contain portions of nesting, roosting or foraging (NRF) habitat (See analysis file for map and GIS file of exact areas).

• Within the mixed conifer stands proposed for treatment in Alternative 2, the portions of stands mapped as NRF habitat will retain a canopy closure of 60% post treatment (Units

115, 118, 144, 145, 146, 152, 158, 176, and 194. See analysis file for map and GIS file of exact areas).

• To protect nesting Bald Eagles the National Bald Eagle Management Guidelines (USDI 2007a) will be followed in units 20, 82, 83, 84, 86, and 199 (additional units may be affected if Bald Eagles move nest site around Diamond Lake). They include:

> Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season (January through August 31st) within 660 feet of the nest.
>
> No prescribe fire activities shall occur during the breeding season (Unit 82) without consulting the planning wildlife biologist to check nesting status of eagles prior to treatment.

• To protect nesting Osprey, nest sites will have a 600 foot operating restriction from timber sale activities from March 1st through August 31st. This will affect units 50, 51, 89, 91, 156, 160, 161, 162, 163, 164, 198, 204, and 215 (see analysis file for map and GIS file).

• In the stands mapped as nesting/roosting/foraging (NRF) habitat for spotted owls, retain existing coarse woody debris (>10 inch diameter) and snags to the extent practical and safe.

• Where feasible, avoid mechanical impacts and movement of large down wood and leave felled snags on site. In particular retain the largest lodgepole snags in units harvesting lodgepole where feasible.

• Per provision C(T)2.35, leave a total of 280 linear feet of logs per acre for down wood mitigation. Logs to be left will be at least 10" in large end diameter and 20' in length to be retained within portions of units containing NRF habitat.

Rx If feasible, in skyline units, retain all trees used as anchors in the skyline operation as long as they do not pose a hazard.

Rx Incorporate existing snag patches (e.g., pine beetle mortality, root-rot pockets, etc.) in the no harvest areas with prescriptions 1 and 2 in all alternatives to be utilized as hiding cover and sources of cavities. When feasible retain large diameter lodgepole trees with mistletoe in the crown for use by wildlife in these no harvest areas.

Rx Retain clumps and individual snags as available. Retain all hollow snags and logs, and snags with existing cavities as much as practical.

Rx OSHA requires that hazardous trees/snags be felled to protect workers on the ground during forest operations. Snags that must be felled for safety reasons should be retained to help attain down wood requirements.

Rx Where feasible in areas treated with mechanical harvest cut hazard trees as high as possible to be retained for wildlife use, except within 50’ of Highways 138, State Route 230 or FR 4795.

ROCK SOURCE DEVELOPMENT

BMPs R-22, R-17

ACTIONS:

✓ Use of the Boundary rock pit will be limited to loading and removal of crushed aggregate from existing stockpiles designated in the timber sale contracts. Disturbance of areas outside the existing pit boundaries will be avoided.

✓ Use of the Lemolo Dam rock pit will be limited to loading and removal of riprap and other pit-run materials from locations designated in the timber sale contracts. Pit area surfaces disturbed by the rock removal activities will be sloped to disperse water and minimize erosion following use. Disturbance of areas outside the existing pit boundaries will be avoided.

SOIL AND SITE PRODUCTIVITY

BMPs T-9, T-12; Forest Plan S&Gs IV-67-1, 2, 3, IV-71-12

ACTIONS:

✓ All new landings and temporary roads used by the purchaser will be subsoiled to increase water infiltration and reduce surface water runoff to streams. Subsoiling will occur to a depth of 20 inches. An exception may be given to areas where the sale administrator determines slash concentrations are too high to allow subsoiling.

✓ Under the timber sale contract, the purchaser will be required to subsoil approximately635 acres under Alternative 2 and 598 acres under Alternative 5. At a minimum, the purchaser will be responsible forall temporary roads, skid trails (to 100 feet of each landing), and all landings used by the purchaser in mechanical harvest to meet soil standards and guidelines.

✓ During the rainy season (November 1 - April 30), no more than one-half acre of exposed soil (S&G#13, LRMP pp. IV-71), including landings, skid trails, and temporary roads, would exist at any time without erosion control that is effective in preventing sediment from reaching streams or any concentrated surface flow in excess of 1.0 cfs. Note: Silt fencing is not effective at flows in excess of 1.0 cfs (Brown, et al., 1986).

✓ Designate and locate skid trails to minimize the area affected by logging operations; use pre-existing skid trails at the discretion of the sale administrator and to the extent feasible.

✓ Maintain at least 65 percent effective ground cover in order to maintain soil productivity and prevent soil erosion.

✓ Where bio-fuel projects are implemented, bio-char (the by-product of bio-fuel production), will be applied to areas where the feedstocks for the bio-fuel project originated to replace the above ground carbon being removed (Draft Wildland Forest Soil Carbon Management, April, 2010, Washington Office memo).

✓ The levels of effective ground cover will be monitored, as funding allows. If monitoring determines that effective ground cover goals are not met, then site-specific recommendations will be developed by a soil scientist and the timber sale administrator. Units around summer homes and lodgepole pine stands shall be given priority for monitoring.

Rx In order to minimize effects to soils, slash piles will be placed on new and existing skid trails and away from waterways and ditches, where practical.

RECREATION, SCENERY AND CULTURAL RESOURCES

Forest Plan S&Gs IV-12-5 (Developed Recreation); IV-14-3, 4 (Dispersed and Unroaded Recreation); IV-17-2 (Trails); IV-29-5 (Cultural Resources); IV-19-1, 2, 4, 5, 6, 8, 10, 12 (Visual Resource).

• Safety signs will be maintained on the main travel routes during logging operations, including highways 138 and 230, and roads 4795, 60, 2610, and 2614. Flaggers will be required when falling trees that may potentially reach any main travel route.

• Trees deemed as a hazard to structures (such as recreation facilities, recreation residences, lodges and associated employee housing/out-buildings) will be identified and may be felled prior to commercial logging operations.

• Effort was made to GPS all known utility lines, water lines, sewer lines, and other infrastructures. Pre-sale and sale administration will consult the GIS shapefile regarding the location of these lines and will work with the purchaser to avoid damaging utility lines.

• Any access road used by special use permitees to access their cabin or developed facility that is used under a timber sale will be returned to pre-logging conditions, at minimum.

• Equipment used for logging and yarding will be restricted to main roads within recreation sites, so as to not damage pavement, unless low PSI equipment can be utilized without damaging pavement. Equipment needing to utilize hydraulic stablizers must use matting or plywood as a ‘cushion’ between the pavement and equipment base.

• In order to provide visitors a positive recreation experience, no operations will be conducted between Memorial Day and Labor Day at the following sites: summer homes/recreation residences, west side of Diamond Lake; South Shore Picnic Site; Broken Arrow Campground; Thielsen View Campground, Poole Creek Campground; and within all special use permit areas (Diamond Lake Resort, Diamond Lake RV Park, and Lemolo Resort).

• For operations near the Dellenback Trail, limit hours of operations to 8 a.m. to 6 p.m., Monday through Friday.

• To accommodate use, detour bicyclists and hikers from the Dellenback Trail onto Forest Road 4795 during times equipment will be operating near the trail. Post safety signs and closures when needed.

• In order to maintain visual quality along the Dellenback Trail in units 82 and 86 where skyline corridors will be apparent, a 50-foot no-cut buffer will be applied north of the bike trail into the units. Hazard trees may be felled and yarded uphill, but not across the bike trail.

• Parallel skyline corridors would be minimized in Units 82 and 86 to maintain the visual quality from Diamond Lake Resort.

• For trails 1410, 1446, 1448, 1451, 1457, 1460, 1460H, 1460J, 1460K, 1460L, 1476, 1481, 1589, 1589L, and 1591, post signs indicating trail closures when operating near (within 200 feet) the trail.

• All trail treads on existing hiking, biking and OHV trails will be rehabilitated to their pre-logging condition by the operator/purchaser.

• To the extent practical, avoid felling trees that have signs or symbols posted on them, such as signs marking cross-country ski or snowmobile routes. In the event a tree with a symbol or sign needs to be felled, contact the sale administrator prior to felling the tree. The sale administrator will work with the district recreation staff to re-post the symbol or sign.

• Post closures as needed at all dispersed recreation sites when equipment will be working in the area.

• In the event that an unknown historic or prehistoric site is discovered in the course of the project, the activity will be stopped and the appropriate measures will be taken to stop any adverse effects to the site resulting from the activity (BT6.24). Any adverse effects, should they occur, shall be mitigated.

• Cultural resource personnel shall be consulted prior to conducting sale layout, sale implementation, and post-sale activities in order to inform other personnel of known cultural resource locations or other areas of concern.

• At several sites within the D-Bug planning area, mitigation measures will be applied and monitoring will be conducted in order to protect known cultural resources. Prior to project implementation, including burning, data will be collected at some sites to monitor the site before activities begin. Sale administrators and layout personnel will be advised of locations of known cultural resources by cultural resource personnel; areas of concern will be flagged prior to activity and/or marking in order to avoid known sites. Operators in specified units will be cautioned by sale administrators to stay out of specified area. Monitoring of these sites will occur as needed.

• Mitigation for known cultural resources includes directional felling, avoidance, fall burning, smoothing tread, and use of low impact techniques.

• Known survey benchmarks and corners will be protected during project implementation.

Rx During pre-work meetings with contractors, the sale administrator will emphasize the need to minimize damage to green leave trees along highways 138 and 230; roads 4795, 2610, and 60; campgrounds and other facilities; and along trails.

Rx Slash treatment in the following units in VQO areas of retention will be prioritized for disposal as soon as feasible to minimize visual impacts. Avoid concentrating piles near or adjacent to high use areas. Units in all action alternatives that this prescription applied include: 1, 2, 3, 5, 6, 7, 8, 15, 35, 45, 54, 76, 77, 78, 81, 86, 89, 90, 178, 199, 202, 203, 205.

• Apply marking paint on the side of trees that face away from major roads and trails.

• To meet visual quality standards, the stumps of harvested trees will be cut to a 6 inch to 8 inch height within 50 feet of Highways 138 and 230; FS roads 4795 and 2610; and within the Broken Arrow and Thielsen View Campgrounds. To meet the Retention VQO, there would be a 50-foot no-cut buffer uphill of the Dellenback trail in Units 82 and 86, and the stumps of harvested trees would be cut to a 6 inch to 8 inch height within 50 feet of the Dellenback Trail in the other units the trail traverses (Units 2, 3, 4, 8, 12, 17, 19, 33, 36, 37, 89, 90, 91). Hazard trees that need to be felled in the above areas may need to be cut to a taller height for safety reasons. As funding is available, these stumps would be cut flat with the bark side of the stump to the road or trail. The stumps would be cut as low to the ground as safety allows, ideally flush cut but not to exceed 6 to 8

inches in height. Hazard trees should be felled away from, not across, the Dellenback Trail (BT6.42, CT6.41).

• Where temporary roads are constructed to enter highways 138 and 230, orient the road at a 90-degree angle from these highways to reduce views into treatment units.

FUEL MANAGEMENT AND AIR QUALITY

BMPs F-1, F-2, F-3; Forest Plan S&Gs IV-68-2, 3 & 4; IV-92-4, 7, 8; NWFP S&Gs C-35 & 36, FM-1, FM-4.

OBJECTIVE: Meet air quality regulations and reduce water quality degradation and soil erosion caused by prescribed fire and other types of fuel treatments. Minimize soil compaction, soil displacement and damage to trees remaining after harvest.

ACTIONS:

✓Hand and grapple piles will be burned under moisture conditions that minimize impacts to soils.

✓ Burn plans would include water quality objectives when appropriate.

✓ Burn plans will be prepared in advance of ignition and approved by the appropriate line officer for each prescribed fire.

✓ Where fireline would be needed on slopes exceeding 30 percent, water bars would be installed. Fireline water bars would deflect surface run-off from the trail down slope onto stable material such as rock surface cover. Fireline construction would generally avoid sensitive areas like unique habitats.

✓ Post-harvest fuels monitoring will take place at a scale deemed appropriate by district fire managers to ensure activity-created fuel loads do not generally exceed those predicted or otherwise present hazardous conditions.

Rx Grapple piles would be constructed to the following specifications: All slash from two inches in diameter up to six inches in diameter and exceeding three feet in length shall be piled. Exclude/remove from pile any piece greater than nine inches in diameter on the small end and greater than six feet in length. Piles would be constructed compactly with minimal soil in the piles and covered to shed water so they remain dry for burning during the fall or winter; height would be at least six feet and no greater than 12 feet; width would be at least six feet and no greater than ten feet. Piles would be evenly spaced between trees and snags left after harvest. Piles would be placed on temporary roads or designated equipment trails, when possible. Piles would be placed at least 50 feet away from live streams and at least 100 feet from the edge of paved roads.

Rx Hand piles would generally be no smaller than four feet in height and no wider than they are tall. Handpiles would be partially covered to create a dry pocket of fuel so that piles would burn in the fall or early winter.

Rx Every effort should be made to encourage biomass removal and use whenever economically feasible, particularly when costs of removal would approximate costs to handpile and burn, or otherwise dispose of, the material.

Rx In treatment units cut via CTL system, about 80 – 90 percent of the activity fuels would be placed on the skid trail and compacted well. In visually sensitive areas, the first 50 feet of the slash mat on skid trails seen from the road would be removed or masticated.

Rx Special emphasis and expense would be placed on reducing activity-created fuel loads within 150 feet of structures or improvements.

• Air quality would be emphasized during prescribed fire planning. Mitigation measures would be considered, including extending the burning season to spread emissions throughout the year. All burning would be planned and conducted to comply with applicable air quality laws and regulations and coordinated with appropriate air quality regulatory agencies.

BOTANY

R-6 Invasive Plant FEIS (USDA Forest Service, 2005a) S&Gs 2, 3, 7, & 13; Forest Plan S&Gs IV-200 (C5-I); Contract Provision B/BT6 35.

ACTIONS:

• Establish a 75-foot no-entry buffer around the *Buxbaumia aphylla* location that occurs between units 130 and 131 and the *Grimmia anomola* location in unit 997.

• Establish a 100-foot, no-entry buffer around all *Gyromitra melaleucoides* sites and a 150-foot no-entry buffer around all other Category B fungi locations.

• Establish a 150-foot no-harvest buffer (Forest Plan S&G IV-200 [C5-I]) around unique habitats to minimize potential impacts. Unique habitats are located adjacent to units 18, 19, 25, 27, 28, 33, 34, 35, 95, 96, 97,162,164,185 and 189.

• Establish a 50-foot no-harvest buffer around the unique habitat at Rabbit Creek adjacent to units 53, 54, 56 and 215.

• Establish a 300-foot no-harvest buffer around the great gray owl meadow habitat south of Diamond Lake adjacent to units 18, 19, 22, 25, 32, 34 and 35 (note that some units that border multiple meadows may have different sized buffers on different sides of the unit. Check project shapefile for specifics).

• Treat known sites of spotted, diffuse and meadow knapweed (*Centaurea stoebe ssp. micranthos, C. diffusa, and C. nigrescens*), as necessary and funded, on haul roads, landings, and skid roads prior to logging activities. Higher priority would be given to sites where there is a threat of moving seed from contaminated to uncontaminated areas. Treatments would be based on the Forest Integrated Weed Management Decision Notice and Finding of No Significant Impact signed in June, 2003. The Forest Service will flag noxious weed sites to be avoided in the higher priority sites, prior to work commencing. Infested sites to be avoided will be marked with florescent orange flagging and labeled “NOXIOUS WEEDS” with black lettering. Forest Service will provide the contractor with a map indicating where the known infestations of Forest Rated “A” noxious weeds and other invasive weeds of concern are located. Contractor will avoid ground-disturbing activities in the flagged and/or staked areas unless otherwise directed by the Forest Service.

• Actions conducted or authorized by written permit issued by the Forest Service that will operate outside the limits of the road prism (including public works and service contracts) require the cleaning of all heavy equipment (bulldozers, skidders, graders, backhoes, dump trucks, etc.) prior to entering National Forest System lands (Prevention Standard 2—Regional Invasive Plants FEIS and B/BT6.35).

• A district or forest weed specialist will inspect active gravel, fill, sand stockpiles, quarry sites and borrow material for invasive plants before use and transport. Use only gravel,

fill, sand, and rock that is judged to be weed free by district or forest weed specialists (including material from commercial sites) (Prevention Standard 7 - Regional Invasive Plants FEIS).

• Treat or require treatment of infested sources before any use of pit material (Prevention Standard 7 - Regional Invasive Plants FEIS). Starting with the highest slopes that have invasive vegetation growing in previously disturbed areas, scrape off the top several inches of soil and rock to remove the entire seed bank. Stockpile this material in a location at the quarry where it would not be disturbed (i.e. no machinery should drive over the pile). This contaminated material would be monitored and covered as necessary to ensure it does not become a future source of weeds at the quarry.

• All personnel, contractors, etc., working on the project will be made aware of the high-priority "A" weeds (specifically spotted knapweed) that could be found during activities; any high-priority noxious weeds found should be reported to the Forest Service.

•Use signs such as "logging use only" to discourage public access to active temporary road construction sites by establishing road closures. Allowing only vehicles involved with the construction on the site will help limit introduction of noxious weed seed.

• After harvest, treat remaining or new infestations of noxious weeds for up to three years following sale closure.

• Use native revegetation techniques to re-establish native plants on sites where weeds are removed as well as in areas where exposed mineral soil provides optimal conditions for weeds to colonize. Native plant materials are the first choice in revegetation for restoration and rehabilitation where timely natural regeneration of the native plant community is not likely to occur (Prevention Standard 13 - Regional Invasive Plants FEIS).

• Seed or plant appropriate native vegetation within all units where there is insufficient ground cover (approximately $\geq$ 15 percent bare ground) immediately adjacent to the edge of the road shoulder of Highway 138 (north of the Highway 230 junction), Forest Service roads 60 and 2610 to discourage weed movement from the road shoulder. Revegetation should extend at least ten feet and up to 25 feet into the stand as conditions warrant.

• Seed all temporary roads and landings north of Highway 230 with native vegetation, as appropriate, within the first season subsequent to completion of activities that require the roads or landings. Stands south of Highway 230 are naturally depauperate of understory vegetation.

• Maintain desirable roadside native vegetation, where feasible. If desirable vegetation is removed to bare mineral soil during blading or other ground disturbing activities, that area must be revegetated, where appropriate and practicable.

• Conduct road blading, brushing and ditch cleaning in areas with high concentrations of invasive plants in consultation with district- or forest-level invasive plant specialists; incorporate invasive plant prevention practices, as appropriate (Prevention Standard 8 - Regional Invasive Plants FEIS). High-priority weed infested sites will be marked with florescent orange flagging and labeled "NOXIOUS WEEDS" with black lettering. Forest Service will provide the contractor with a map indicating where the known infestations of forest-rated "A" noxious weeds and other invasive weeds of concern are located. Contractor will avoid ground-disturbing activities in the flagged and/or staked areas unless otherwise directed by the COR/FSR. Whenever possible, roadside brushing will

be accomplished prior to seed setting of noxious weed species (approximately late June) in noxious weed flagged areas. The intent of this is to stop and/or prevent noxious weed spread and establishment.

• If needed, use weed-free straw and mulch for all projects conducted or authorized by the Forest Service on National Forest System lands. If state-certified straw and/or mulch are not available, then it must be certified, all states, noxious-weed free (Prevention Standard 3 - Regional Invasive Plants FEIS). Note: Because of the aquatic nature of rice, the harvested straw is already considered weed-seed free. The district or forest weed specialist may approve the use of rice straw for some applications.

SILVICULTURE AND VEGETATION MANAGEMENT

BMP T-20

OBJECTIVE: To manage and protect desired vegetation and to reforest all suitable land within five years after regeneration harvest harvesting.

ACTIONS:

✓ Implementation monitoring will occur concurrently during lodgepole pine harvest in variable-density thinning (Rx 2) areas to determine if specifications for live-crown ratio, average tree-retention numbers, aggregated no-treatment areas, and 40-acre size limit on areas with 20 trees per acre are met. If the number of leave trees per acre exceeds plus-or-minus ten percent of the target, remarking or amending the silvicultural prescription will be necessary. No single contiguous area of 20 leave trees per acre can be greater than 40 acres.

Rx Western white pine reforestation activities may occur on approximately 20 percent of overstory removal acreage within lodgepole pine thinning units, if funding is available, on 200 acres in Alternative 2.

Rx Bare root stock will be inoculated with mycorrhizal fungi spores mixed with water and a material such as Terrasorb right before outplanting.

Rx Tree handling will meet Regional standards.

Rx The timber sale contract will require purchasers to apply sporax to the cut stumps of all true firs when more than 25 percent for the leave trees are true fir that are greater than 12 inches in diameter in order to control the spread of *Fomes annosus*

• Mortality of merchantable leave trees from slash burning operations should not exceed five percent in pile burn areas and ten percent in underburn areas.

• Sale Administrators will stress the need to protect residual trees during logging. This measure is especially important when logging the mechanized units during times when leave trees are susceptible to bark slippage.

CHAPTER 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

Introduction

This chapter describes the components and scope of the human environment that may be affected by implementation of the alternatives outlined in Chapter 2. It discloses the potential consequences of implementing each alternative including the mitigation measures, watershed best management practices and management requirements associated with each alternative. A complete description of each alternative is found in Chapter 2.

This chapter presents the scientific and analytic basis for the comparison of alternatives. The effects are discussed in terms of social and environmental changes from the current condition and include quantitative assessments, where possible, as well as qualitative assessments. All discussions are tiered to the 1990 Umpqua National Forest Final Environmental Impact Statement, as amended. In addition, many of the discussions in this chapter utilize the information found in supporting documents such as the 1996 Upper Clearwater and 1998 Lemolo Lake/Diamond Lake Watershed Analyses and the 2008 Vegetation Management Plan/Watershed Analysis (WA) iteration. This chapter also incorporates by reference all reports and analysis prepared by resource specialists, which are summarized in this chapter.

Changes Between Draft and Final

This chapter contains a number of refinements and clarifications, as well as new analysis, based on the addition of Alternative 5 and deletion of alternatives 3 and 4. Details on Alternative 5 and rationale for deleting alternatives 3 and 4 appear in Chapter 2.

The discussion on air quality moved from the “Terrestrial Environment” section to “Specifically Required Disclosures” near the end of this chapter. It was refined to enhance consistency with regional policy.

Changes were made to the OCRA, IRAs, and Potential Wilderness Areas section to clarify differences between areas that meet Forest Service definitions as Potential Wilderness Areas (FSH 1909.12(70)) ,and areas proposed for wilderness by environmental organizations. The potential impacts to both of these areas are disclosed. Because of this only Potential Wilderness Areas 1, 4 and 5 remain in the analysis. Potential Wilderness Area 2 was combined with PWA 5. Areas proposed for wilderness (APW) will be identified separately.

The Forest Plan amendment for timber harvest in the lodgepole pine climax ecoclasses was eliminated from both action alternatives. On further examination, it was determined that National Forest Management Act (NFMA) supported activity in these areas in order to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area to meet overall multiple-use objectives” (16 USC 1604(g)(3)(B)). Futhermore, regulations at 36 CFR 219.27(c)(1-2) support activity in these areas, precluding the need for an amendment. The regulations state that “sales

necessary to protect other multiple-use values or activities that meet other objectives" may occur on lands not suitable for timber production if the Forest Plan supports the action. Furthermore, stands that are in "imminent danger of insect or disease attack" may count towards planned volume, so long as the harvest is consistent with silvicultural and environmental standards. The Forest Plan Standards and Guidelines for Timber/Vegetation Management support harvest on unsuitable lands when needed to enhance other resource objectives, so long as activities are documented in the environmental analysis.

The NFMA determination of significance for changes to Land and Resource Management Plans was updated to take into account new policy appearing in the Forest Service Manual (FSM 1926.51). Also, discussion of the lodgepole pine amendment was removed for the reasons discussed in the preceding paragraph.

Where feasible throughout the FEIS, dates and analyses were updated to reflect the most current available data. Of particular note are: (1) updated maps reflecting the extent of mountain pine beetle infestation, (2) updated Forest Vegetation Simulator runs using the most current dates.

Table numbers 3-10 and 3-11 are intentionally omitted from this chapter.

Activities That May Contribute To Cumulative Effects

Potential cumulative effects are analyzed by considering the proposed activities in the context of past, present, and reasonably foreseeable actions. For this project activities are considered in the entire Diamond Lake and Lemolo Lake fifth-field watersheds[8] and in the Clearwater River Headwaters and Stump Lake sixth-field subwatersheds[9] of the Clearwater River fifth-field watershed. These are the areas where cumulative effects may occur as a result of this project. All alternatives are considered in the context of relevant past, present, and reasonably foreseeable activities in this area[10].

The following relevant[11] past management activities have occurred in the cumulative effects analysis area (Table 3-1).

Table 3-1. Past Management Activities in the Cumulative Effects Analysis Area.

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
Recreational Use	1910 - Present	Diamond Lake Lemolo Lake Clearwater River	Recreational fishing began at Diamond Lake in 1910 when the Oregon Fish Commission began stocking with hatchery trout. The first roads were constructed in the area in the early 1920s and campgrounds were established; boat ramps were

[8] A watershed refers to a land and water area that has all the surface drainage within its boundary converging to a single point. A fifth-field watershed refers to a large area ranging in size from 40,000 to 250,000 acres that encompasses multiple smaller subwatersheds; i.e., the Diamond Lake fifth-field watershed encompasses three subwatersheds.
[9] Sixth-field subwatersheds are subdivisions within large watersheds that generally range in size from 10,000 to 40,000 acres; i.e., Lake Creek is one subwatershed within the larger Diamond Lake watershed.
[10] Cumulative effects are analyzed at scales most appropriate for individual resources.
[11] The Diamond Lake Restoration FEIS contains a very thorough list of all past actions in the Diamond Lake and most of Lemolo Lake watershed and is incorporated by reference; activities such as federal land designation are included in that table, but are not referenced here.

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
			constructed and boat use occurred. Camping, hunting, hiking, and horseback riding were among the other early recreation uses at the lake. A history of recreation use over time is included in the Diamond Lake/Lemolo Lake Watershed Analysis (1998).
USFS Camps	1920 – 1965	Diamond Lake, Diamond Lake	Campgrounds were established and in use by 1920. Facilities eventually included developed campsites, pit/vault toilets, and potable water from springs.
Diamond Lake Shoreline Road	1922	Diamond Lake, Diamond Lake	A road was constructed around the north, west, and south shores of Diamond Lake. The road was completed in 1922 and graveled in 1928.
Diamond Lake Improvement Company	1922 – 1965	Diamond Lake, Diamond Lake	Special use permit issued to Diamond Lake Improvement Company to build a resort at the north end of Diamond Lake. The improvements consisted of a lodge, a store, and several tents.
Diamond Lake Recreation Cabins	1924 – present	Diamond Lake, Diamond Lake	Permits were issued between 1924 – mid-1950s for a total of 102 cabin sites and associated improvements.
North Umpqua Road Construction and Reconstruction	1939, 1964, 1977-1978	Diamond Lake Lemolo Lake Clearwater River	The original road connecting Roseburg and Diamond Lake was completed in 1939, based on an old Indian trail. The surface was originally dirt and rock.
Mechanical and Chemical Control of Tui Chub; Rotenone Treatment of Diamond Lake	1946 – 1955	Diamond Lake, Diamond Lake	Seining and spot rotenone treatments of shallow water areas were implemented to reduce the chub population. Control activities were carried out annually and resulted in the removal of millions of tui chub. Physical improvements constructed in 1953 included a canal and a flow control structure. The rotenone treatment occurred in September 1954 and involved 100 tons of powder rotenone and 275 gallons of liquid rotenone. An estimated 32 million tui chub that totaled 400 tons were killed.
Fish Stocking, Diamond, Pit, and Lemolo Lakes	1910 – 2002	Diamond Lake Lemolo Lake	Fish stocking occurred throughout the lakes with various species.

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
Timber Harvest (regeneration harvest, shelterwood, final removal and commercial thin)	1950 – 1959	Lemolo Lake Clearwater River	A total of 119 acres of regeneration harvest were completed in Lemolo Lake and 566 acres in Clearwater River. Associated activities included road building and slash treatment.
	1960 – 1969	Diamond Lake Lemolo Lake Clearwater River	A total of 35 acres of regeneration harvest were completed in Diamond Lake; 896 acres in Lemolo Lake, and 1,007 acres in Clearwater River. Associated activities included road building and slash treatment.
	1970 – 1979	Diamond Lake Lemolo Lake Clearwater River	A total of 35 acres of regeneration harvest were completed in Diamond Lake; 852 acres in Lemolo Lake, and 1,378 acres in Clearwater River. Associated activities included road building and slash treatment.
	1980 – 1989	Diamond Lake Lemolo Lake Clearwater River	A total of 130 acres of regeneration harvest were completed in Diamond Lake; 1,144 acres in Lemolo Lake, and 2,501 acres in Clearwater River. Associated activities included road building and slash treatment.
	1990 – 1999	Lemolo Lake Clearwater River	A total of 1,623 acres of regeneration harvest were completed in Lemolo Lake, and 652 acres in Clearwater River. Associated activities included road building and slash treatment.
	2000-2008	Clearwater River	A total of 432 acres of regeneration harvest were completed in Clearwater River. Associated activities included road building and slash treatment.
Special Use Permits Burning Pre-commercial Thinning Animal Damage Control Pesticide Use for Mosquito Abatement Diamond Lake Area Improvements	1922 – present	Diamond Lake Lemolo Lake	Special use permits issued by the USFS for Diamond Lake Resort, Lemolo Lake Resort, and the Diamond Lake RV Park.
	1950s to present	Lemolo Lake Clearwater River	Burning occurred throughout the Lemolo and Clearwater Watersheds as follows: 1950s – 444 acres; 1960s – 904 acres; 1970s – 946 acres; 1980s – 725 acres; 1990s – 453 acres; 2000s – 1,644 acres.
	1960s to present	Lemolo Lake Clearwater River	Pre-commercial thinning occurred throughout the Lemolo and Clearwater watersheds as follows: 1960s – 21 acres; 1970s – 13 acres; 1980s – 1,628 acres; 1990s – 259

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
			acres; 2000s – 125 acres.
	1960s to present	Lemolo Lake Clearwater River	Animal damage control occurred throughout the Lemolo and Clearwater watersheds as follows: 1960s – 637 acres; 1970s – 9 acres; 1980s – 696 acres; 1990s – 1,060 acres; 2000s – 550 acres.
	Mid-1960s – 1982	Diamond Lake fifth-field watershed in its entirety	Douglas County officials, permittees, and later the USFS, used malathion and MLO-FLIT for mosquito abatement in the Diamond Lake area. Chemicals were applied to South Shore Marsh and to areas around the lakeshore.
	1968 – 1972 Mid 1980s to early 1990s	Diamond Lake	Major water and sewer facilities were constructed to reduce water quality impacts to Diamond Lake in the late 1960s. In the 1980s, other improvements were made including construction of the paved Dellenback Bike Trail.
PacifiCorp Operations	1950s - Present	Lemolo Lake, Poole Creek	Lemolo 1 project is a portion of the North Umpqua Hydroelectric Project. Physical project structures include Lemolo Dam, Lemolo Reservoir (454 acres), 16,705 feet of waterways (canals), 7,328 feet of penstock, a power plant, and a substation. Associated improvements include maintenance/access roads, forebay construction, and transmission/distribution lines.
Hazard Tree Falling	1970s – Present	Diamond Lake Lemolo Lake Clearwater River	Hazard tree falling around roads and campgrounds has occurred over the past 30+ years.
Herbicide Use for Road Maintenance Purposes	1980 – 1983	Diamond Lake, Diamond Lake East Diamond Lake South	Herbicides were used by Douglas County officials along Highway 138 to clear vegetation from road shoulders. Chemicals used included Cimizine, 2, 4 Dichlorophenol, and Trichlopyr.
Snowcat Skiing	1981 – present	Diamond Lake, Diamond Lake West Silent Creek	A snowcat skiing operation was created to offer expert skiers a backcountry skiing experience.
Lemolo Fuels Reduction Project	1998 – 2002	Lemolo Lake, Calamut Lake Lake Creek	A fuels reduction project was completed by the Diamond Lake RD fire staff. A total of 1,432 acres were treated on Bunker Hill and along roads #2610,

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
		Poole Creek	2614, 2612, and 60.
Diamond Lake Fuels Reduction Project (Phase I and II)	1998 – 2002	Diamond Lake, Diamond Lake	Fuels reduction projects completed by the Diamond Lake RD fire staff. Natural fuels were treated in the vicinity of Diamond Lake, mostly focusing around the campgrounds, the Lodge, the RV park, and summer homes.
Fire Camp Improvements	2002-2003	Diamond Lake, Diamond Lake South	Improvements were made to the Broken Arrow Campground Overflow Area to provide a site for expanded fire camps. Improvements included rocking existing roads, spreading woodchips on high use areas, and clearing areas for parking. The fire camp area was used for the Kelsay Fire in 2003.
Diamond Lake drawdown, fish netting, and rotenone treatment; fish restocking	2005 – 2006 2007 - 2008	Diamond Lake, Diamond Lake	Drawdown of the lake by about 8 feet to prepare for rotenone treatment to remove tui chub from the lake. Other connected actions included removing debris from the boat docks, temporary boat dock construction and other activities as described in the Diamond Lake FEIS. In July of 2006, contract netters removed thousands of fish from Diamond Lake. In the fall of 2006, Diamond Lake was treated with rotenone to kill all fish. The lake was then refilled that winter and fish were restocked in 2007/2008
Lemolo Watershed Projects	2006 – Present	Lemolo Lake, Lake Creek Calamut Creek	The Lemolo Watershed projects involved several timber sales and associated road building and restoration.
Diamond Lake Viewpoint	2005 - 2007	Diamond Lake, Diamond Lake East	A Scenic Byway Enhancement Project was constructed to give visitors a place to enjoy the scenery and rest, picnic, etc.
Herbicide Use for Noxious Weeds	2008-2010	Diamond Lake, Diamond Lake East Diamond Lake South Lemolo Lake, Lake Creek, Poole Creek	The herbicide Picloram is being used by the Oregon Department of Agriculture along roadsides to control spotted and diffuse knapweed populations. Picloram is spot-sprayed on individual plants or groups of plants. A total of 422 acres were treated in 2009.

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
Diamond Lake Paving Project (Phase II)	2008-2009	Diamond Lake, Diamond Lake South Silent Creek Lemolo Lake, Lake Creek	A paving overlay is planned for the south end of the Diamond Lake Loop Road and at the Lake Creek crossing.
Lemolo Watershed Project Activities	2008-2009	Lemolo Lake, Calamut Lake Lake Creek Poole Creek	The Lemolo Watershed projects involved several timber sales and associated road building and restoration.
Lemolo Lake Fuels Reduction Project	2010	Lemolo Lake, Lemolo Reservoir	Thinning for hazardous fuels reduction occurred on 74 acres in 2010.

There are multiple ongoing activities that may contribute to cumulative effects for the D-Bug Hazardous Fuels Reduction Timber Sale Project. Table 3-2 displays relevant present activities within the cumulative effects analysis area.

Table 3-2. Present Management Activities in the Cumulative Effects Analysis Area.

Activity	Location (5th, 6th Field)	Description and Extent of Activity
Diamond Lake Natural Fuels Project	Diamond Lake, Diamond Lake	An ongoing fuels reduction project is being completed by the Diamond Lake RD Fire Staff. The project will total 876 acres of treatment in the vicinity of Diamond Lake, mostly focusing around the campgrounds, the Lodge, the RV park, and summer homes. Some of this planned work will be replaced with treatments under the D-Bug project.
Hydrologic and Fishery Monitoring	Diamond Lake, Diamond Lake Lemolo Lake, Lake Creek	ODF&W is monitoring the Diamond Lake fishery; water quality monitoring continues throughout the watersheds.
Hazard Tree Removal	Diamond Lake and Lemolo Lake fifth-field watersheds in their entirety	A Title II (PAYCO) funded project is being implemented. This project removes approximately 2,000 trees in the Diamond Lake area. Hazard trees will continue to be removed from areas of high recreational use and when localized events (blowdown, bugkill, fire, etc.) require tree removal for safety and/or structure protection purposes.
Herbicide Use for Noxious Weeds	Diamond Lake, Diamond Lake East Diamond Lake South	The herbicide Picloram is being used by the Oregon Department of Agriculture along roadsides to control spotted and diffuse knapweed populations. Picloram is spot-sprayed on individual plants or groups of plants.

Activity	Location (5th, 6th Field)	Description and Extent of Activity
	Lemolo Lake, Lake Creek Poole Creek	
Lemolo Lake Fuels Reduction Project	Lemolo Lake, Calamut Lake, Lake Creek, Poole Creek	An ongoing fuels reduction project is being completed by the Diamond Lake RD fire staff. The project totals 1,432 acres of treatment on Bunker Hill and along roads #2610, 2614, 2612, and 60.
Maintenance Activities	Diamond Lake, Lemolo Lake, and Clearwater River fifth-field watersheds in their entirety	Maintenance activities are ongoing. Maintenance is required for trails, roads, culverts, buildings, water and sewer systems, campground facilities, and signs.
PacifiCorp Operations	Lemolo Lake, Poole Creek	Lemolo 1 project is a portion of the North Umpqua Hydroelectric Project. Physical project structures include Lemolo Dam, Lemolo Reservoir (454 acres), 16,705 feet of waterways (canals), 7,328 feet of penstock, a power plant, and a substation. Associated improvements include maintenance/access roads and transmission/distribution lines.
Recreational Use	Diamond Lake, Lemolo Lake, and Clearwater River fifth-field watersheds in their entirety	Recreational use in the area is down from historic levels, but is the highest on the Umpqua National Forest and is improving since the 2006 rotenone treatment. USFS campgrounds, Diamond Lake Resort, Diamond Lake RV Park, and the summer homes have a total capacity of 780 available units. The most common recreational activities include sightseeing, hiking, camping, fishing, bicycling, boating, swimming, hunting, backcountry skiing, and snowmobiling.
Water Rights	Diamond Lake, Lemolo Lake	Water rights issued in the past continue to be utilized.

Reasonably foreseeable actions in the analysis area can also contribute to cumulative effects (Table 3-3). No private land is located in the Diamond Lake, Lemolo Lake or Clearwater Watersheds. For the Umpqua National Forest, the following activities are likely to occur over the next five years.

Table 3-3. Reasonably Foreseeable Management Activities in the Cumulative Effects Analysis Area.

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
Campground Improvements	2010 on	Diamond Lake and Lemolo Lake fifth-field watersheds in their	Campground improvements will be made as funding from PAYCO, Fee Demo, PacifiCorp, and other sources

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
		entirety	becomes available. The area occupied by the current facilities will not increase as a result of improvements.
Diamond Lake Fuels Reduction Project (Phase II)	2010	Diamond Lake, Diamond Lake	Completion of the Diamond Lake Fuels Reduction Project (Phase II).
Fire Camp	2010 on	Diamond Lake, Diamond Lake South	The recently improved South Diamond Firecamp (located south of Broken Arrow Campground) will be used if large fires occur in the area and extensive suppression efforts are applied.
Fishery and Water Quality Monitoring	2010 on	Diamond Lake, Diamond Lake Lemolo Lake, Lake Creek	ODF&W will continue to monitor the Diamond Lake fishery. Water quality will continue to be monitored.
Fish Stocking, Diamond Lake	2010 on	Diamond Lake, Diamond Lake	Fish stocking activities will continue at Diamond Lake.
Fish Stocking, Lemolo Lake	2010 on	Lemolo Lake, Calamut Lake Lake Creek Poole Creek	Fish stocking will continue with rainbow trout hatchery catchables, as needed, to provide a recreational fishery during the mid-summer months when brown trout are hard to catch.
Hazard Tree Removal	2010 on	Diamond Lake and Lemolo Lake fifth-field watersheds in their entirety	Hazard trees will continue to be removed in the future from areas of high recreational use and when localized events (blowdown, bugkill, fire, etc.) require tree removal for safety and/or structure protection purposes.
Herbicide Use for Noxious Weeds	2010 on	Diamond Lake, Diamond Lake East Diamond Lake South Lemolo Lake, Lake Creek Poole Creek	Herbicides will continue to be used by the Oregon Department of Agriculture along roadsides to control spotted and diffuse knapweed populations. The chemical used in the past has been Pickloram and has been spot-sprayed on individual plants or groups of plants.
Lemolo Watershed Project Activities	2012	Lemolo Lake, Calamut Lake	The Lemolo Watershed projects involve several timber sales and associated road building and restoration. This project will continue to be implemented.

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
Maintenance Activities	2010 on	Diamond Lake and Lemolo Lake fifth-field watersheds in their entirety	Maintenance activities will continue at current levels. Maintenance activities include trails, roads, culverts, buildings, water and sewer systems, campground facilities, and signs.
PacifiCorp Operations	2010 on	Lemolo Lake, Poole Creek	Lemolo 1 project is a portion of the North Umpqua Hydroelectric Project. Physical project structures include Lemolo Dam, Lemolo Reservoir (454 acres), 16,705 feet of waterways (canals), 7,328 feet of penstock, a power plant, and a substation. Associated improvements include maintenance/access roads and transmission/distribution lines. Hazard tree falling will continue.
Recreational Use	2010 on	Diamond Lake and Lemolo Lake fifth-field watersheds in their entirety	Recreational use in the area is likely to continue at or above current levels, which is the highest on the Umpqua National Forest. The most common recreational activities include sightseeing, hiking, camping, fishing, bicycling, boating, swimming, hunting, backcountry skiing, and snowmobiling.
Water Rights	2010 on	Diamond Lake, Diamond Lake Lemolo Lake, Lake Creek	Water rights issued in the past will continue to be utilized.
Diamond Lake Restoration Project Specific Monitoring Activities	Until 2011	Diamond Lake and Lemolo Lake fifth-field watersheds	Appendix BB of the Diamond Lake Restoration Project FEIS provides a detailed description of monitoring activities that would occur in association with Alternative 5 of the FEIS. The project record contains similar information for Alternative 4.
Winter Snowparks	2010-2011	Diamond Lake	Two snoparks will be improved: Cinnamon Butte (located immediately off of Highway 138 at the junction of Road 4793), and Three Lakes (located off of Highway 230 off road 3703).
Lemolo Pine Health Maintenance Burn	2011-2012	Lemolo Lake	Two units will be burned to maintain historic fire regime conditions and pine health. The units total 89 acres.
Umpqua Travel Management Plan	2010 on	Forest-wide	The Forest will designate routes and areas authorized for motorized use consistent with the Final Travel

Activity	Time Period	Location (5th, 6th Field)	Description and Extent of Activity
			Management Rule.

Terrestrial Environment

A detailed description of the terrestrial environment can be found in the 2008 Vegetation Management Plan and Watershed Analysis Iteration for Diamond and Lemolo lakes (USDA, Umpqua National Forest, 2008). Site-specific field work and analysis for this project produced additional information, which is provided in the following sections.

Two spatial scales are used in many of the following discussions: (1) the landscape scale; and (2) the stand scale. The landscape scale focuses on larger-scale conditions such as forest vegetation patterns as seen from an airplane over thousands of acres. Satellite imagery and landtype maps were used to characterize vegetation and landforms at the landscape scale. The stand scale refers to areas several to hundreds of acres in size. Stand exams and other field data were used to characterize vegetation conditions at the stand scale. Existing and future conditions were quantified and modeled using this stand exam data and the Forest Vegetation Simulator Model (Dixon, 2003) and Fire and Fuels Extension to the Forest Vegetation Simulator Model (Reinhardt and Crookston, 2003).

FOREST VEGETATION - TRACKED AS A SIGNIFICANT ISSUE

During scoping, issues were raised about the extent and intensity of treatments in mature lodgepole pine (*Pinus contorta*) stands. During the comment period, several commenters expressed concern over the size of the harvest units and the intensity of the heavy thinning, due to potential detrimental impacts to wildlife habitat. This significant issue was addressed with the development of Alternative 5 and is tracked by acres of lodgepole pine harvested with 20 large[12] trees per acre (TPA) retained and acres of lodgepole thinning with an average of 40 large TPA retained (Table 2-7). The effects of the extent and intensity of thinning for both action alternatives are disclosed in this section. The scientific controversy surrounding the use of thinning to prevent and suppress a mountain pine beetle epidemic also is discussed in this section.

Existing Landscape Conditions

The D-Bug planning area landscape was broadly classified in terms of both successional stage and forest type using raster data (LEMMA, 2010), 2006 and 2008 National Agriculture Imagery Program (NAIP) aerial imagery, and landtype maps. Successional stage and forest type classifications were subsequently validated using field reconnaissance, aerial imagery, landtype maps, and stand exam data analyses.

12 Large lodgepole pine trees are defined here as those five inches or larger in diameter at breast height (dbh).

Existing Landscape Conditions – Successional Stages

Forest age-classes[13] that develop following a major disturbance, such as stand-replacing wildfire or clearcutting, are used to characterize current conditions across the landscape (Figure 3-1).

1. Early seral - Young stand with an open canopy. Stand age is generally less than 30 years, but can be older, especially in the high-elevation, cold/dry sites where canopy closure is delayed 10 to 20 years or more on average.
2. Stem exclusion - Stand with full site occupancy, where new species do not appear and some present species are dying due to competition or understory shading. Stand age is generally from 40 to more than 100 years, the average tree diameter is about 10" dbh, and canopy cover is ≥53 percent.
3. Mature - Stand where trees reach their maximum height potential. Stand age is generally from 80 to 150 years, the average tree diameter is 10 to 19" dbh, and canopy cover is ≥53%. This stage includes the "understory re-initiation stage", where the understory develops in response to small openings in the canopy (Oliver and Larson, 1996) and the "transition stage", defined in the Northwest Forest Plan as transitioning toward late seral.
4. Late seral - Stand with overstory trees dying in an irregular fashion and with understory trees filling the gaps. Stand age is generally more than 150 years, average tree diameter is ≥20" dbh in low-elevation, mixed conifer stands, and conifer canopy cover is ≥70 percent. Late seral includes the "shifting gap" stage (USDA/USDI, 1994).

The forest vegetation age class distribution across the D-Bug planning area is predominantly characterized by the stem exclusion stage (46 percent of the landscape). Mature (27 percent) and late seral (24 percent) age classes represent a substantial proportion of the landscape, while early seral vegetation comprises two percent of the planning area. Sparsely vegetated areas account for just one percent of the planning area landscape. Non-forested portions of the planning area (land not conducive to conifer establishment, such as land dominated by rock and water) were not included into the above age class calculations.

Existing Landscape Conditions – Forest Types

The D-Bug planning area landscape also was classified in terms of dominant forest type and species composition using raster data (LEMMA, 2010). Forest types were defined according to tree species dominance (comprising greater than 75 percent of the basal area for trees 3" dbh and greater within each 30-x30-meter GIS pixel; Figure 3-2). The planning area landscape is stratified into two distinct forest types (differing mostly with respect to site productivity and associated species composition): the lodgepole pine forest type and the mixed conifer forest type. These forest types were further characterized using plant series and plant association classifications for

[13] Forest age-classes were developed to model an even-age succession stage in mixed conifer forests. Applying this classification to the lodgepole forest type in the high Cascades is problematic for the following three reasons: (1) The stem exclusion stage is often very long and dominance is not well expressed; (2) the mature stage is often shortened because lodgepole is not long-lived; and (3) the mature stage often has a mean dbh less than 10 inches. Thus, satellite imagery classifies many mature lodgepole pine stands as the stem exclusion stage age class in the planning area.

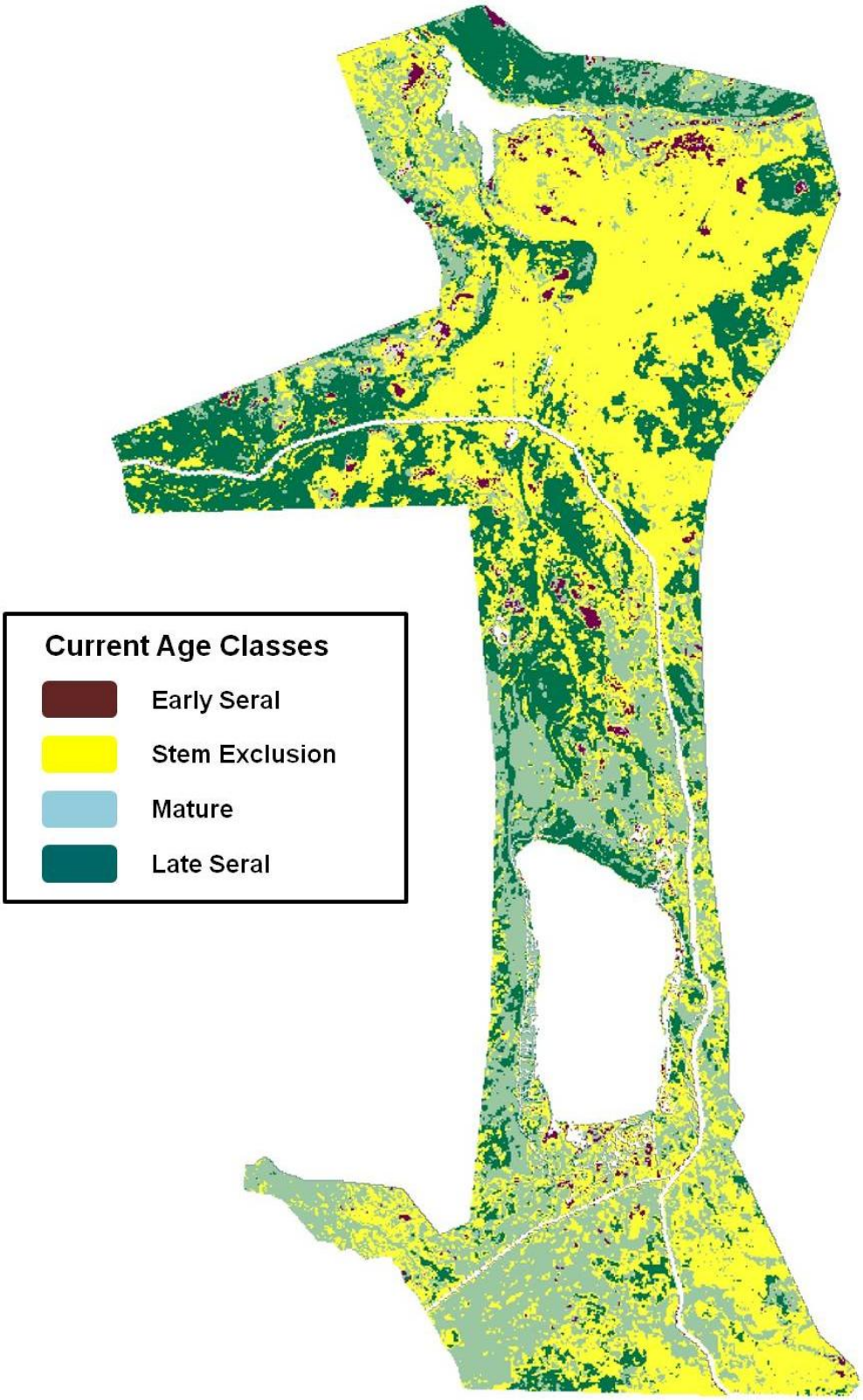


Figure 3-1. Current distribution of age classes across the D-Bug planning area landscape. Most mature lodgepole stands are classified as the stem exclusion stage because of the small average diameter of lodgepole at maturity.

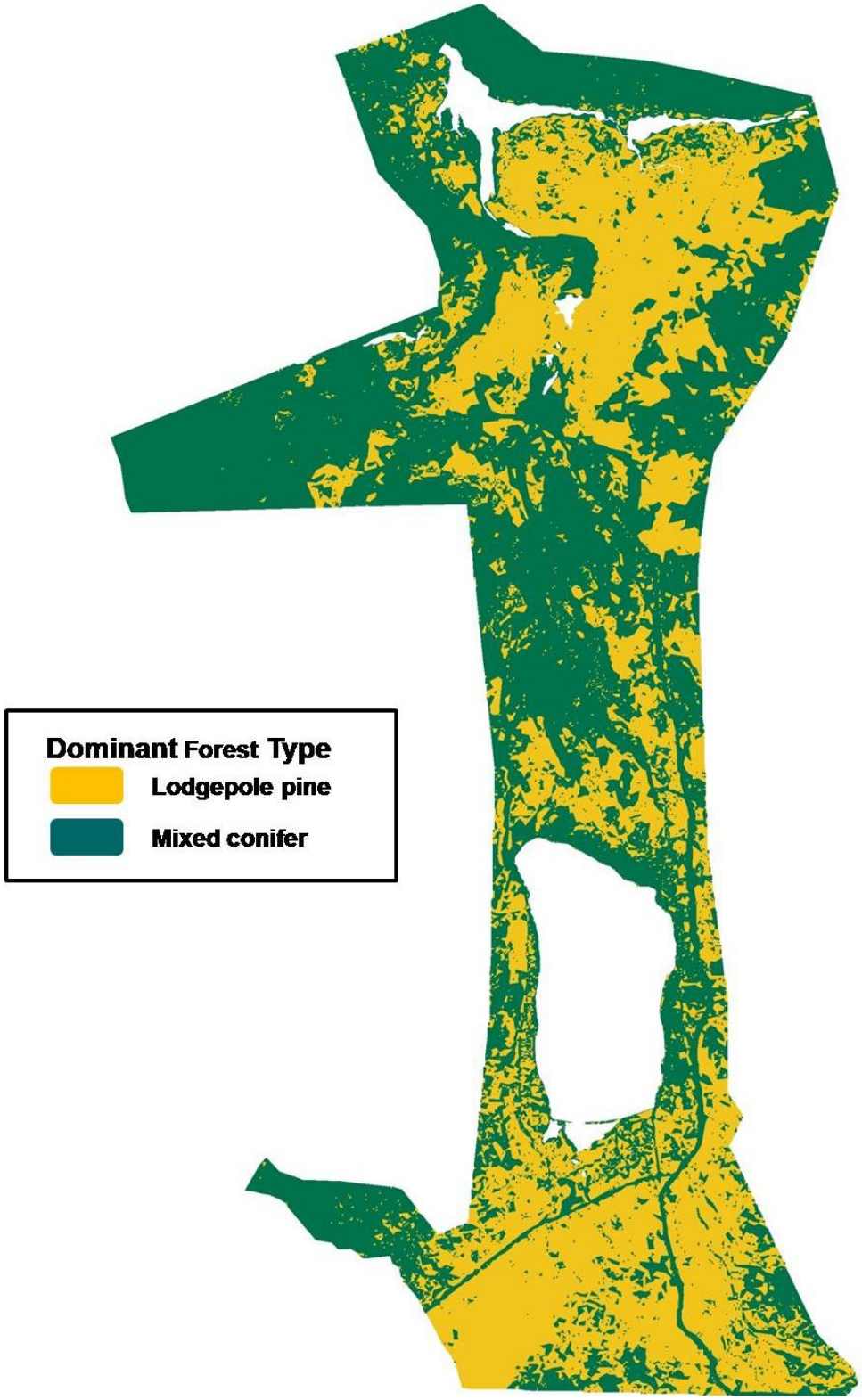


Figure 3-2. Current distribution of forest types across the D-Bug planning area landscape. The mixed conifer forest type represents multiple conifer species, including Douglas-fir, true fir and hemlock species, while the lodgepole pine type is dominated by lodgepole.

existing vegetation to describe the potential natural vegetation (the climax vegetation conditions that would be present in the absence of disturbance) across the landscape (USDA, 1996). Potential natural vegetation classifications include two levels, the broader division of the plant series (based on the dominant, most shade tolerant, regenerating tree species on site) and the finer division of plant associations within the plant series (patterns of presence or absence and abundance of plant species; USDA, 1996).

The mixed conifer forest type is dominant across the D-Bug planning area, comprising 57% of the landscape. This mixed conifer forest type includes warm/dry, low elevation forests below 5,000 feet which are dominated by Douglas-fir and white fir and cool/dry, high-elevation forests above 5,000 feet which are dominated by mountain hemlock and Shasta red fir. In addition, some mixed conifer forests at both low and high elevations are dominated today by lodgepole pine, the pioneer tree after stand replacement fire, with mixed conifer in the understory.

The lodgepole pine forest type represents cool, dry forests with both an overstory and an understory dominated by lodgepole pine, accounting for the remaining 43 percent of the planning area. This forest type occurs primarily on the pumice flats, associated with cold air drainage patterns, shorter growing seasons, colder average temperatures, and low-productivity growing sites. Topographic depressions driving cold air drainage patterns can affect stand regeneration capability as well as vegetation composition in both the overstory and understory. These areas of cold air drainage often serve as transition zones between lodgepole pine and mixed conifer forest types, with localized cold air pockets favoring the more tolerant lodgepole pine.

Existing Landscape Conditions – Age Class Distribution of Forest Types

The age class distribution across the D-Bug planning area landscape varies by forest type (Figure 3-3). Vegetation in the lodgepole pine forest type is currently 34 percent early seral, representing 30 to 40 year-old clear-cuts and patches of unmanaged lodgepole that regenerated after a mountain pine beetle epidemic in the 1970s. Stem exclusion and mature lodgepole that is mostly even-aged and 80 to 120 years old represents 63 percent of the lodgepole type while only three percent of the lodgepole forest type is currently in the late seral stage. The abundance of stem exclusion and mature lodgepole reflects the pattern established by stand-replacement fires of the 19th and early 20th centuries. Early seral and stem exclusion successional stages represent 18 and 12 percent of the mixed conifer forest type across the planning area landscape, respectively. Mature and late seral successional stages represent 42 and 28 percent of the mixed conifer forest type, respectively.

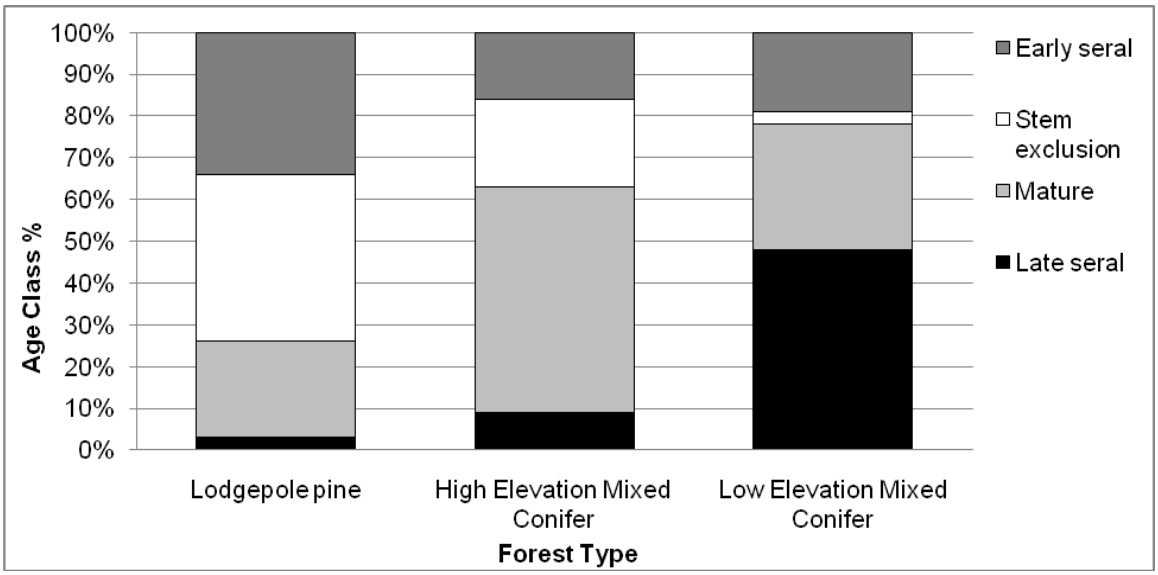


Figure 3-3. Current distribution of age classes by forest type across the D-Bug planning area landscape.

Existing Landscape Conditions – Species Composition of Forest Types

Species composition within the two primary forest types varies depending on multiple site factors, including elevation, moisture, and aspect. Lodgepole pine is present across 59% of the planning area. Pure lodgepole pine stands generally occupy the cold, pumice flats to the south of Diamond Lake and Lemolo Lake, which are characterized by frost pockets and low-productivity sites. Mixed stands of lodgepole pine and mixed conifer generally occupy the slightly more productive slopes adjacent to these flats. Douglas-fir (*Pseudotsuga menziesii*) is distributed across 26 percent of the planning area, occurring primarily at elevations below 4,500 feet with white fir (*Abies concolor*; 2%), and western hemlock (*Tsuga heterophylla*; 2%). Dominant species at high elevations include Shasta red fir (*Abies shastensis*; 6%) and mountain hemlock (*Tsuga mertensiana*; 4%). Incidental species (dominant in less than 1% of treatment acres) include Pacific silver fir (*Abies amabilis*), subalpine fir (*Abies lasiocarpa*), noble fir (*Abies procera*), incense cedar (*Calocedrus decurrens*), Engelmann spruce (*Picea engelmannii*), sugar pine (*Pinus lambertiana*), western white pine (*Pinus monticola*), ponderosa pine (*Pinus ponderosa*), and western redcedar (*Thuja plicata*).

Existing Landscape Conditions – Plant Association Classifications of Forest Types

Plant associations characterizing the potential natural vegetation across the D-Bug planning area landscape vary by forest type. The lodgepole pine forest type is characterized by the Lodgepole Pine-Mountain Hemlock/Depauperate plant association (USDA, 1996). The vegetation of this potential vegetation type exhibits very low species richness, averaging only six species. Lodgepole pine dominates the understory and mountain hemlock occurs frequently, while Shasta red fir and western white pine occur occasionally.

The mixed conifer forest type is characterized by four plant associations, depending on elevation and species composition. Potential natural vegetation of the low-elevation mixed conifer forest type is represented by the White Fir/Pacific Rhododendron-Dwarf Oregon Grape plant association (USDA, 1996). The vegetation composition and

structure of this plant association exhibits high species richness, averaging 36 species. Douglas-fir is frequent in the overstory, white fir and sugar pine are common, and western hemlock and Pacific yew (*Taxus brevifolia*) occur frequently. Incense cedar and golden chinquapin (*Chrysolepis chrysophylla*) are common understory species.

The mixed conifer forest type at high elevations can be characterized by the Shasta Red Fir-Mountain Hemlock/Pinemat Manzanita/Common Prince's-Pine and the Mountain Hemlock/Grouse Huckleberry/Common Prince's-Pine plant associations (USDA, 1996). The vegetation composition and structure of the Shasta Red Fir-Mountain Hemlock/Pinemat Manzanita/Common Prince's-Pine plant association is characterized by very low species richness, averaging 15 species. Shasta red fir dominates the overstory and understory tree layers, with mountain hemlock occurring frequently and lodgepole pine commonly and western white pine occasionally present. The Mountain Hemlock/Grouse Huckleberry/Common Prince's-Pine plant association has very low species richness, averaging nine species. Overstory tree species are predominantly mountain hemlock, with Shasta red fir and lodgepole pine occasional. Understory tree species are dominated by mountain hemlock, with Shasta red fir common, and lodgepole pine and western white pine less common.

The potential natural vegetation of the lodgepole pine-dominated mixed conifer forest type is characterized by the Mountain Hemlock/Grouse Huckleberry/Common Prince's-Pine (described above) and the White Fir-Shasta Red Fir/Common Prince's-Pine-Threeleaf Anemone plant associations (USDA, 1996). The latter plant association exhibits intermediate species richness, averaging 33 species. Dominant overstory and understory tree species include white fir, Shasta red fir, and Douglas-fir, with Pacific yew, golden chinquapin, and lodgepole pine exhibiting potentially high cover.

Existing Landscape Conditions – Disturbance History

Current vegetation patterns across the 42,000-acre planning area reflect the following forest disturbance processes and associated structural characteristics:

1. The full spectrum of fire severity regimes, including:
    a. Low-severity regimes in the low-elevation mixed conifer forest type with ponderosa pine present and a 10- to 40-year average fire return interval.
    b. Moderate-severity regimes in low-elevation mixed conifer and lodgepole pine types and the high elevation Shasta red fir type with a 40- to 70-year average fire return interval.
    c. High-severity regimes in high-elevation lodgepole and mountain hemlock types with a 60- to 80-year average fire return interval.
2. Past high-severity fires that typically occurred on 60- to 80-year intervals and replaced entire stands with high-intensity fire have resulted in even-aged lodgepole pine stands.
3. Pure lodgepole forest types in valley bottoms and on flats are products of cold air drainage and periodic stand-replacement fire.
4. The long fire-return interval characteristic of high elevations has resulted in uneven-aged, late seral Shasta red fir stands that have been the least affected by fire exclusion and are least likely to burn with high severity today.

5. Fire exclusion has affected the existing uneven-aged, late seral white fir/Douglas-fir stands with ponderosa pine that are more likely to burn with high severity today because of fuel buildups.
6. The presence of all ages of ponderosa pine in stands on south-facing slopes indicates that they were open, mixed conifer stands historically. The dense growth of shade-tolerant firs currently growing under these pines, an effect of fire exclusion, represents substantial risk to the health of these forest types due to increased competition. The consequence of this competition can be reduced tree vigor and a resulting higher susceptibility to bark beetle attack.

Existing landscape vegetation conditions also reflect recent mortality associated with the ongoing mountain pine beetle outbreak across the D-Bug planning area (Figure 3-4). The extent and severity of this mountain pine beetle outbreak was assessed using aerial survey data from the Pacific Northwest Region's Forest Insect Health and Disease Aerial Detection flights over the region's forested federal and state land. Mortality due to mountain pine beetle primarily is confined to lodgepole pine but also occurs in western white pine and sugar pine. The extent of mortality was greatest in 2007, with 10,300 acres experiencing tree mortality due to mountain pine beetle. Aerial detection data indicates that the extent of mountain pine beetle mortality has continued to spread through 2009, with the mortality pattern suggesting the outbreak will continue its southern expansion. Other insect and disease mortality agents active in the planning area since 2000 include the fir engraver beetle, western pine beetle, and lodgepole pine needle cast.

Desired Landscape Conditions

Desired landscape conditions are determined by evaluating existing conditions relative to corresponding historical reference conditions (Keane, et al., 2009), as well as potential conditions resulting from future climate change (USDA, 2008, 2010a, and 2010b; Kurz, et al., 2008; Körner and Basler, 2010). This approach represents a way to identify major departures from reference conditions in present-day landscapes and identify specific characteristics that might be modified through management. Understanding the history of ecological systems, including their past composition and structure, spatial and temporal variability, and key processes that shaped them, helps guide managers in designing sustainable management strategies and achieving desired management objectives (Hessburg, et al., 1999; Landres, et al., 1999; Keane, et al., 2002). By managing forest ecosystems in a manner consistent with historical conditions and processes, as well as addressing projected changes in climatic conditions, existing forest spatial patterns can be managed to reflect natural disturbance regimes and patterns of biophysical environments within a range of conditions that are feasible to maintain in the existing management context (Attiwill, 1994).

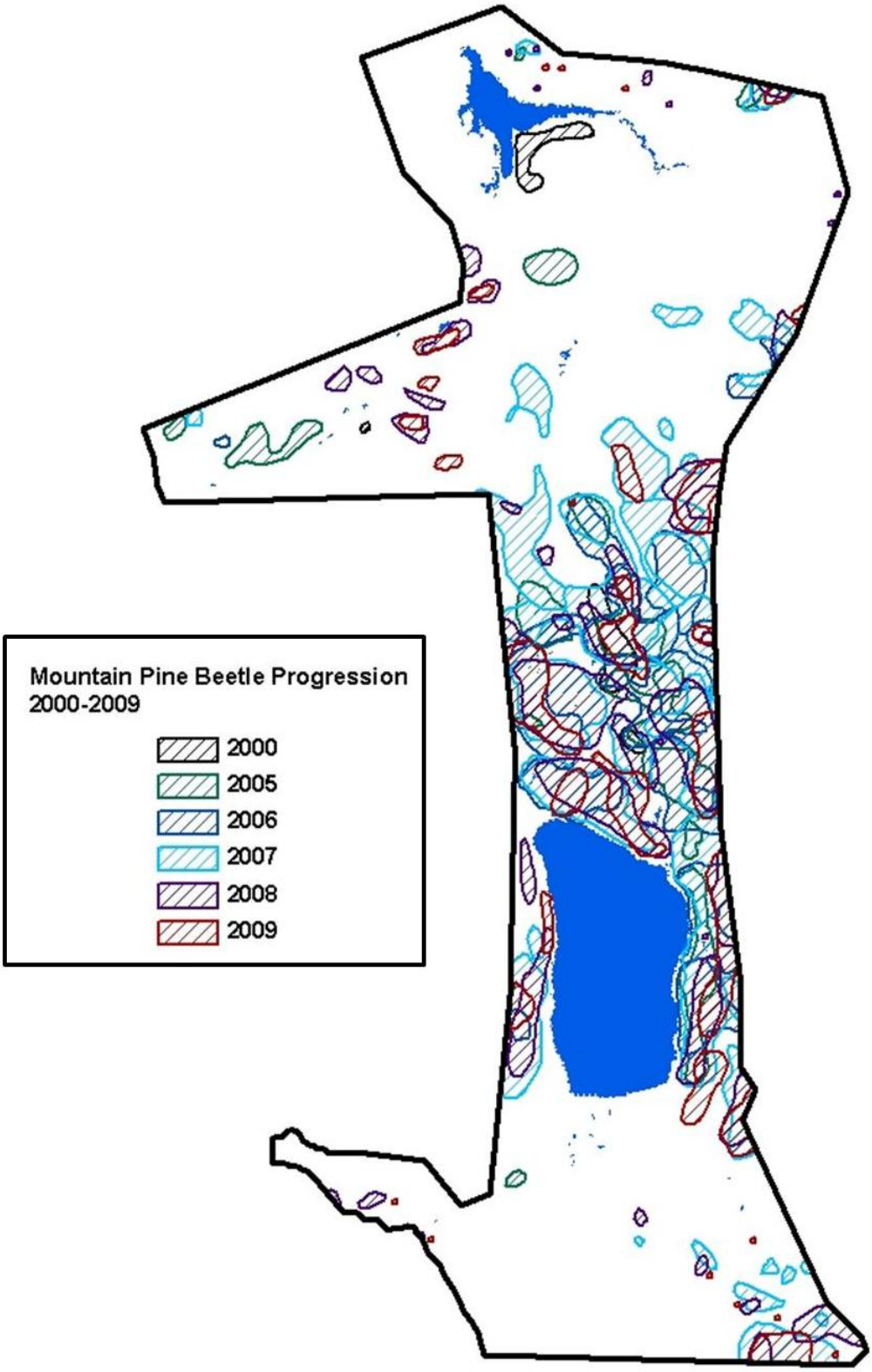


Figure 3-4. Progression of mountain pine beetle across the D-Bug planning area landscape from 2000 through 2009. (Forest Insect Health and Disease Aerial Detection flight data not collected between 2001 and 2004.)

Desired Landscape Conditions – Reference Vegetation Conditions

Reference, or historic, vegetation conditions for the D-Bug planning area landscape were characterized using LANDFIRE biophysical setting models and corresponding geospatial data (USDI, 2007). LANDFIRE data models relate biophysical gradients and topography to field map units based on NatureServe Ecological Systems ecological unit classifications (Comer, et al., 2003). Vegetation dynamics models are based on the current biophysical environment, the competitive potential of native plant species, and current scientific knowledge regarding the functioning of ecological processes (such as fire) in the centuries preceding non-indigenous human influence. These models represent the vegetation that may have been dominant on the landscape prior to Euro-American settlement and represent the natural plant communities that would become established at late or climax stages of successional development in the absence of disturbance. In this way, these models serve as a baseline for quantifying the degree of departure of current vegetation from reference conditions and are thus similar to the concept of potential natural vegetation classifications.

Reference conditions in the D-Bug planning area are represented by LANDFIRE's California Mixed Conifer (MCON) biophysical setting model. This montane forest type extends from the Sierra Nevada and Coast Ranges of California through the Klamath Mountains and Southern Cascades of southwestern Oregon, ranging from relatively dry to mesic sites on gentle to moderately steep slopes and at elevations ranging between 2,000 and 6,000 feet. This biophysical setting is characterized by primarily short-interval (10- to 20-year) surface fires and occasional mixed-severity and stand-replacement fires (30- to 10-year intervals), resulting in a mosaic of successional classes interspersed across the landscape (Table 3-4). Stands range from open to relatively densely stocked and typically are dominated by mixtures of early- to mid-seral species, depending on site type and fire history. The majority (40 percent) of the Mixed Conifer potential vegetation type is comprised of the late-open successional stage with stands often containing substantial amounts of large and very large ponderosa pine. The closed, mid-development and closed, late-development successional classes also constitute a substantial proportion of this vegetation type, with overstories in late-development stands dominated by white fir and/or Douglas-fir and understories dominated by shade-tolerant conifers.

Within the California Mixed Conifer biophysical setting, the D-Bug planning area is represented by four main potential vegetation types (Table 3-5; Figure 3-5), including Mediterranean California Mesic Mixed Conifer Forest and Woodland, Mediterranean California Red Fir Forest, North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest, and Rocky Mountain Poor-Site Lodgepole Pine Forest. Two riparian system types also occur in the planning area, including the California Montane Riparian System and the Inter-Mountain Basins Montane Riparian System, covering 6% and 2% of the planning area, respectively.

The Mediterranean California Mesic Mixed Conifer Forest and Woodland potential vegetation type represents over one-third of the planning area. This vegetation type is typically composed of three or more species, including white fir, Douglas-fir, ponderosa pine, sugar pine, and incense cedar. Major disturbance and mortality agents include fire, insects, and drought. Insect-related mortality is tied to periodic droughts and recurs every 30 years, on average, resulting in characteristic patchiness across affected portions of the landscape.

Table 3-4. Successional class reference conditions for the California Mixed Conifer biophysical setting.

Successional Class	Percent of Landscape	Description
Post-replacement	10	Early succession after moderately long-interval stand replacement fires; dominated by grasses, shrubs, and tree seedling to sapling stages.
Mid-development, closed	10	Mixed conifer saplings to medium-sized trees (>40% canopy cover).
Mid-development, open	25	Mixed conifer saplings to medium-sized trees (<40% canopy cover).
Late-development, open	40	Overstory of large and very large diameter mixed conifer species (<40% canopy cover) in small- to moderate-size patches, generally on southerly aspects and ridgetops.
Late-development, closed	15	Overstory of large and very large diameter mixed conifer species (>40% canopy cover) in small- to large-size patches, particularly on steep northerly aspects and lower slopes.

Table 3-5. Summary of potential vegetation types for the D-Bug planning area within the California Mixed Conifer biophysical setting.

Potential Vegetation Types	Percent of Planning Area
Mediterranean California Mesic Mixed Conifer Forest and Woodland	38
Mediterranean California Red Fir Forest	22
North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	12
Rocky Mountain Poor-Site Lodgepole Pine Forest	8
Riparian Systems	8
North Pacific Mountain Hemlock Forest - Xeric	4
North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	3
Other	5

The Mediterranean California Red Fir Forest vegetation type includes red fir and white fir as the primary overstory species, with lodgepole pine, and mountain hemlock present in lesser amounts. Western white pine, incense cedar, and knobcone pine (*Pinus attenuata*) also occur in this vegetation type. Tree canopy cover is generally greater than 60 percent, with the shrub and herb layers each contributing less than 30 percent ground cover. Primary disturbance and mortality agents include fire, insects, disease, and wind and ice storms. Wind events can result in windthrow of dominant and co-dominant trees, thus releasing established understory trees and resulting in structural patchiness across the landscape. Insect-related disturbance is most pronounced in closed, late-successional and closed, mid-successional stands (USDI, 2007).

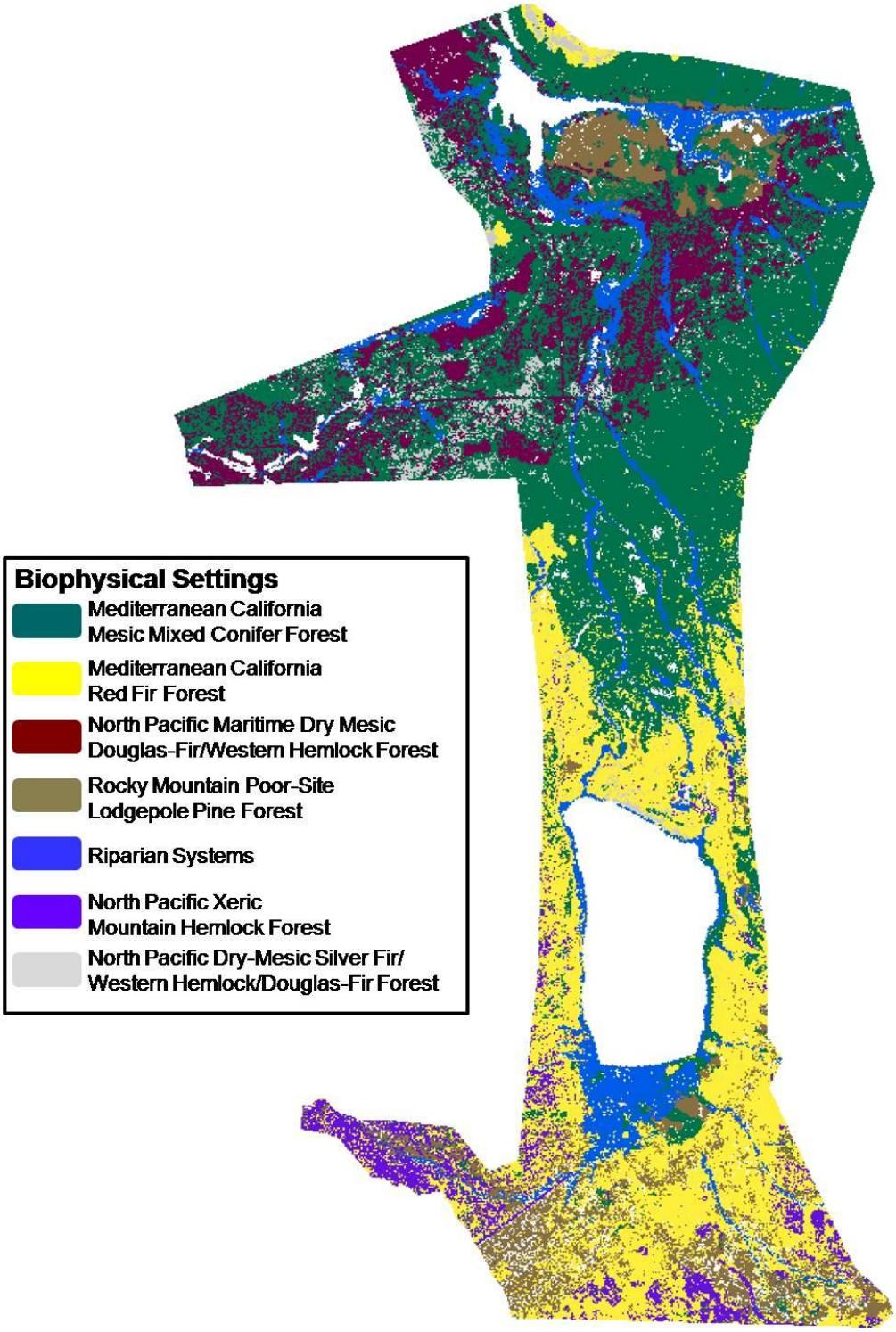


Figure 3-5. Distribution of biophysical settings across the D-Bug planning area.

For the North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest vegetation type, Douglas-fir is the most common tree species, with western hemlock, western redcedar, grand fir, and lodgepole pine occurring as seral associates. Fire is the primary disturbance agent in this forest type, functioning as the primary driver of continued Douglas-fir dominance in these landscapes. Other disturbance agents, including insects, pathogens, and windthrow, interact with drought and other extreme weather conditions to create isolated disturbance patches in affected stands.

The Rocky Mountain Poor-Site Lodgepole Pine Forest vegetation type occurs east of the Cascades in Oregon on deep Mazama ash and pumice. This vegetation type is dominated by self-replacing stands of lodgepole pine and generally occurs as a single layered canopy. Associated conifer species include ponderosa pine, white fir, and western white pine. This lodgepole pine pumice system is shaped by large-scale fire and insect outbreaks. Fire-scarred trees are more susceptible to subsequent beetle attack and blue-stain-fungi-caused mortality, creating a cycle of damage and succession. Wind disturbance events also create a patchwork of windthrow gaps and successive regeneration by lodgepole pine following disturbance.

Riparian systems in the planning area are characterized by the California Montane Riparian vegetation type and the North Pacific Montane Riparian Woodland and Dry Shrubland vegetation type. Both vegetation types occur as mosaics of communities that can be tree-dominated with a potentially diverse understory shrub component, depending on disturbance history. Vegetation in these riparian systems is shaped by hydrologic disturbances and is maintained through limited flooding, scouring, and deposition events.

Desired Landscape Conditions – Management Objectives

The D-Bug Hazard Reduction Timber Sale Project was initiated to move current conditions in pine dominated landscapes within and near the WUIs and evacuation routes, towards the desired condition of stand structural conditions that are more resilient to infestation from mountain pine beetle and thus represent a lower wildfire threat to important high-use recreation areas and homes both inside and outside WUIs, thus meeting the Purpose and Need.

Several desired conditions and recommendations from the 2008 Diamond Lake/Lemolo Lake Vegetation Management Plan and Watershed Analysis Iteration helped craft the D-Bug proposal (USDA, Umpqua National Forest, 2008):

1. Community Wildfire Protection – Implement fuel reduction treatments in Wildland Urban Interface areas. Thin overly dense stands near special use sites in collaboration with permittee holders.
2. Desired stand structure in mature lodgepole pine – Where lodgepole pines exist with live crowns sufficient to respond to thinning, use thinning and overstory removal to create a mosaic of variable density tree retention to reduce susceptibility to mountain pine beetle attacks.
3. Desired stand structure in 30-to-80-year-old lodgepole pine (stem exclusion) – Reduce density in a cost-effective manner to increase individual tree growth and reduce fire hazard.
4. Desired stand structure in mixed conifer and lodgepole pine/mixed conifer types – Use density and fuel reduction treatments to improve resiliency to stand

replacement fire effects. Release mature ponderosa pines and western white pines from competition with subordinate trees.

5. Vegetation management in high-use areas – Remove existing and future hazard trees around high-use developments. Some hazard trees would be left and/or aggregated in suitable locations around recreation sites to enable watchable wildlife for visitors.
6. Bald Eagle habitat - Use uneven-age management with preference for ponderosa pine, Douglas-fir, and Shasta red fir to perpetuate nesting and foraging habitat in old growth mixed conifer stands that currently provide these habitat elements.

Existing Stand Conditions

Raster data (LEMMA 2010), 2006 and 2008 NAIP aerial imagery, stand exam data, and field reconnaissance were used to classify stands in the D-Bug planning area in terms of both forest type and successional stage. Stands in the D-Bug planning area are stratified into two distinct forest types: lodgepole pine and mixed conifer. In general, planning area stands are primarily lodgepole and mixed conifer forest types in stem exclusion and mature age classes. Species include lodgepole pine, Douglas-fir, white fir, and western hemlock at elevations below 4,500 feet with scattered western white pine, Pacific silver fir, and to a lesser extent, subalpine fir at elevations above 4,500 feet. Engelmann spruce is present in riparian areas of some stands, while ponderosa pine is present in a few low-elevation, dry sites on south-facing slopes.

Lodgepole pine stands represent cool, dry forests with both an overstory and an understory dominated by lodgepole. Existing stands include both unmanaged, even-aged, stem exclusion and mature stands of pure lodgepole pine that originated after stand replacement fires in the late 1800s and early 1900s, early seral patches of unmanaged lodgepole stands that regenerated after a mountain pine beetle epidemic in the 1970s, and densely-stocked, small-diameter plantations that originated as clearcuts in the 1970s and 1980s. The extensive, dense tracts of stem-exclusion/mature lodgepole pine represent optimal habitat for mountain pine beetle infestation (Goheen and Bridgewater, 2007) and indicate a considerable departure from reference conditions. Lodgepole pine stands are primarily on the pumice flats which can serve as transition zones between lodgepole pine and mixed conifer forest types, with localized cold air pockets favoring the more tolerant lodgepole pine. Lodgepole stands account for 36 percent of D-Bug planning area stands (33 percent for Alternative 5).

Existing mixed conifer stands include both mature/late seral stands that survived stand replacement fires of the late 1800s and early 1900s as well as stands that are mostly 80 to 120 years old and even-aged. Mixed conifer stands include warm/dry, low elevation stands below 5,000 feet dominated by Douglas-fir and white fir as well as cool/dry cool, high elevation stands above 5,000 feet dominated by mountain hemlock and Shasta red fir. In addition, many mixed conifer stands at both low and high elevations are pine-dominated today with a mixed conifer understory. Some of these stands have an unmerchantable overstory of both mature and dead lodgepole pine and an understory of dense, small-diameter conifers. In addition, due to fire exclusion, stands in the white fir series are exhibiting a departure from historic composition and structure. These stands currently consist primarily of an overstory of very large Douglas-fir and ponderosa pine with substantial in-growth of white fir developing underneath. Much of the white fir is already mature and forms a sub-canopy below the Douglas-fir and ponderosa pine and occupies gaps generated by the dying overstory trees. Ponderosa pine is able to

withstand less vegetative competition than white fir and eventually will be replaced in the absence of disturbance. Low- and high-elevation mixed conifer stands account for 25 percent of the D-Bug planning area stands (20 percent for Alternative 5) while mixed conifer stands with a substantial lodgepole pine component account for 39 percent of the D-Bug planning area stands (47 percent for Alternative 5).

Existing stands represent structural conditions resulting from past management, as well as from natural disturbance events. In general, stands in the planning area currently lack both the openings and the structural diversity consistent with natural disturbance processes (Table 3-4; Figure 3-3). Currently, open canopy conditions exist in early seral vegetation, in some mature lodgepole pine stands, and in recently thinned mixed conifer stands at low elevations. Open conditions in today's low and high-elevation mixed conifer forests are well below reference conditions, particularly in the mature and late-seral age classes where most thinning is proposed. Under reference conditions, open, late-seral stands would occupy about 40 percent of low-elevation mixed conifer and about 35 percent of high-elevation Shasta red fir types. Today, open canopy conditions occupy just over 20 percent of the mixed conifer forest type across the planning area landscape (Barrett, et al., 2004; USDI, 2007). In addition, the amount of early seral vegetation varies by forest type, from less than two percent in high elevation mixed conifer to 15 percent in lodgepole pine stands. The uniform structure and expanse of the even-age lodgepole pine stands and the density of trees in mixed conifer types in the planning area indicate a departure from historic conditions, particularly in the unmanaged forest at low elevations. Stand-replacement fire in mixed-conifer stands is now more likely due to the uncharacteristic buildup of live and dead vegetation in this forest type. The effects of fire exclusion are less pronounced for stands in the mountain hemlock and Shasta red fir plant series that are less prone to regular fire. However, even these high-elevation mixed conifer stands are likely characterized by reduced age and structural diversity relative to reference conditions. Based on the premise that ecological processes function more naturally when they are within the historic range of variability (USDA/USDI, 1994), this ecosystem may become stressed if conditions exceed the range of variation for open, early seral vegetation.

Desired Stand Conditions

In general, desired stand conditions would maintain large patches[14] of four age-class structures in a multi-aged, layered stand structure. Within stands, desired conditions would represent a diversity of stand structures and fuels by using variable density tree retention and by creating a mosaic of fuel reduction zones congruent with historic fire disturbance regimes (USDI, 2007). The desired vegetation pattern at low elevations would be variable and would be consistent with partial stand replacement effects of low to moderate severity fire regimes. Where fires burned with low severity, historically on south aspects at low elevation, the desired conditions would maintain open, mature, and late seral stands with large, fire-resistant trees such as ponderosa pine. Where fires historically burned with moderate severity, desired conditions would be characterized by a complex pattern of large openings. In high severity regimes at high elevations, desired patch sizes would be larger to approximate historic fire disturbance that covered thousands of acres.

Desired conditions for mature lodgepole stands would be characterized by an open mosaic of variably spaced, uneven-aged mature residual trees. Structural conditions would mimic the patchiness resulting from historical low-intensity and stand-replacement

[14] Landscape patches are contiguous areas of vegetation of the same age class, structure, and forest type.

fires (Agee, 1993; Arno, 2000) and mountain pine beetle-caused mortality (Schowalter, 2006; British Columbia FPB, 2007). The reduced number of potential host trees would create less hospitable microclimate conditions for the mountain pine beetle by increasing ambient temperatures and increasing light intensity (Amman and Logan, 1998). Treatments would thus reduce the amount of suitable beetle habitat, resulting in a reduced stand susceptibility to mountain pine beetle infestation and reduced accumulations of fuel and hazard trees resulting from mountain pine beetle attack. Desired conditions for stem exclusion lodgepole stands would include reduced density to open up uncharacteristically dense stands, resulting in modified fire behavior and increased resilience to stand replacement fire effects. Open structural conditions would reduce competition-induced mortality and improve stand vigor and growth, relative to some overstocked historic clearcuts in the planning area. Desired conditions also would improve safety and access for fire-fighting crews and would provide fire managers a greater range of response options.

Desired conditions for mixed conifer stands vary by elevation and fire severity regimes. Objectives for mixed conifer stands are to increase fire resiliency by advancing the stem exclusion stage or maintaining a mature stand structure. In low-elevation mixed conifer stands, desired conditions would resemble open structural conditions characteristic of historical moderate severity fire regimes. For existing lodgepole pine-dominated mixed conifer stands, desired conditions would be achieved by shifting the species dominance away from lodgepole pine and towards more fire-resilient conifer species. This objective would be achieved by thinning from below and releasing mature ponderosa pine and western white pine trees from competition with subordinate trees, thus increasing stand resilience to stand replacement fire effects. Desired conditions for high elevation mixed conifer stands would be characterized by a more fire-resilient stand structure and species composition, with more open canopies and larger, more fire-resilient tree species, such as Shasta red fir. More open canopies also would release trees (including mature ponderosa pine and western white pine) from competition, thus accelerating tree growth and the development of stand structural complexity.

Proposed Thinning Treatments

Desired stand conditions will be achieved with a suite of proposed commercial and non-commercial thinning and fuels reduction treatments (tables 3-6, 2-1 and 2-4). Treatments are designed to move existing lodgepole pine and mixed conifer stands towards desired conditions by creating diverse stand structure through variable-density tree retention and by creating a mosaic of fuel reduction zones. Commercial thinning is a tool that can be used to remove larger host lodgepole pine trees before mountain pine beetles infest an area (Fettig, et al., 2007). Reducing the number of potential host trees and creating a sunny microclimate can reduce the amount of suitable beetle habitat, thus decreasing the amount of beetle-caused tree mortality and subsequent accumulation of fuel and hazard trees. Similarly, commercial and non-commercial tree removal can open up uncharacteristically dense stands to modify fire behavior, lower the risk of stand replacement fire, improve stand vigor and resistance to insects, and allow fire-fighting crews safe access to stands affected by fire. Action alternatives propose commercial thinning in stem exclusion, mature, and late-seral stands, and non-commercial thinning in the early seral and stem exclusion stages. The effects of proposed treatments were modeled using the Forest Vegetation Simulator, a stand growth-and-yield model (Dixon, 2003).

Table 3-6. Summary of proposed commercial and non-commercial treatments.

Treatment Type	Acres[15]		
	Alternative 1	Alternative 2	Alternative 5
Lodgepole Overstory Removal	0	59	0
Lodgepole Variable Density Thinning	0	4,369	3,431
Mixed Conifer Thinning	0	2,247	1,497
Hazard Tree Removal and Fuel Reduction	0	0	556
Non-commercial Thinning	0	2,026	2,082

Commercial Thinning Treatments

Five types of commercial treatments are proposed in lodgepole pine stands to reduce stand density, to prevent the buildup of fuels, and to address safety concerns associated with existing hazard trees (Table 3-6):

1. Overstory removal of trees greater than 5” dbh in lodgepole pine stands, retaining 20 TPA 5” dbh and greater (Alternative 2 only);
2. Variable density thinning (proportional thinning) in lodgepole pine stands, retaining 20-70 TPA 5” dbh and greater (Alternative 2). In Alternative 5, 30-70 TPA 5” dbh and greater will be retained. Retained trees will be variably spaced and interspersed with ten percent of the stand area not treated;
3. Variable density thinning in stands of lodgepole pine overstory and mixed conifer understory, retaining 50-200 TPA 5” dbh and greater. This prescription includes post and pole stands to produce biomass;
4. Salvage of dead/dying lodgepole pine, retaining 50-200 TPA; and,
5. Hazard tree removal and fuel reduction (Alternative 5 only), potentially removing a commercial product, if necessary to reduce hazard and increase safety.

Overstory removal prescriptions (retaining 20 TPA 5” dbh and greater) and variable density thinning prescriptions (retaining 20-70 TPA and 50-200 TPA 5” dbh and greater) would be implemented in accordance with 1996 National Forest Management Act guidelines by retaining full stocking relative to productivity standards identified for the Lodgepole Pine-Mountain Hemlock/Depauperate plant association (Wessell, 2010). Heavy thinning treatments also are consistent with recommendations for prevention and suppression of mountain pine beetle infestation and spread within mature lodgepole pine stands (Goheen, 2008). Post-treatment stands would retain stocking levels necessary to prevent major losses of dominant and co-dominant trees (Blackburn, 2008). The Live Crown Ratio (LCR) of retention trees would be at least 40 percent, which is a good threshold for the desired lodgepole pine response to thinning. Prescription guidelines for spacing, species preference and, in some stands, understory thinning, would retain

[15] Lodgepole Overstory Removal is the sum of acres for Prescription 1 (Table 2 and Table 6). Lodgepole Variable Density Thinning is the sum of acres for Prescriptions 2-4 minus no thin acres within stands where Prescription 2 would apply. Mixed Conifer Thinning is the sum of acres for Prescriptions 9-13. Hazard Tree Removal and Fuel Reduction is the sum of acres for Prescription 14. Non-commercial thinning acreage is the sum of acres for Prescriptions 5-8.

variable density and spacing of residual trees and would give preference to mixed conifer species, including fire-tolerant species such as ponderosa pine and western white pine.

Variable spacing resulting from thinning from below coupled with no thin areas in the variable density prescription would enhance stand complexity by creating a structural mosaic of skips and gaps. Resulting stand conditions would emulate the inherent patchiness resulting from mountain pine beetle attacks (British Columbia Forest Practices Board, 2007) and fire-caused mortality in lodgepole pine stands but without the fuel buildup associated with insect-related mortality. At the same time, proposed overstory retention levels would likely improve the resilience of retained trees to mountain pine beetle attack (Goheen, 2008) and limit understory regeneration of lodgepole pine compared to a regeneration harvest.

A “no thin” prescription would apply to ten percent of pure lodgepole pine stand acres in heavy thinning prescriptions (retaining 20-70 TPA 5” dbh and greater) to achieve a variable stand density, to meet aggregated green-tree retention guidelines for Matrix land allocations (USDA/USDI, 1994, C-41), and to follow Land and Resource Management Plan direction regarding prescriptions within dispersed recreation areas (USDA, Umpqua NF, 2008).

Salvage harvest prescriptions would remove trees that are dead or dying, infested, or weak and therefore susceptible to mountain pine beetle attack. Removing these trees would reduce potential mountain pine beetle habitat, free up growing space to enhance vigor in residual trees, and reduce fire hazard resulting from fuel accumulations.

A danger tree removal treatment is proposed in a 150-foot strip in 14 units under Alternative 5. A danger tree (also called “hazard tree”) is defined as a standing tree that presents a hazard to people due to conditions such as, but not limited to, deterioration or physical damage to the root system, trunk, stem, or limbs and the direction or lean of the tree (FSH 6709.11). The objective of this treatment is to decrease the immediate and likely safety hazards from tree toppling or branch fall from either dead or live trees of all species across roads or trails. This prescription has the possibility of trees 7” dbh and greater to be decked and sold or fallen, bucked, and left onsite as coarse wood. Activity fuels will be treated using mastication or handpiling following danger tree removal.

Regional policy regarding danger trees indicates that danger trees near evacuation routes are a high priority for removal, given the potential for tree failure. Hazard exists when a tree of sufficient size and mass to cause injury or damage is within striking distance of any object of value (USDA, 1992). Hazard increases with increasing tree defect, potential for failure, and potential for damage. Management actions are taken to mitigate the hazard when risks (the product of damage potential and consequences of damage) are unacceptable. Risk is defined as acceptable (hazard will not be mitigated) when all components of hazard have been fully evaluated and the probability of failure and/or damage is very low. Risk is defined as unacceptable (hazard will be mitigated) when the amount of defect indicates failure is likely, the potential for failure and relationship to targets indicates damage is likely, and the target value is moderate or high.

Danger trees will be assessed by a trained and qualified danger tree expert in accordance with Forest Service directives (FSM 7733; USDA/USDI, 2008). Danger tree identification will be based on existing tree condition and the characteristics of the particular tree species. The qualified danger tree expert will identify tree defects to assess the tree’s failure potential, identify the tree’s potential failure zone (typically

defined as a circle with a radius 1 ½ times the tree height or dislodged tree segment, plus an additional distance for ground slope and tree lean), then determine what actions to take if the tree is determined to be a danger. Failure potential is the probability that a tree will fail and is classified as low, likely, or imminent[16]. Key variables considered during evaluation of tree failure potential include degree and direction of tree lean, presence and extent of lethal or weakening root, stem, or branch disease or insect infestation, cracks and structural defects, fire damage, root damage, dead, broken, or hanging branches, and windthrow potential (Harvey and Hessburg, 1992; USDA, 2008). Trees with low failure potential are defective or rotten trees, snags, or their parts that require considerable effort to make them fall and have a low probability of failure within 10 years of rating, while trees with likely failure potential require some effort to make them fail and have a high probability of failure within 3-5 years. Trees with imminent failure potential require little effort to make them fail and have a high probability of failure within one year.

Four types of commercial treatments are proposed in mixed conifer stands to reduce stand density, prevent the buildup of fuels, and to address safety concerns associated with existing hazard trees (Table 3-6):

1. Thinning from below in diameter classes greater than 3” DBH, retaining 50-90 TPA 7” dbh and greater;
2. Thinning from below in stands dominated by small-diameter red and white fir, retaining 50-90 TPA 7” dbh and greater;
3. Thinning from below in stands of Douglas-fir with a ponderosa pine component, retaining 50-90 TPA 7” dbh and greater; and
4. Hazard tree removal and fuel reduction (Alternative 5 only), potentially removing a commercial product, if necessary to reduce hazard and increase safety.

The objective for commercial thinning in mixed conifer stands is to advance stands that are approaching or are currently at maturity. Prescriptions incorporating variable spacing and species preferences would retain 50-90 TPA 7” dbh and greater using thinning from below. Variable spacing and species preference guidelines will be used to achieve desired conditions of maintaining and advancing complex, mature forest structure while improving fire resiliency. Variable density thinning and individual tree release combined with fuels reduction treatments would restore low-elevation mixed conifer stands to more open conditions characteristic of moderate severity fire regimes. At higher elevations, moderate thinning[17], individual tree release, and fuels reduction treatments would be used to create a more fire-resilient stand structure.

The action alternatives include 200-300 acres of mixed conifer stands that qualify as nesting, roosting, and foraging (NRF) habitat for Northern Spotted Owls (Table 3-25, Wildlife section). Treatments in these areas would maintain 60% canopy closure, thus maintaining suitable NRF habitat following treatment. Elsewhere, heavier thinning would occur to achieve more crown separation to meet the purpose and need of reducing the probability of stand replacement fire. Uneven-aged, layered stand structural conditions would result following thinning treatments (Figure 3-6).

[16] One of the failure indicators for danger tree identification is insect-caused damage. Bark beetles, including the mountain pine beetle, are among the most important insects that cause tree mortality. Tree failure potential increases dramatically with cumulative impacts of multiple defects, such as dwarf mountain pine beetle damage, mistletoe damage, fungal decay, and frost cracks.

[17] Moderate thinning retains from 70 to 100 large trees per acre 7” dbh and greater.

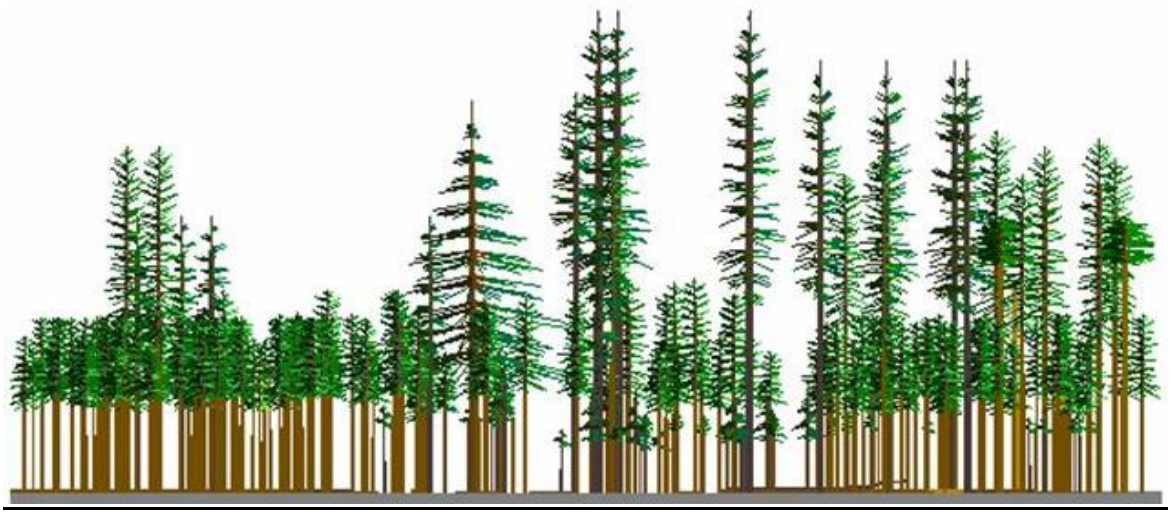


Figure 3-6. Example of desired stand conditions for mixed conifer stands 30 years after thinning, with multiple age classes, large overstory trees released by thinning, and a layered understory that developed under canopy openings.

Non-Commercial Thinning Treatments

Stands proposed for non-commercial thinning are both managed and unmanaged. They include lodgepole pine plantations that originated as clearcuts in the 1970s and 1980s as well as unmanaged, small-diameter stands in both lodgepole pine and lodgepole/mixed conifer forest types. Many stands of the latter type have an unmerchantable overstory of both mature and dead lodgepole pine and an understory of dense, small-diameter conifers.

Two types of non-commercial thinning are proposed in the action alternatives (Table 3-6):

1. Understory thinning and removal of fuels by pre-commercial thinning, mastication, whip felling, chipping, and piling and burning of slash; and
2. Non-commercial hazard tree removal and fuels reduction in a 150-foot roadside strip within 14 units. Activity fuels will be treated using mastication or handpiling following danger tree removal.

Non-commercial treatments include removal of fuels in 2,026 acres and 2,082 acres in Alternative 2 and Alternative 5, respectively. Non-commercial treatments also are proposed in 556 acres in the hazard tree removal and fuels reduction treatment (Alternative 5 only).

Direct and Indirect Effects

Direct effects are those that are triggered immediately as a result of implementation at the stand scale. Indirect effects are those effects that would occur within the treatment areas and at the landscape-scale over a period of 30 to 50 years.

Direct and indirect effects to forest vegetation were assessed by tracking three key measures for the Purpose and Need elements identified in Chapter 1, including acres of susceptible lodgepole pine treated, acres of commercial harvest within developed recreation sites and by private dwellings/businesses, and acres of mixed conifer stands thinned (Table 3-7). Direct and indirect effects of the action alternatives differ in the

degree to which they meet the Purpose and Need elements for establishing stand trajectories to meet desired future conditions.

Table 3-7. Purpose and Need element measures related to direct and indirect effects to forest vegetation by alternative.

Purpose and Need Element Measure	Alternative 1	Alternative 2	Alternative 5
Acres of susceptible lodgepole pine treated	0	4,743	3,634
Acres of commercial treatment within developed recreation sites and by private dwellings/businesses.	0	199	199
Acres of mixed conifer stands thinned	0	2,247	1,790

Element 1 of the Purpose and Need addresses the need to modify mountain pine beetle habitat conditions in stands containing lodgepole pine to reduce potential beetle infestation. This element is measured by acres of susceptible lodgepole treated.

Alternative 1 would not result in any direct effects to lodgepole pine because no thinning, fuels treatments, or other forest vegetation treatments would occur. However, failure to treat the existing, densely-stocked stands of lodgepole pine across the D-Bug planning area landscape under the no action alternative would indirectly result in continued vegetation growth, increasingly dense stands, and increased competition between and among trees, leading to competition-induced mortality and increased fuel accumulations (Figure 3-6A). Indirect effects of Alternative 1 also could include continued departure of stand structure and composition from desired, resilient conditions, continued beetle activity in infested areas, continued beetle-caused tree mortality and resulting fuel accumulations, and increased susceptibility to widespread fire over time.

The immediate direct effects of the lodgepole pine overstory removal and variable density thinning treatments in the action alternatives include reduced stand densities (meeting Element 1 of the Purpose and Need) and reduced lodgepole pine crown volume. Removal of some overstory lodgepole pine and the heavy thinning of host trees would reduce the number of potential host trees necessary for mountain pine beetle population expansion and would create more open stands with less suitable mountain pine beetle habitat (Table 3-8).

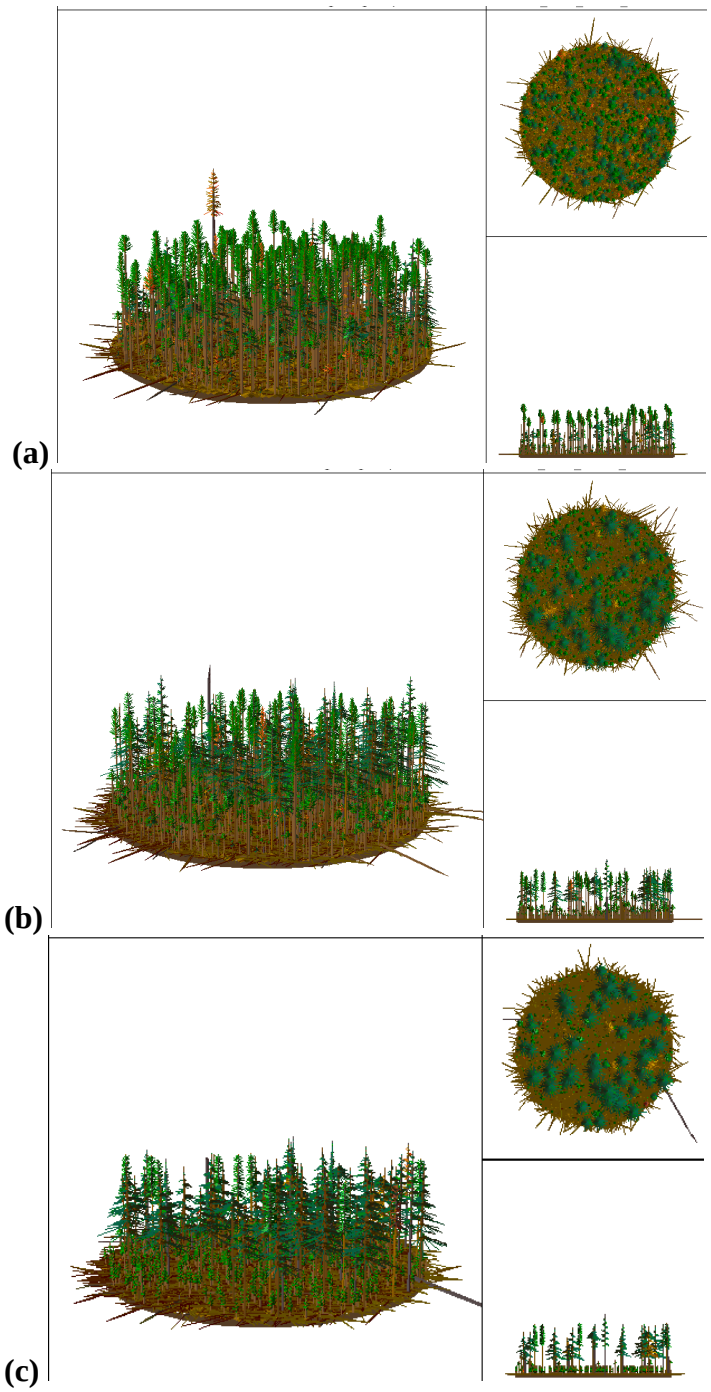


Figure 3-6A: Forest Vegetation Simulator images of representative lodgepole pine stand proposed for variable density thinning depicting (a) Current conditions in 2010 characterized by dense stocking and high fuel loads; (b) Conditions in 2040, following 30 years of no action, characterized by increasingly densely-stocked stands, increasing amounts of mortality, and fuel accumulations; and, (c) Conditions in 2040, 30 years after variable density thinning and fuels treatments. Stand conditions are characterized by variably-spaced trees, an increased mixed conifer species component and decreased lodgepole pine component, and decreased fuel loads, relative to no action.

Indirect effects of lodgepole pine treatments would include more open stands with less hospitable microclimate conditions for mountain pine beetle due to increased ambient temperatures and increased light intensity, thereby interrupting tree-to-tree spread of beetles during future outbreaks (Figure 3-6A). The indirect effect of increased vigor of residual trees also would decrease the susceptibility of residual trees to attack and increase the likelihood they would survive future beetle attack, thereby reducing fuel accumulations over time. For mixed-conifer stands containing mature lodgepole in the overstory, indirect effects of treatment would include more open stands over time, less suitable mountain pine beetle habitat, and more fire-resistant and beetle-resistant mixed conifer species. Shifting the future species composition away from lodgepole pine dominance toward fire-resilient mixed conifer tree species dominance by removing some suitable host lodgepole pine and retaining fire- and beetle-resistant mixed conifer species would maintain species diversity, improve structural diversity, increase residual tree vigor, and limit the extent of mountain pine beetle habitat over time. Variable spacing resulting from thinning from below coupled with no thin areas would enhance stand complexity by creating structural mosaics of skips and gaps, emulating the inherent patchiness resulting from mountain pine beetle attacks and fire-caused mortality in lodgepole pine stands but without the fuel buildup associated with insect-related mortality. At the same time, proposed overstory retention levels likely would improve the resilience of retained trees to mountain pine beetle attack and limit understory regeneration of lodgepole pine compared to a regeneration harvest.

Alternative 2 would treat 31 percent more acres of susceptible lodgepole than Alternative 5 (Table SW-5). Alternative 2 would thus result in greater beneficial direct and indirect effects than Alternative 5. Both action alternatives would result in more beneficial effects to lodgepole pine than the no action alternative (Table 3-8).

Table 3-8. Average conditions in lodgepole pine stands in 2010 and in 2040 under the no action alternative and under the action alternatives with variable density thinning treatments.

	2010	2040	
Stand Condition	**Existing Condition**	**No Action**	**Action Alternatives**
Total trees per acre	1046	933	442
Lodgepole pine per acre 7” dbh and greater	128	93	20
Mixed conifer per acre 7” dbh and greater	25	30	33
Basal area per acre (ft.^{2}/acre)	113	115	64

Today, approximately 34 percent of the lodgepole forest type in the planning area is early seral (Figure 3-3). The action alternatives propose treatments that would increase the amount of early seral lodgepole pine between 10 and 12 percent of the D-Bug planning area, relative to pre-treatment early seral acres (Table 3-9).[18] The additional acres of open, early seral lodgepole stand conditions created by the proposed treatments would increase the current proportion of lodgepole pine in the early seral stage by approximately 12 percent in Alternative 2 and by nearly ten percent in Alternative 5. Following treatment, early-seral lodgepole stands would approach reference conditions for early seral lodgepole, or approximately 45 to 50 percent of the landscape (USDI, 2007).

Table 3-9. Acres of lodgepole pine thinning treatments and corresponding post-treatment early seral conditions.

Treatment Type and Post-treatment Age Class Condition	Acres		
	Alternative 1	Alternative 2	Alternative 5
Lodgepole Thinning	0	4,369	3,431
Lodgepole Overstory Removal	0	59	0
Post-treatment early-seral lodgepole forest	0	2,016	1,594
Post-treatment early-seral percentage of D-Bug planning area lodgepole forest19	34%	46%	44%

Element 3 of the Purpose and Need addresses the need to remove existing dead and imminently dying pine and other hazard trees in areas already infested where human use is high in order to protect the recreating public. The ongoing mountain pine beetle epidemic has resulted in continued tree mortality in some stands within campgrounds and other concentrated use areas. Removing imminently dying trees and salvaging dead trees would result in the desired condition of reduced human exposure to hazard trees. This element is measured by acres of commercial harvest within developed recreation sites and by permitted dwellings/businesses (Table 3-6).

Alternative 1 would not result in any direct effects because no hazard tree reduction treatments would occur. Failure to treat the existing dead and imminently dying pine and other hazard trees under the no action alternative would indirectly result in continued danger due to hazard trees in these developed recreation sites and near private dwellings and businesses. Indirect effects include continued safety risks over time and increased potential for human injury or infrastructure damage due to hazard tree toppling.

The action alternatives would result in the direct effect of fewer dead and dying trees within developed recreation sites and near private dwellings and businesses. The indirect effects of treatments would include increased safety, reduced potential damage

[18] Post-treatment early-seral lodgepole pine acres would be those areas where canopy closure is reduced below 20% and retention of mature trees would be a minimum. Variable density thinning (Prescription 2, Table 2) would reduce canopy closure to less than 20% over as much as 45% of the pure lodgepole thinning stands and thus create openings in these stands. The overstory removal (Prescription 1, Table 2) would also reduce canopy closure to less than 20% over as much as 85% of the stand area. Total treatment acres are summarized in Table 3-6.

[19] Approximately 44% of the D-Bug planning area (18,000 acres) is occupied by pure lodgepole pine forest including lodgepole/ mixed conifer sites.

to residual trees from toppling and breakage, and improved stand fire resiliency. Alternatives 2 and 5 both propose treating 199 acres and therefore do not differ in the degree to which they harvest within developed recreation sites and adjacent to infrastructure. The direct and indirect effects of this treatment would therefore be the same for both action alternatives. Both action alternatives would result in more beneficial effects of removing existing dead and imminently dying pine and other hazard trees than the no action alternative (Table 3-6).

Element 4 of the Purpose and Need addresses the need for improving fire resiliency and increasing stand vigor in densely-stocked mixed conifer stands containing older, large ponderosa pine, western white pine, Shasta red fir, and Pacific silver fir. Existing conditions have developed in the absence of natural surface fires over many years. In stands containing ponderosa and western white pine, increased competition resulting from dense stocking has decreased tree vigor, increased the pine's susceptibility to mortality from mountain pine beetle and other pathogens, and has increased the risk of stand replacement fire. Reducing stand density by thinning would result in the desired condition of improved resiliency of older mixed conifer stands to the effects of fire and potential insect and disease outbreaks. This element is measured by acres of mixed conifer stands thinned.

Alternative 1 would have no direct effects on forest vegetation because no thinning, fuels treatments, or other vegetation modification treatments would occur. Indirect effects of Alternative 1 would include continued vegetation growth without treatment, denser stands, and increased competition between and among trees, leading to mortality. The lodgepole pine component in these mixed conifer stands would continue to grow and would continue to provide suitable mountain pine beetle habitat over time, constituting an increased risk to future beetle infestation and resulting fuels accumulations.

The direct effects of mixed conifer thinning treatments would include reduced stand densities, more open canopies, and variable stand density and structure (meeting Element 4 of the Purpose and Need). Immediately following thinning, stand density would range from 50 to 200 TPA 7" dbh and greater, depending on the forest type, thinning intensity, and the amount of unthinned area within stands. At the individual tree scale, thinning would have the beneficial effect of improved health and vigor and increased growth. Long-term indirect effects at the stand scale would include increased structural complexity characteristic of late seral stands due to understory growth and development and increased species diversity. Fuel treatments also would have the beneficial effect of reducing the likelihood of stand replacement fire effects.

The action alternatives would differ regarding their direct and indirect effects on mixed conifer stands. Alternative 2 would better respond to Element 4 of the Purpose and Need by improving fire resiliency and increasing stand vigor on nearly 50% more acres than Alternative 5. Both action alternatives would result in more beneficial effects to mixed conifer stands than the no action alternative (Table 3-6).

During scoping, an issue was raised regarding the extent and intensity of treatments in lodgepole pine (Issue 6). The no action alternative and the action alternatives differ in terms of both the extent and the intensity of lodgepole pine treatments.

Alternative 1 would have no direct effects on forest vegetation because no thinning, fuels treatments, or other vegetation modification treatments would occur. Alternative 1 would have the indirect effects of continued vegetation growth without treatment, denser stands, increased competition between and among trees, leading to mortality. For lodgepole stands, the indirect effects of Alternative 1 would include continued spread of

the mountain pine beetle outbreak, tree mortality associated with beetle kill, increased fuel loads resulting from beetle-induced mortality, and increased susceptibility to widespread fire.

The immediate direct effects of the action alternatives for lodgepole pine stands would include reduced stand densities (meeting Element 1 of the Purpose and Need), lower number of snags, lower amounts of forest floor litter, and reduced crown volume.

The long-term indirect effects of the action alternatives for lodgepole pine stands would include more space between residual trees, increased light availability, increased species diversity, increased fire resiliency, reduced susceptibility to mountain pine beetle attack, and improved structural diversity over time. Over time, the indirect effects would be increased vigor and health of stands as individual trees increase growth and competitive stress is reduced. For mixed conifer with a lodgepole pine component, long-term beneficial effects at the stand scale would include increased structural complexity characteristic of late seral stands due to understory growth and development and increased species diversity. Fuel treatments also would have the beneficial effect of reducing the likelihood of stand replacement fire effects. At the individual tree scale, thinning would have the beneficial effect of improved health and vigor and increased growth.

For the action alternatives, the beneficial effects of reduced pine beetle habitat and reduced fire hazard would be achieved by lodgepole thinning and overstory removal as well as variable density lodgepole treatment acres. Increased spacing between trees would result in a microclimate that is less hospitable to mountain pine beetle. Treated stands would have greater potential to resist attack by mountain pine beetle. Alternative 2 proposes to treat the greatest extent of lodgepole pine (4,744 total acres) while Alternative 5 would treat a lesser extent (3,506 total acres), thus doing less to reduce mountain pine beetle infestation and resulting mortality.

In terms of intensity of lodgepole treatment, Alternative 2 includes 59 acres of overstory removal treatment in two units (retaining 20 TPA 5” dbh and greater) while Alternative 5 proposes no overstory removal. The variable density treatment in Alternative 2 also proposes a more intense lodgepole pine thinning treatment, retaining 20-70 TPA 5” dbh and greater, while Alternative 5 proposes to retain 30-70 TPA 5” dbh and greater. In terms of extent and intensity, Alternative 2 would have the greatest beneficial effect on modifying mountain pine beetle habitat while Alternative 5 treatments would affect a smaller extent with lower thinning intensity. It is fully recognized that the lodgepole treatments can only influence mountain pine beetle in the stands treated. Over 300,000 acres surrounding the planning area will remain basically “unmanaged”, as these areas occur in land allocations where management is generally precluded and mountain pine beetle will continue to play a natural role across the landscape.

HFRA requires that covered projects retain the largest trees and restore old growth conditions. This section of the Act applies to those actions under Section 102(a)(1), in particular, in the WUI portion of this project. The large tree and old growth components do not apply for those actions taken to reduce or slow the mountain pine beetle outbreak (actions under Section 102(a)(4) of the Act), as treating these areas often includes larger host trees. In mixed conifer stands within WUI, the prescriptions specify thinning from below only, retaining the largest trees and increasing stand resiliency, thus meeting HFRA requirements. Within the lodgepole stands, where the primary objective is to reduce the amount of suitable mountain pine beetle habitat, large (5” dbh and greater)

lodgepole pine will be removed by the thinning prescriptions, which is allowed under HFRA.

Cumulative Effects

Cumulative effects of the action alternatives on forest vegetation are addressed at the scale of the D-Bug planning area landscape. The time frame for analyzing cumulative effects is 30 to 50 years, the period of time that proposed treatments would influence susceptible lodgepole pine stands, treated stands adjacent to developed recreation sites and private dwellings/businesses, and mixed conifer stands in the planning area. Past, present, and reasonably foreseeable activities overlapping spatially and temporally were taken into account in the analysis of vegetative age and structural class distribution (tables 3-1 through 3-3).

Based on past management activities (Table 3-1), approximately six percent of the Clearwater, Lemolo Lake, and Diamond Lake watersheds has been harvested in the last 30+ years in all forest types. Many of the 9,000 acres of regeneration harvest since 1970 are now in open, early seral conditions today, including the lodgepole overstory removal units. Along with fire exclusion, these past activities have created the conditions that exist today.

Current management activities (Table 3-2) include a Title II hazard tree removal project in the Diamond Lake and Lemolo Lake 5th Field Watersheds removing approximately 2,000 hazard trees and the Lemolo Lake Fuels Reduction Project on 1,432 acres in the Lemolo Lake 5th Field. The cumulative effects of present actions and the action alternatives would result in hazard trees being treated across the Diamond Lake and Lemolo Lake 5th Field Watersheds, effectively reducing risks associated with existing hazard trees, high fuel loadings, and high fire risk in areas of high public use. Reasonably foreseeable management activities (Table 3-3) include Phase II of the Diamond Lake Fuels Reduction Project, ongoing hazard tree removal in the Diamond Lake and Lemolo Lake 5th Field watersheds, ongoing Lemolo Watershed Project and PacificCorp activities in the Lemolo Lake 5Th Field Watershed. There would be a beneficial cumulative effect of continued fuels reduction and hazard reduction where the Diamond Lake Phase II activities overlap or adjoin the proposed D-Bug units. By treating more acres, Alternative 2 realizes this beneficial effect to a greater degree than Alternative 5. The continued implementation of the Lemolo Watersheds project would also beneficially contribute to a cumulative effect of increased stand resiliency and reducing fuels where these units adjoin D-Bug units.

Departure from reference conditions was determined by comparing historical vegetation conditions to existing conditions to help assess cumulative effects for lodgepole pine treatments. The historic range of variation of open lodgepole pine forest was likely extreme in a high severity fire regime, varying widely over time from a very low proportion of the landscape in open conditions to a very high proportion of the landscape over time (Table 3-4). The lodgepole thinning and lodgepole overstory removal treatments proposed by the action alternatives would have the cumulative effect of adding to existing openings, but would likely not exceed the historic range of variation for open stand conditions in the lodgepole forest type. Thinning treatments to reduce stand density in mixed conifer stands would result in the cumulative effect of increased resiliency of treated stands to the effects of future fire and insect and disease outbreaks.

Scientific Controversy and Efficacy of Treatments

During scoping, conservation groups stated that there is scientific controversy surrounding the efficacy of logging of lodgepole pine to prevent and suppress the mountain pine beetle outbreak and they requested consideration and disclosure of this controversy. Central to this controversy are the conflicting perspectives on using active forest management versus allowing natural processes to proceed without management intervention. *Logging to Control Insects: the Science and Myths Behind Managing Forest Insect Pests* (Black, 2005) presents the following arguments in favor of allowing natural disturbance processes to occur without management intervention:

- Management has detrimental impacts. Logging roads are vectors for invasive plants, cause fragmentation of existing forest habitat and allow the vehicle access that may harass wildlife. Logging damages residual trees that are intended to function as a future forest structure. Logging may have detrimental consequences to ecological relationships between lodgepole pine forests, mountain pine beetles, fire, and fungi.
- There is little evidence that mountain pine beetle mortality contributes to higher fire hazard.
- There is little evidence that logging can control bark beetles once an outbreak has started.
- Drought and associated high-severity fire events are principal drivers of ecosystems affected by mountain pine beetle outbreaks. Management cannot alter or prevent the effects of wildfire under severe weather conditions.
- Management simplifies forest structure and complex wildlife habitats.

Conversely, peer-reviewed research addressing the efficacy of thinning to reduce the mortality associated with beetle outbreaks demonstrates the potential ecological benefits of management intervention. In fact, the bulk of the literature cited by Black (2005) found that prevention of bark beetle attacks by thinning overly dense forest before, rather than after, an outbreak has started is one of the best methods of reducing infestation and reducing mortality.

The following scientific principles were used to develop the proposed thinning prescriptions and the extent of their application in the D-Bug planning area:

- A high proportion of lodgepole pine in the D-Bug area is very likely to be infested within the next few years, resulting in as much as 90% mortality of overstory pines (Goheen, 2008).
- Although likely effective at the stand level, as proposed in D-Bug, forest management is unlikely to prevent a landscape-scale mountain pine beetle outbreak because of the extent of unmanaged mature lodgepole forest surrounding the D-Bug planning area, the uncertainty of climatic effects on tree stress, and the ability of large numbers of insects to overcome healthy trees (Romme, et al., 1986).
- Thinning may reduce tree-to-tree competition, increase tree vigor and thus reduce the frequency of mountain pine beetle attacks (Amman and Logan, 1998; Shaw, et al., 2009).

- Thinning to a wide spacing of 3 to 4 meters (10 to 13 feet) between residual trees may create a desirable microclimate for “beetle-proofing” a stand (Whitehead and Russo, 2005).
- Thinning lodgepole pine stands may significantly reduce mortality compared to no treatment (Cole, et al., 1983).
- Mountain pine beetle attacks in unmanaged stands were related to tree diameter and spacing among trees, with beetles showing a decided preference for colonizing trees with large diameters. Trees with small diameters (<9” dbh) were rarely attacked unless they were close to other trees under attack (Preisler and Mitchell, 1993).
- Branch wood and needle distributions in dense, untreated lodgepole stands are concentrated in the upper half of the canopy compared to thinned stands. Thirty years after thinning, the fine fuels are more uniformly distributed from the surface to the upper canopy (Gary, 1978). Therefore, thinning is a good long-term strategy for reducing crown fire activity, especially if mortality is reduced by the treatment.
- A multi-age, multi-size tree distribution is often the natural structural effect of mountain pine beetle activity in unmanaged, mature lodgepole stands (British Columbia FPB, 2007). Setting the stage for the development of a similar structure while removing trees to reduce fuel loading in the future are objectives for the proposed variable-density retention. Thinning to create a pattern of stands in various ages and species will limit the amount of continuous food supply both spatially and temporally.

Concerns also were raised during scoping regarding the regrowth of trees following the thinning and overstory removal treatment in lodgepole pine stands. One commenter was concerned that an overabundance of lodgepole pine would regenerate after the stands were treated with thinning or overstory removals. A second commenter was concerned that such treatments would lead to poor regeneration of seedlings due to the low productivity of the soils, harvest impacts, and the climate, referencing data showing poor growth rates of nearby plantations in the planning area. Both commenters observed specific locations in the planning area where plantations are stocked with high seedling densities and extreme competition, resulting in slow growth. Previous treatments in the area led to these conditions because most historic treatments were clearcuts that were also broadcast burned. As such, lodgepole regeneration was stimulated by the broadcast burning, leading to densely stocked plantations.

These concerns are addressed in the action alternatives by treating activity fuels in lodgepole pine units with mechanical fuels treatments instead of burning. Moreover, the lodgepole treatments in the action alternatives, including the overstory removal treatment leaving 20 trees per acre, would maintain both an overstory and an existing midstory and understory that would restrict the ability of lodgepole pine to densely stock the understory. This growth pattern is evident in lodgepole stands in the planning area south of Highway 230 that were thinned over 30 years ago. The established residual leave trees more effectively competed for available soil moisture, thereby preventing new understory lodgepole seedlings from overstocking the area. As such, advanced regeneration already present in these areas would remain largely intact (except in skid trails, estimated to comprise less than 30% of a treatment area), and the areas would thus not function as clearcuts. The retention of live overstory, midstory, and understory trees in these areas does not represent a regeneration harvest nor would they function

as such. Post-treatment stands would remain stocked to meet management guidelines necessary to prevent major losses of dominant and co-dominant trees (Blackburn, 2008), and future stand development would proceed with larger-sized trees, fuller crowns, and higher growth rates than some of the overstocked historic clearcuts in the planning area.

FUELS - TRACKED AS A SIGNIFICANT ISSUE

The purpose of this project is to lessen the fuel and safety hazards associated with the ongoing outbreak of mountain pine beetles and the ongoing impacts from fire exclusion by timely implementation of commercial harvest and non-commercial treatments in strategic locations.

Background

The Diamond Lake area contains about 450 campsites, numerous picnic sites, trailheads, and other recreation sites, a resort/lodge with a large complex of structures and buildings, many miles of high use trails, and more than 100 privately owned recreational residences. The Lemolo Lake area contains another 95 campsites, many more miles of trails, and another lodge complex. In total, these two areas receive well over 700,000 visitor days a year. On any given midsummer weekend, thousands of visitors and workers are likely to be in the area at any one time. A large fire in this area could threaten the safety of thousands of visitors, cause millions of dollars in damage, heavily impact the local economies and livelihoods, cause long-term degradation to scenic and recreational qualities, and cost millions of taxpayer dollars to suppress.

Both the Lemolo Lake and Diamond Lake areas are identified as communities-at-risk in the Federal Register (Vol. 66, No. 160) and are within identified WUIs in Community Wildfire Protection Plans (CWPPs) according to the Healthy Forest Restoration Act (HFRA). For additional information about these CWPPs, including recommended fuels treatments and this proposed project's relationship to HFRA, see Chapter 1.

The Diamond Lake / Lemolo Lake Vegetation Management Plan and Watershed Assessment (WA) Iteration (USDA, Umpqua National Forest, 2008) encompasses the D-Bug planning area and provides a meaningful landscape-scale context for discussing fire and fuel conditions. A detailed discussion of the reference (historic), existing, and desired future conditions is presented in the previous section of this chapter under Forest Vegetation.

To reduce fire hazard in western forests, scientific research overwhelmingly supports a combination of managing tree density, stand canopy characteristics (e.g., canopy bulk density, canopy base height), tree size class distribution, and species composition in combination with surface fuel treatments. (*See* Graham, et al*.*, 1999; Peterson, et al., 2005; Graham, et al., 2004; Agee and Skinner, 2005; Martinson and Omi, 2003; Strom and Fule, 2007; Stephens, et al., 2009; Graham, et al., 2009). The most effective wildfire hazard treatments (i.e., fuels treatments) target crown canopy, ladder, and surface fuels (Graham, et al., 1999; Peterson, et al., 2005; Graham, et al., 2004; Agee and Skinner, 2005). Crown fires are often considered the primary threat to forest resources as well as human values and firefighter and public safety. Crown fires also present the greatest challenges in terms of resistance to control and are most likely to become large and costly (Graham, et al., 2004). Depending on the specific stand conditions and fuels objectives, treatment of surface and ladder fuels is sometimes sufficient in reducing fire hazard without a need to treat canopy fuels. Fuels treatments that treat only canopy characteristics, but ignore surface and/or ladder fuels can increase some metrics of fire

hazard (Graham, et al., 1999). Similarly, treatment of surface fuels alone may not fully address fire hazard associated with canopy fuels. The best available science indicates there are competing variables that are impacted by thinning a forest stand that drive fire behavior calculations. Thinning a stand tends to open the forest floor up to more wind and solar penetration of the canopy. These factors can cause an increase in some fire behavior aspects, most notably midflame wind speed, a key variable in Rate of Spread (ROS) calculations (Weatherspoon, 1996; van Wagtendonk, 1996). Proposed prescriptions are designed to account for these competing variables.

The objective of any fuels treatment is to alter fire behavior within the treated area. Fuelbreaks and defensible space are not designed to stop fires, but to alter fire behavior in a way that allows firefighters a higher probability of success and a relatively safe working environment. In this case, fuelbreaks are also designed to provide a valuable safety cushion between hazardous fire behavior and the public should an evacuation become necessary.

The proposed fuels treatments focus on strategic locations to directly enhance protection of improvements, provide safe evacuation routes, and increase defensible space for firefighters to base suppression efforts. Proposed fuels treatments include fuelbreaks[20], as well as defensible space around structures, improvements, and areas of high human use. Treatments would increase stand resiliency to uncharacteristic fire behavior by protecting large-diameter trees from fire-caused mortality. Some units are also designed to reduce potential fuel loads in stands with substantial lodgepole at high risk to heavy mortality from bark beetle activity anticipated in this area (Goheen, 2008).

Issues Raised in Scoping

During scoping, concerns were raised regarding the location, width, and characteristics of thinning treatments proposed for some of the fuelbreaks. Some commenters questioned the effectiveness of, and impact from, the fuelbreaks and expressed doubt over the effectiveness and necessity of the fuelbreaks. Others encouraged the treatment of even larger areas. This issue is tracked by total acres of key fire behavior classifications within 400 meters of roadside fuelbreaks, evacuation routes, and structures (figures 3-8A and 3-8B, tables 3-13 and 3-14) and several stand-level indicators of fire behavior (Table 2-7). A 400-meter width was selected because this size best meet the purpose and need. This width is generally adequate for the specific conditions, objectives, and values present, and is well documented in the scientific literature as an adequate fuelbreak width (Agee, et al., 2000; Safford, et al., 2009; Quincy Library Group, 1997; Van Wagdendonk, 1996; and described in Arno and Allison-Bunnell, 2002, p. 144).

Several groups felt that the fuelbreaks along the Kelsey Point, Thirsty Creek, and Windigo Pass roads were redundant and not a priority, given they are not within the Lemolo Lake WUI. This is tracked by acres of commercial thinning along these roads (Table 2-7). The redundant fuel breaks within IRA in this area were removed from Alternative 5 in response to public comments.

Some groups questioned the need for treatments within the Mt. Bailey IRA west of the Diamond Lake summer homes, particularly commercial treatments. In response to these

[20] Fuelbreaks in this document refer to “shaded” fuelbreaks, defined as those “created by altering surface fuels, increasing the height to the base of live crown, and opening the canopy by removing trees” (Agee et al., 2000).

concerns, the planning team reexamined this area and determined a portion of the commercial thinning could be dropped in Alternative 5 and still meet the purpose and need, though to a lesser extent. This issue is tracked by acres of commercial thinning and acres with different crown fire and flame length classifications (figures 3-8C and 3-8D and tables 2-7, 3-15 and 3-16) within treatment units in the Mt. Bailey IRA west of the summer homes.

Models and Indicators

A variety of models and data sources were used in this analysis to optimize the ability to examine the tradeoffs using the best available science. Both large-scale (landscape) and stand-level modeling output is used in this analysis as each has unique advantages. The effects analysis is organized by stand and landscape modeling results. Existing conditions within the planning area were determined using Stand Exams (SE), remote sensing (satellite, beetle mortality flights, and aerial photography), and field data collection and validation (summer of 2007). Grouping of like stands and prescriptions was used to characterize the various stands, describe treatments, and display output.

Stand Scale

Forest Vegetation Simulator (FVS) (Dixon, 2010) and its Fire and Fuels Extension (FFE) (Reinhardt and Crookston, 2003) is a vegetation growth and yield model used in this analysis to describe existing conditions and make predictions about future conditions at a stand scale. FVS-FFE is also useful for quantifying the effects of specific prescriptions. FVS-FFE has the capability to model key fire behavior and fuel loading metrics and how they change with time, but it is limited to a stand- or treatment-unit scale. Key metrics generated in FVS-FFE used in this analysis include: Crowning Index (CI), Torching Index (TI), and flame length (surface fire only). CI and TI are defined respectively as the 20-foot wind speed needed to sustain an active crown fire and initiate torching or carry a fire into the canopy (higher values are a lower hazard). Flame length, as measured in FVS, is the length of a flame front under a given set of weather conditions (this analysis used 97th percentile), from the forest floor to the tip of the flame. FVS measures only flame lengths from surface fire and does not include flame lengths associated with crown fire or torching.

Landscape Scale

For landscape-scale assessments, additional satellite-based data was obtained from LandFire[21]. Based on field verification, some alterations to the raster data were made to more closely resemble existing conditions. For each alternative, additional adjustments were made to raster data to express treatment effects. Detailed assumptions and changes are available in the project record. The raster data was then imported and modeled using FlamMap[22] (Finney, et al., 2007) to obtain basic fire behavior outputs at a landscape scale for each alternative. FlamMap is useful in describing some general fire behavior metrics at a large scale and comparing different alternatives, but does not have growth and yield capabilities to model vegetation or fuels dynamics over time. Key metrics generated in FlamMap include crown fire hazard and flame length. Crown fire hazard is broken into three classifications (excluding non-burnable). A value from one to

[21] Satellite derived data is available at LandFire.gov for the lower 48 states that describe forest and fuels conditions appropriate for landscape-level analysis in a grid format (maximum resolution of 30M).
[22] FlamMap model creates raster maps of fire behavior outputs based on LandFire inputs and a Digital Elevation Model (DEM). It is not a fire-spread model, but indicates hazard at a given location. Gridded output is considered independent. In other words, the output in any given cell has no impact on neighboring cells.

three describes, respectively, a surface fire, passive crown fire, and active crown fire threat under the modeled weather conditions (in this case, 97th percentile). Flame length, as measured in FlamMap, is also the length of the flaming front from the forest floor to the tip of the flames. Unlike FVS, FlamMap includes both surface and aerial fuels in assessing flame length. Thus, where torching and crown fire are predicted, the flame length predicted by FlamMap will be much higher. Because “wall-to-wall” data coverage is available for this model, output is not limited by geographic extent. As such, it can be used for larger-scale modeling, but it lacks the site-specific detail that FVS can provide and is not capable of modeling vegetation or fuels dynamics over time.

Existing Conditions

Fire Hazard and Risk

The existing fire hazard in the planning area is predominantly high. A landscape analysis of fire hazard indicates much of the planning area near structures and identified evacuation routes is currently rated as a high hazard due to crown fire potential and dangerous fire behavior (flame lengths)(figures 3-8A and 3-8B, tables 3-13 and 3-14). At a stand scale, there are hazardous conditions, including crown fire potential within treatment units, in close proximity to evacuation routes, proposed fuelbreaks, and infrastructure. Current stand-scale crown fire hazard ranges from moderate to high (Table 3-12) due, in part, to dense stand conditions and ladder fuels that would cause torching and crowning fire behavior under modeled conditions (97th percentile). Predicted flame lengths in these critical areas are dangerously high and would compromise safety of evacuating public and firefighters (Figure 3-8B). The high flame lengths and the presence of crown fire hazard are indicators that the untreated roadsides would make poor fuelbreaks and dangerous evacuation corridors, reducing or eliminating defensibility of structures in the area. The CWPPs for these communities also acknowledge these hazardous conditions. Current and predicted beetle mortality in these areas is expected to further exacerbate the problem where lodgepole and other pine are present in the stand, contributing to fireline intensity, and reducing firefighter effectiveness as mortality and associated fuel loading increases.

There is widespread agreement that wildfires are becoming larger with more expansive areas burned under high severity than experienced in even the recent past in western states. Alarmingly, in the Pacific Northwest, losses of key habitat on public lands from wildfire have often exceeded losses from timber harvest. Fires on the Umpqua National Forest are clearly following this trend, becoming substantially larger in recent history than those experienced in the past five decades. Recent fire seasons have seen numerous large fires with periods of extreme fire growth, large areas of undesirable fire effects, and negative impacts to local business owners and utilities. A recent assessment of acres burned indicates that the Umpqua National Forest ranks fifth in the region (Oregon and Washington) among all national forests in terms of acres burned between 2001 and 2009, and was less than 8,000 acres away from the third ranked forest (internal document). Because these fires burned in areas of dense and continuous vegetation without fuelbreaks, these fires often escaped aggressive, and very expensive, efforts to contain them. These fires forced evacuations, endangered the public and firefighters, closed a major highway accessing the planning area two years in a row and caused major losses of revenue for power utilities, local businesses, and outfitters. In addition, these past fires led to resource damage to recreation facilities, wildlife habitat, timber resources, water resources, and other values. They also cost many millions of tax payer dollars to suppress.

A recent analysis by experts in fire behavior and long-term forecasting during the Boze Fire on the Tiller Ranger District of the Umpqua National Forest compared a critical fire behavior prediction metric (Energy Release Component (ERC)) for two periods of time; 1982 through 1994, and 1995 through 2008. They found that 90th and 97th percentile weather (the hottest and driest ten percent and three percent of days during fire season) rose by ten percentage points and the peak average value went up a full 15 points (Aney and Loomis, 2009, p. 16). The ERCs that occurred during the 2009 fire season would have been “off the charts” for the period of time between 1982 and 1994. If this trend continues, fire size and severity can be expected to increase even more in areas where fuel is not a limiting factor and comprehensive hazardous fuels treatments have not been implemented.

It is not precisely known how climate change will influence fire, insect, disease, and other disturbance regimes and interactions between these disturbances. However, there is general agreement that climate change will cause (or already is causing) uncharacteristic disturbance impacts (magnitude and extent), particularly on over-stocked stands. Should the area become hotter and drier with climatic shifts, tree stress is likely to increase, causing additional mortality and potentially greater expanses of successful bark beetle attack. Because ecosystem health is closely tied to fire hazard goals, it is crucial to carefully consider robust prescriptions that result in stand conditions that are resilient and resistant to a wide variety of future climatic and disturbance-related influences. Fire seasons are likely to continue to extend further and further into the fall and spring (Brown, et al., 2004; Westerling, et al., 2006.), and fires are expected to increase in size and severity in western states (Flannigan, et al., 2000; McKenzie, et al., 2004). In considering the potential for longer fire seasons and more extreme weather events, prudent fire hazard reduction activities become even more critical to the safety of firefighters and public, structures and improvements, as well as the health and resilience of forest habitat, visual quality, and other resource values.

Most acreage burned in these large fires typically occurred when key weather and fuel variables aligned, creating uncontrollable and uncharacteristic fire growth. These extreme fire events are associated with very dry conditions, multiple consecutive days with high Haines indexes (a measure of atmospheric stability), poor night time recovery of relative humidity (commonly associated with a strong high pressure ridge), and availability of dense canopy coverage and/or high surface fuel loads. Of these factors, only one component, fuels/vegetative conditions, can be modified to reduce risk of hazardous fire behavior.

Local fire managers agree that a substantial fire hazard exists within the planning area. They have expressed concerns at public meetings that some structures, including the Diamond Lake recreation residences on the west shore, would not be defensible if a large fire approached given the current adjacent vegetation and fuel conditions,. Furthermore, there are currently no treatments along evacuation routes to increase safety for evacuees or ingress/egress of firefighters, and no available fuelbreaks to manage undesirable fire that threatens human safety, structures, and resource values. A network of fuel breaks and defensible space would also provide fire managers a greater range of response options in dealing with future fires. Given the current continuous fuel loads and extremely high values, public safety, and local economy at stake, fire managers have little choice but to aggressively attack all fires in and around the planning area.

Vegetation and Historic Fire Regime

Lightning is very common in these high-elevation forests. It is not uncommon to have several lightning-caused ignitions from a single storm in and around the planning area. Hundreds, perhaps even thousands, of fires have been suppressed on the district. Prior to active fire suppression, these fires would have burned for weeks or months, resulting in a large, complex mosaic of burned and unburned areas, creating a diversity in age classes, species mixes, and fuel loading conditions. Such conditions are resilient to disturbance and resistant to high-severity fires over large areas.

The vegetation types within the planning area (see Forest Vegetation section) are each uniquely adapted to periodic disturbance from wildland fire. For example, some species, such as ponderosa pine and Douglas-fir, have traits that help them survive frequent low-intensity fire, while others, such as lodgepole pine, have evolved to quickly recolonize areas after wildfire. These species historically depended on a fire disturbance regime to maintain or create landscape-scale forest structures resistant or resilient to insects, disease, and uncharacteristically large or intense wildfire (USDA, Umpqua National Forest, 2008). The vegetation types discussed in the Forest Vegetation section are grouped into three general vegetation types (Table 3-3). In the discussion that follows, the mixed conifer type includes both high- and low-elevation types and lodgepole pine with a conifer understory.

Lodgepole Pine

Both low-intensity and stand-replacement fire were historically common in pure lodgepole stands in the planning area. Although lodgepole of the Pacific Northwest are generally considered non-serotinous (can regenerate without fire), fire is the primary natural regeneration agent. Historically, these fires burned in a patchy mosaic creating patches of different age classes over the landscape (Arno, 2000; Agee, 1993) with different degrees of susceptibility to future insects and stand replacing wildfire. The fire-return interval for lodgepole pine stands in this area is thought to be about 60 to 80 years (Agee, 1993; USDA, Umpqua National Forest, 2008). Low-intensity fires also occurred in lodgepole pine forests of the Pacific Northwest; these fires often spread slowly from log-to-log in what is referred to as “cigarette burns[23]”. Prior to fire exclusion, these low-intensity fires effectively reduced surface fuel loads between the large-scale stand-replacement fire events, and helped minimize fire severity to soil during these events. Prior to fire exclusion, most fuel conditions consisted of relatively light fuels in low quantities, while the vast majority of current conditions consist of relatively heavy fuels in higher concentrations (USDA, Umpqua National Forest, 1998, Appendix A).

Effective fire exclusion over the last century, combined with widespread anthropogenic fire use and lightning caused fire in the late 19th and early 20th centuries[24] in the planning area, have created extensive areas dominated by mature lodgepole (USDA, Umpqua National Forest, 2008). When large areas of a landscape are occupied by mature lodgepole, fires of uncharacteristic extent and intensity (at a landscape scale), and/or uncharacteristically widespread insect outbreaks, often occur. Research in Canada indicates that the current spatial extent of mature lodgepole is uncharacteristic

[23] Lodgepole pine stands generally lack enough fine fuels at the surface to carry low-intensity fire. The tendency of the logs to rot from the inside out cause the cigarette-like tendency typical of low-intensity fire spread prior to fire exclusion (Agee, 1993).

[24] According to analysis done for the Vegetation Management Plan and Watershed Analysis Iteration for this area, use of fire for clearing vegetation was widespread among stockmen. At least three large conflagrations can be documented between 1880 and 1910, at least some of which were started by lightning storms.

and can result in an uncharacteristic extent of high fuel loads (Taylor and Carroll, 2003; Taylor, et al., 2006). When these conditions exist, interactions between wildfire and beetle outbreaks may exacerbate the problem, particularly in areas of high human use and values. The combinations of fire exclusion and bark beetle activity have created, or are predicted to create, high surface fuel loads at an uncharacteristic extent that, when present near structures and areas of high human use, can create a dangerous fire hazard.

Most available research suggests that beetle-caused mortality in lodgepole pine decreases foliar moisture content (while needles remain on the trees following mortality) and increase fuel loads as branchwood and stems begin to fall, causing increases in fire hazard (Kaufmann, et al., 2008; Lynch, et al., 2006; Turner, et al., 1999; Page and Jenkins, 2007). Most scientists, however, acknowledge that additional research is necessary in this area and hazards need to be considered in the context of the landscape and values at risk. In the planning area, it is anticipated that existing and projected hazardous fuel loads would threaten human safety, structures, large-diameter trees, and other values and resources unless managed in key areas.

The current widespread mature lodgepole pine conditions (see Forest Vegetation section), combined with the current and predicted degree of bark beetle mortality, are increasing the risk of large and uncontrollable wildfire. Wildfire hazard is particularly high just after trees die and before the needles fall off (usually one to three years). Hazard may abate for a time, but again increases as dead trees fall and create heavy surface fuel loads, particularly when wind events cause rapid accumulations. This disturbance regime tends to perpetuate itself as another single-age class of lodgepole regenerates over large areas of the landscape (as opposed to smaller scattered patches found in reference conditions). There is a need to manage these conditions where they occur near high visitor-use areas, within the Wildland Urban Interface (WUI), and near evacuation routes. There is also a need to restore patches of differing age classes to increase resiliency to widespread disturbance at the landscape scale in the future, and to reduce existing or potential fuel loads at the stand scale to better approximate reference conditions. Most treatment units are also intended to serve as fuelbreaks, giving firefighters greater tactical options to safely manage a wildfire.

At a stand scale, there is currently a “moderate[25]” crown fire hazard in lodgepole pine within proposed treatment units (Table 3-12). This means it would not take a particularly unusual weather event to cause a crown fire in these stands. This hazard will increase as bark beetle activity continues, particularly for the period of time trees retain dead needles. The hazard increases again as surface fuels accumulate to dangerous levels and a new canopy develops above it. FlamMap output shows a lower crown fire risk in pure lodgepole stands relative to mixed conifer (figures 3-8A and 3-8B). However, a major objective of treating these stands is to preemptively remove some stems to avoid very heavy fuel accumulations in the future. The FlamMap model is not sensitive to this future hazard, but it is important to consider it in this analysis.

Mixed Conifer Including Lodgepole Overstory with Mixed Conifer Understory

The mixed conifer in the planning area historically experienced more frequent fires of low-to-moderate intensity, particularly in the lower elevations of the planning area. These fires killed small patches of trees and tended to leave the largest fire resistant

[25] Based on a classification system of Crown Fire Hazard from Fiedler et al. (2004) using Crowning Index and Torching Index as calculated in FVS-FFE.

trees, such as ponderosa pine and mature Shasta red fir and Douglas-fir. Fire exclusion has resulted in higher densities of shade-tolerant trees, such as white fir, with uncharacteristically high surface fuel loadings (USDA, Umpqua National Forest, 2008; Agee, 1993). Additionally, these stands sustain a higher percentage of fire-intolerant species than existed historically (USDA, Umpqua National Forest, 2008). Large-diameter fire-resistant trees are likely to continue to decline due to unnatural competition, high severity fires, bark beetles, and other related stressors. The current bark beetle activity is expected to increase surface fuel loadings where pine species are present, further exacerbating this problem. At the landscape scale, fire exclusion has also caused a loss of openings and variation in a once relatively patchy landscape (USDA, Umpqua National Forest, 2008). These conditions favor a less variable (spatial and temporal) fire regime, tending towards higher-intensity fires and larger fire size than those experienced in the past (O'Laughlin and Cook, 2003; Hessburg, et al., 2005).

Most mixed conifer stands within the planning area are generally rated as a "high" or "independent crown fire" category for crown fire and torching hazard and have potential for hazardous flame lengths (tables 3-12, 3-13 and 3-14 and figures 3-8A and 3-8B). This means that a crown fire could initiate and move through these areas readily, even with a fairly low wind speed when other weather variables align.

Desired Condition

In general, there is a need to lower the existing fire hazard to protect human safety and improvements in and around the Diamond Lake and Lemolo Lake WUIs, including evacuation routes, summer homes and cabins, lodges, campgrounds, administrative sites, and other areas with high visitor use. There is also a need to modify stand conditions, where feasible, to more closely mimic historical stand structures, protect large "legacy trees" and other natural resources from uncharacteristic wildfire effects, and break up the continuity of mature lodgepole.

The desired conditions for reducing fire hazard is effective and well-placed fuelbreaks[26] and defensible space to protect structures and improvements, shield evacuating public from harm, and provide tactical options for firefighters to safely and efficiently manage a wildfire. Generally, a fuelbreak of about 400 meters is preferred and considered adequate under most conditions. This width is well documented in the literature (Agee, et al., 2000; Safford, et al,. 2009; Quincy Library Group, 1994; Van Wagdendonk, 1996; and described in Arno and Allison-Bunnell, 2002, p. 144), supported by many local fire managers, and meets firefighter and public safety objectives. It also meets firefighter effectiveness requirements for this area considering radiant heat, spotting distances, anticipated flame lengths, and other factors. Many of the fuel breaks in this planning area were constricted from this width due to land allocations and designations, specific resource concerns, and in response to public comments. In some cases, the fuelbreak would extend beyond 400 meters to address specific threats, to avoid temporary road building (by extending the unit to an existing road), and to treat mixed conifer stands, where appropriate, to meet this element of the purpose and need.

[26] The value of established fuelbreaks during wildfire suppression is well tested and documented (WFLC 2008, Weatherspoon and Skinner 1996, USDA/USDI 2007, Loehle 2004, Schroeder 2006). However, scientific controversy exists as measuring success in this treatment type is elusive and a subject of debate (Agee et al. 2000) leading some researchers to question the value of improperly placed fuelbreaks or fuelbreaks planned without a landscape context specific to local environmental factors (Finney and Cohen 2003, Van Wagtendonk 1996).

The desired condition in areas with substantial lodgepole pine at risk to bark-beetle-caused mortality is the preemptive removal of future fuel loadings in areas critical to fire control and safety. The desired condition within fuelbreaks include stand conditions that moderate fire behavior so the public could evacuate safely if it becomes necessary and undesirable fire can be controlled.

Low crown fire hazard ratings (see next section) are desired within fuelbreaks and defensible space units, particularly near the center of fuelbreaks (nearest the roads in this case) and nearest structures. A moderate crown fire rating is tolerable in mixed conifer units due to taller trees and higher canopy base heights. This characteristic makes these stands more resistant to crown fire initiation from surface fire and limits interaction between surface and crown fire behavior. Generally, a reduction of flame lengths (surface fuels) to less than four to eight feet for most acres near structures and evacuation routes is also desired. Such surface fuel reductions would allow firefighters alone, or with ground-based equipment (i.e., engines), to protect structures in relative safety.

Direct and Indirect Effects

Both stand-scale and landscape-scale models were selected and used for modeling effectiveness, honing prescriptions, and communicating effects. This section is divided into stand- and landscape-scale assessments, which are discussed separately.

Stand-Scale Assessment

Assessment at the stand scale using FVS-FFE provides the ability to accurately model existing conditions in specific locations based on detailed data gathered in the field (stand exams). The model is also useful because its vegetation and fuels dynamics modeling capabilities allow the projection of treatment effects into the future. The thirty-year projection period (2010–2040) chosen for fuels analysis represents the maximum estimated maintenance interval when additional non-commercial work is predicted to be required to maintain the treatment effectiveness. Output was calculated at time intervals that include: immediately pre-treatment (2010, the existing condition), the first year following all treatment (2014), and three cycles of ten-year intervals (from pre-treatment) until 2040. A complete analysis and detailed description can be found in the project record. A limitation of this model is that it is not sensitive to within-stand variation. Thus, the condition at any given point within a stand may not resemble the composite condition provided by the model.

Three indicators were selected to represent each of the three fuels strata responsible for fire spread: surface, ladder, and crown. The same indicators were used for each alternative and each vegetation type. Crown fire hazard and the hazard associated with ladder fuels has been calculated and classified[27] for each alternative to compare the effectiveness of proposed prescriptions within treatment units to doing nothing (No Action) (Figure 3-12).

<u>Alternative 1 – No Action / Effects of Failing to Implement</u>

Selection of the Alternative 1, or failure to implement the project for other reasons, would result in fuel and vegetation conditions within proposed units that would pose continued and worsening unnecessary risk to the safety of visitors and firefighters as well as the structures, improvements, recreational/visual quality, and other resource values in this

[27] Classifications are based on Crowning Index (CI) and Torching Index (TI). Classifications into High (<25mph), Moderate (25-50 mph), and Low (50 mph+) are based on Fiedler et al. (2004).

area (Table 3-12). No acres would be treated to respond to existing and anticipated hazardous fuels conditions and no measurable reductions in hazardous fuels and vegetation would occur. Potential fire behavior within units would not accommodate safe suppression actions or evacuations of the thousands of visitors and workers that occupy this area on a given summer weekend. Hazardous conditions are expected to worsen in stands with a lodgepole pine component as beetle-caused mortality increases. Fire managers in this area have expressed concern that they will not be able to defend many properties in the project area when a large fire approaches.

Alternatives 2 and 5 – Action Alternatives

Both action alternatives would thin and remove trees and fuels from the stands, reducing canopy continuity and the potential for crown fire spread. Action alternatives also treat the midstory, or “ladder fuels”, and surface fuels within treatment units. Treatment prescriptions are nearly identical between alternatives, differing mainly in geographic extent of treatments as outlined in Chapter 2. Alternative 2 treats more acreage than Alternative 5 and produces slightly higher benefits in terms of acres of reduced threat (Table 2-7).

The action alternatives reduce the potential for crown fire to carry or initiate within treatment units. Treaments under the action alternatives also maintain manageable fire behavior in surface fuels by treating activity fuels in the highest priority areas, such as adjacent to buildings, visitor-use areas and near the center of fuelbreaks where the most benign fire behavior is needed (figures 3-8A, 3-8B). In other areas, some surface fuel will be left to meet relevant standards or address habitat considerations (see Wildlife section).

For most vegetation types, existing crown fire hazard is considered high and would remain so if no action were taken (higher values [mph] indicate a lower hazard) (analysis in project record). The treatments in action alternatives would reduce the hazard to a moderate or low rating for a period of time before the effectiveness begins to taper off, eventually reaching levels similar to existing conditions. For example, figures 3-7A and 3-7B show the average CI[28] and TI for mixed conifer stands within treatment units before and after treatment. The existing condition represents a high crown fire and torching hazard. The treatments detailed in both action alternatives would immediately reduce the hazard for both CI and TI to moderate in 2011 (above 25 mph). An additional spike (lower hazard) in TI is observed in 2021 where a maintenance non-commercial thin is scheduled. Because thinning of overstory trees was not modeled in the maintenance entry, a comparatively small and more temporary gain in CI is demonstrated in 2021. The other vegetation types respond in a very similar way (see project record for additional detail). According to this analysis and knowledge of local managers, the duration of treatment effectiveness would last from 10 to 30 years.

[28] Crowning Index (CI) and Torching Index (TI) are used to measure the propensity of a stand to crown fire, defined respectively as the 20 foot wind speed (higher value represents a lower hazard) necessary to sustain and initiate a crown fire (see glossary). These classifications are discussed below while more details (e.g. changes to the actual values for CI and TI) are available in the project record.

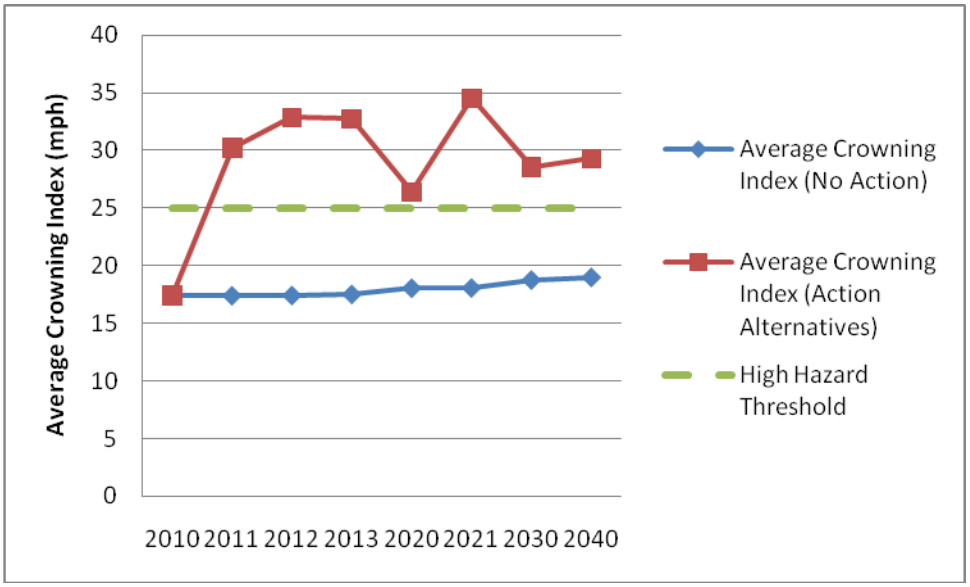


Figure 3-7A. Crowning Index in treated and untreated Mixed Conifer stands.

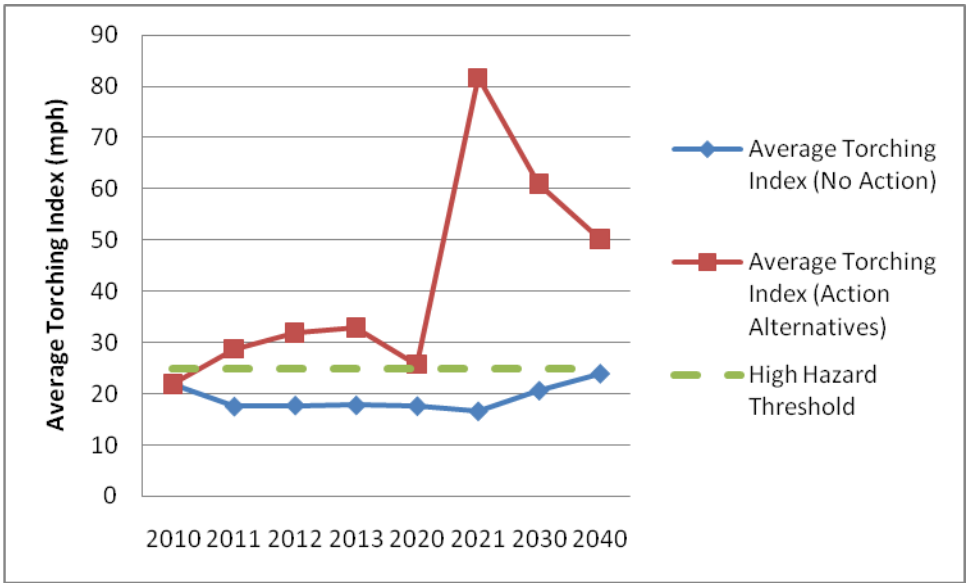


Figure 3-7B. Index in treated and untreated Mixed Conifer stands.

According to FVS-FFE, surface fuel flame lengths following treatment under action alternatives generally do not change drastically with treatment and stay below eight feet in height under the severe fire behavior weather conditions assumed in modeling. This is important because it means the fire could be successfully attacked by ground forces under the action alternatives. In interpreting this output, it is important to note that FVS-FFE models only flame length from surface fuels and does not include flame lengths associated with torching and crown fire. In examining flame length output from models sensitive to these types of fire behavior (i.e., FlamMap), it is apparent that treatment effects substantially reduce overall flame lengths within treated units when these types of fire behavior are considered (Figure 3-8B). The FVS-FFE model is not sensitive to this difference due to limitations of the model. It is appropriate to consider the output from

each of these models to properly assess the tradeoffs between alternatives. A more complete discussion of FlamMap flame length output is provided below.

Table 3-12. Wildfire hazard indicators per vegetation type before and after treatment (including mastication).

Vegetation Type	Crown Fire Hazard*		Ladder Fuel Hazard*		Flame Length <8'*	
	2010	2013	2010	2013	2010	2013
LP	Mod	Low	High	Mod	Yes	Yes
LPMC	High	Low	High	Mod	Yes	Yes
MC	High	Mod	High	Mod/Low	Yes	Yes

LP = Lodgepole pine
LPMC = Lodgepole pine with an understory of mixed conifer including submerchantable stands.
MC = Mixed conifer including both "high" and "low elevation" mixed conifer identified in the Forest Vegetation section.
*Differences in alternatives are expressed as differences in the extents of these results (see Alternatives section of Chapter 2.

The predicted change to fire behavior within fuelbreaks provides evidence of the treatment effectiveness. Moreover, fuelbreaks provide firefighters the opportunity to safely defend the WUIs and evacuatation routes when the need arises. Without proposed fuelbreaks, firefighters may not be deployed to these areas during difficult fire weather.

Landscape Effects

Assessing conditions and treatment effects at larger extents provides context of the treatment at a more ecologically meaningful scale. It is generally necessary to use remote sensing to assess physical conditions at large scales. LandFire data is widely recognized and is frequently used for this purpose and provides the necessary data coverages to import into FlamMap and other landscape-scale modeling software to run a wide variety of fire models.

To assess differences between alternatives at a large, but still meaningful scale, two analysis areas were used (Figure 3-8). One analysis area (12,737 acres) includes a 400-meter buffer area around all evacuation roads, critical fuelbreaks, and structures. This distance was selected because it focuses the output on the highest-priority areas - those immediately adjacent to structures, evacuation roads, and critical fuelbreaks and the most likely places for people to be located. A second analysis area (689 acres) includes a key area 400 meters west of the loop road near the Diamond Lake summer homes, and was developed to respond to specific comments and concerns within the IRA west of the summer homes area (Figure 3-8).

During scoping, an issue was raised regarding the need for "redundant" fuelbreaks in the Windigo Pass area under Alternative 2. Although no current models will effectively quantify tradeoffs of multiple fuelbreaks, there is substantial research linking:

1) lower burn probability with treatment of greater proportions of a landscape (Finney, 2001; Finney, et al., 2007);
2) reductions in fire size with compartmentalizing areas using fuelbreaks (Agee, 2000; Rigolot, 2002; Quincy Library Group, 1997);

3) reductions in rate of spread and area burned with additional overlapping patterns of treatments that disconnect fuel continuity (Finney, 2001; Palma, et al., 2007; Loehle, 2004; Finney, et al., 2007); and
4) increasing the resiliency of untreated acres to stand-replacement fire in proximity to treated acres in what is sometimes called a "fire shadow[29]" or "leverage[30]" (Loehle, 2004; Ager, et al., 2007).

Additional fuelbreaks may also serve as "back-up" or secondary fuelbreaks should one fail (i.e., firefighters do not arrive in time to stop fire burning through primary fuelbreak). Because visitor use and motorized access mainly occurs along or near roads, roadside vegetation is often where fires start (e.g., cigarettes, non-functional spark arrestors, vehicle fires, sparks from roadwork). An additional benefit of fuels treatments along roads is the higher probability of suppression success when fires start in this area. This success is based on relatively early detection, slow rate of spread, and controllable fire behavior compared to untreated vegetation. Furthermore, fuelbreak prescriptions proposed in these areas are carefully designed to restore forest structure, increasing likelihood large trees will remain within treated units over time. However, in response to public comments, Alternative 5 no longer includes the fuelsbreaks east of Windigo Pass. Alternative 2 retains the redundant fuel breaks.

Table 2-7 shows the potential treatment acres by alternative that would beneficially lower fire hazard within fuelbreaks along Windigo Pass, Kelsey Point Road and Thirsty Creek Road, further reducing crown fire hazard and increasing the chances firefighters would successfully stop a fire coming from out of the OCRA or Mt. Thielsen Wilderness.

Alternative 1 – No Action

As can be seen in figures 3-8A and 3-8B and tables 3-13 and 3-14, hazardous crown fire conditions and dangerous fire behavior are common along critical evacuation corridors, strategic fuel breaks, and within close proximity to structures, campgrounds, and other areas frequented by people. This hazard will increase where pine species are present as bark beetle mortality expands within the planning area. Areas currently occupied by lodgepole pine that appear relatively benign under current conditions, such as portions of the "triangle" (north of Crater Lake National Park, between highways 138 and 230), will become more hazardous due to ongoing bark beetle mortality.

Important fire behavior information for the critical area within the Mt. Bailey IRA west of the summer homes is displayed in figures 3-8C and 3-8D and tables 3-15 and 3-16 cover. They show the current hazardous conditions and their juxtaposition with the locations of summer homes and the only evacuation route available to access and evacuate this area. The threat posed to this particular area is demonstrated by the hazardous conditions found immediately adjacent to this critical area.

[29] In terms of fire effects, the "shadow effect" (or "fire shadows") is lower-intensity or severity fire behavior or unburned vegetation downwind of fuels treatment units (assuming the fire is not stopped by suppression at the treated area). As the fire burns into the treated area, fire behavior is subdued. As the fire passes back into untreated area, it takes time to rebuild momentum, leaving an area with lower fire effects that "shadow" the treatment unit.

[30] Leverage is the theory that a single acre of fuel reduction can protect, or lesson impacts on, additional (untreated) acres. It is expressed as the number of acres protected per acre treated. Well-placed, strategically positioned fuels treatments of sufficient size have higher leverage than small or random treatments. Based on simulation modeling by Loehle (2004), a conservative estimate by the fire ecologist of leverage in this project would be 1.5 / 1.

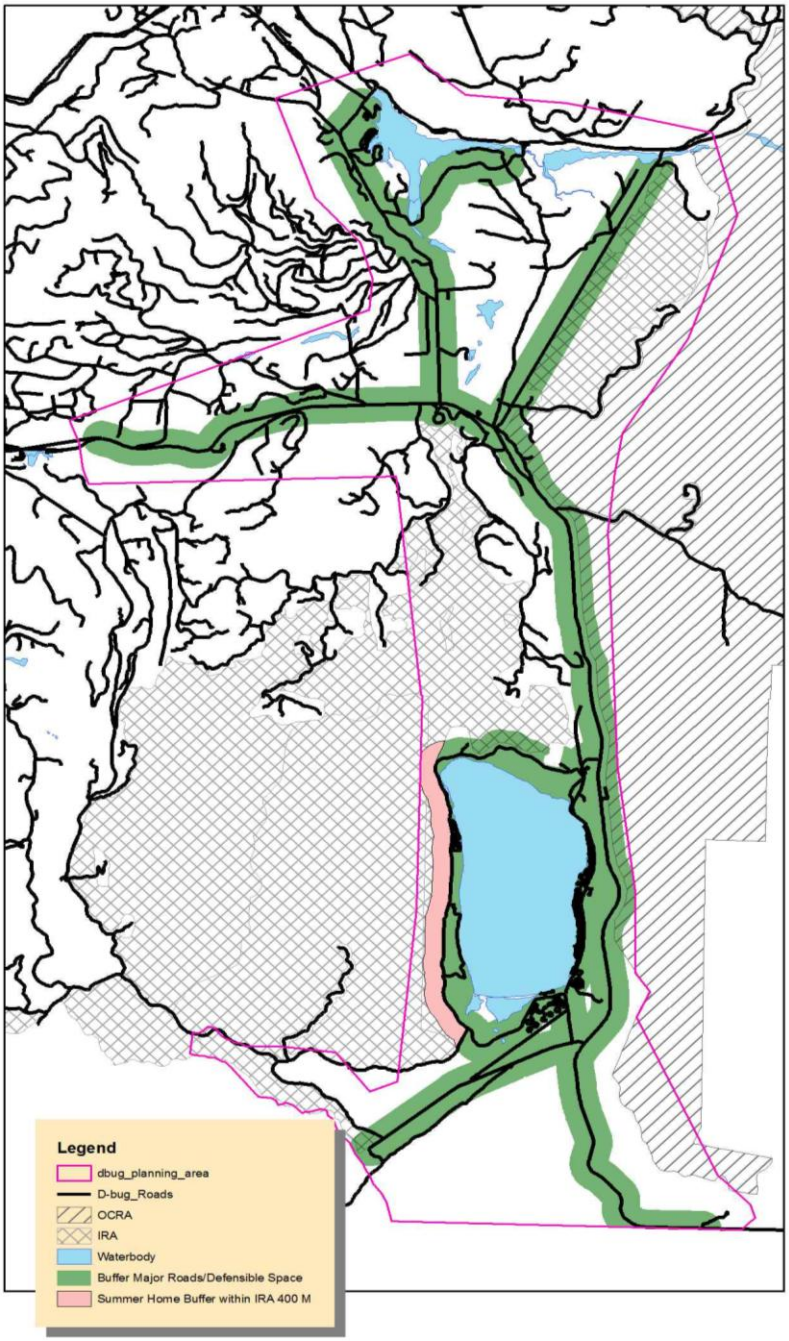


Figure 3-8. Analysis areas used for FlamMap output tables.

Selection of the Alternative 1, or failure to implement the project for other reasons, would result in fuel and vegetation conditions that would pose continued unnecessary risk to the safety of visitors and firefighters, as well as the structures, improvements, recreational/visual quality, and other resource values in this area. No acres would be treated to respond to existing and anticipated hazardous fuels conditions and no measurable reductions in hazardous fuels and vegetation would occur. It would be unlikely that the Diamond Lake summer homes and other structures in the planning area could be safely defended if a large wildfire approached. The safety of the evacuating

public would be in jeopardy along roads adjacent to hazardous fuels conditions. It may be unsafe for firefighters and law enforcement to even access the structures in order to notify visitors and homeowners of evacuation plans. Firefighters would have very few options for managing large fire growth because roads and other features would be ineffective because the break in fuel continuity would be too narrow given predicted fire behavior. Firefighters would not have defensible space to work from in order to protect structures and public safety. Fire managers would have fewer options in responding to fires throughout this landscape. In responding to small fires, they would have little choice but to respond aggressively, which often cost more, exposes firefighters to inherent risks, and exacerbates problems caused by fire exclusion. When dense and continuous fuels and vegetation are present between a given fire start and values at risk or public safety, fire managers have fewer options in responding to these wildfires.

Because under Alternative 1 no thinning or hazardous fuel would be treated, no indirect gains would be realized.

Alternatives 2 and 5

As can be seen in figures 3-8A and 3-8B and tables 3-13 and 3-14, both action alternatives substantially reduce hazardous fire conditions within treatment units in critical areas. Much of the area remaining in a hazardous condition is within riparian and other resource buffers or outside treatment units. Although the hazard remains (physical condition of the stand), the risk is lower than in other areas with similar conditions because the fuel moisture and weather conditions needed for these areas to burn erratically is less likely to occur. Although both action alternatives are effective and meet the purpose and need, Alternative 2 is considered slightly better than Alternative 5 because more acres are moved from a higher to lower hazard classification.

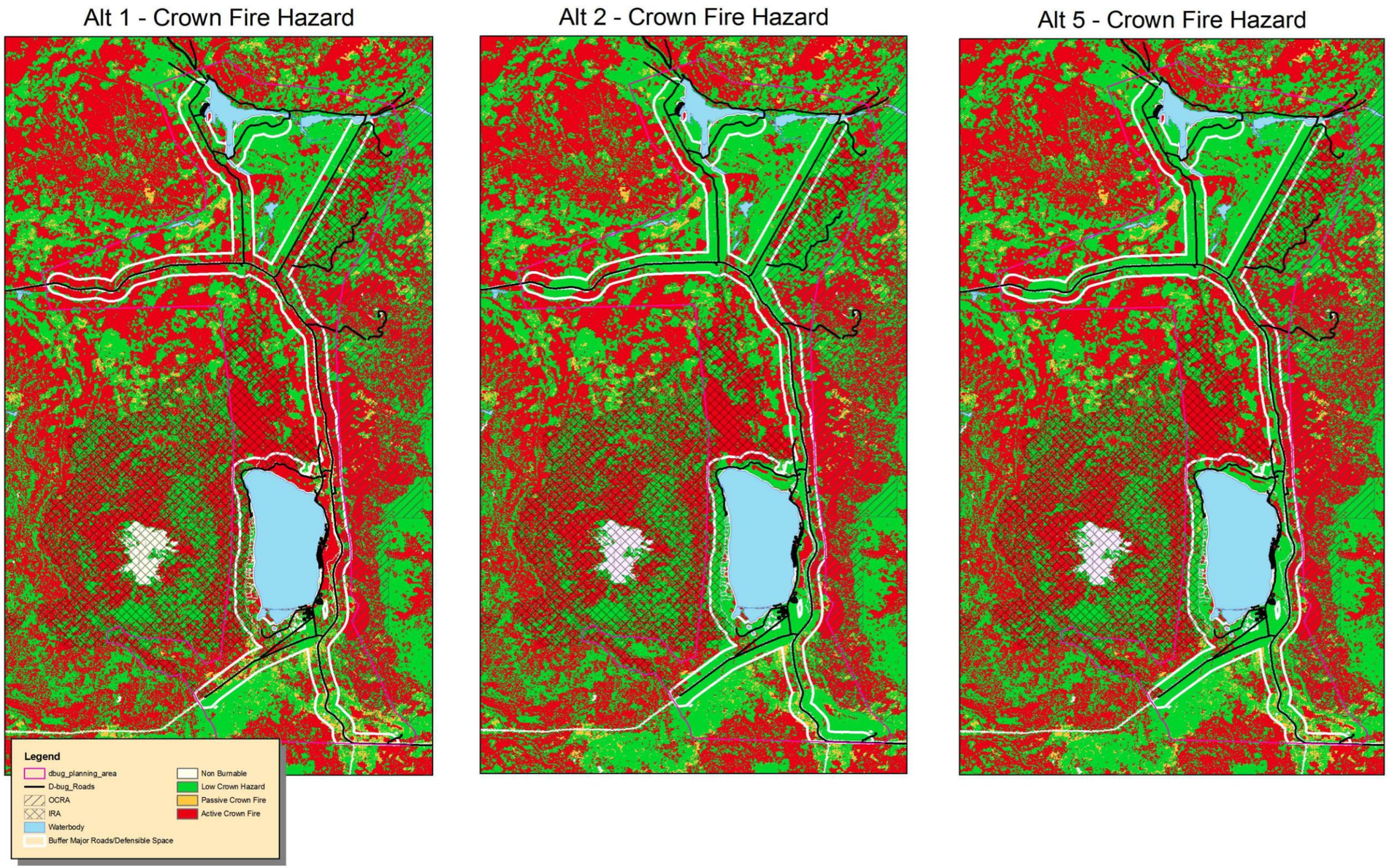


Figure 3-8A. Crown fire hazard classifications for each alternative with 400 meter analysis area identified in white.

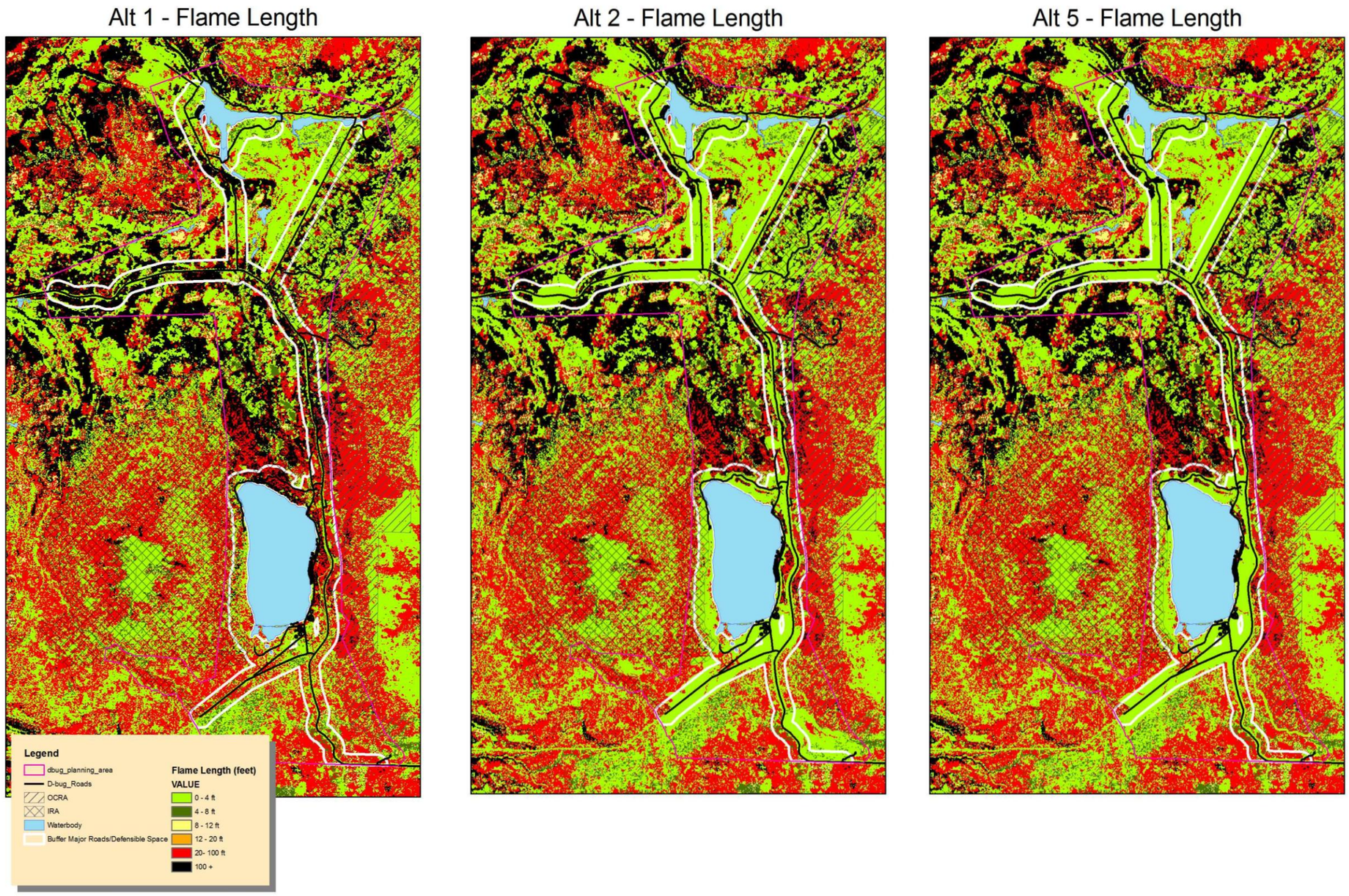


Figure 3-8B. Flame length classifications for each alternative with 400 meter analysis area identified in white.

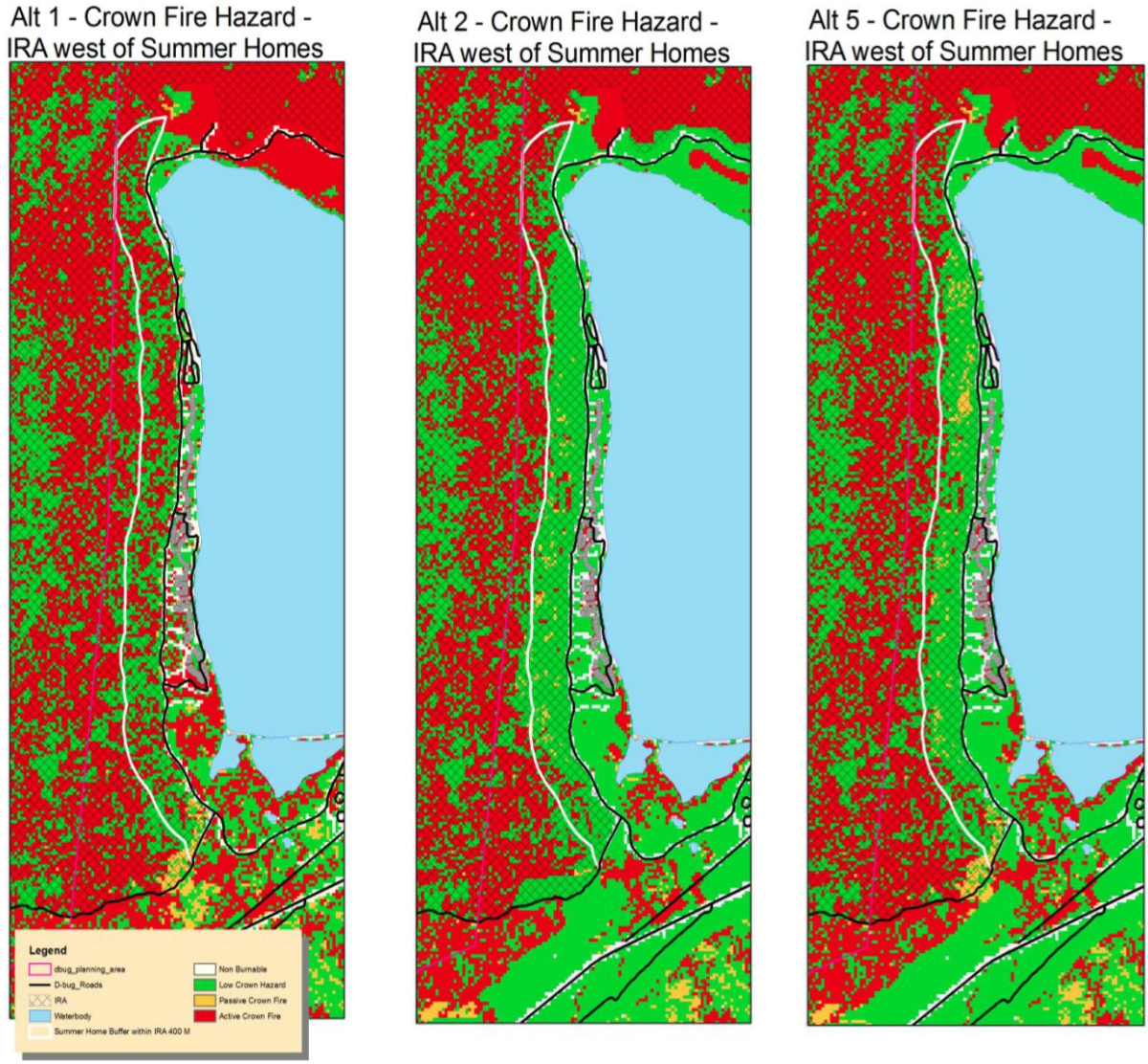


Figure 3-8C. Crown Fire Hazard classifications for each alternative with Summer Home analysis area identified in white.

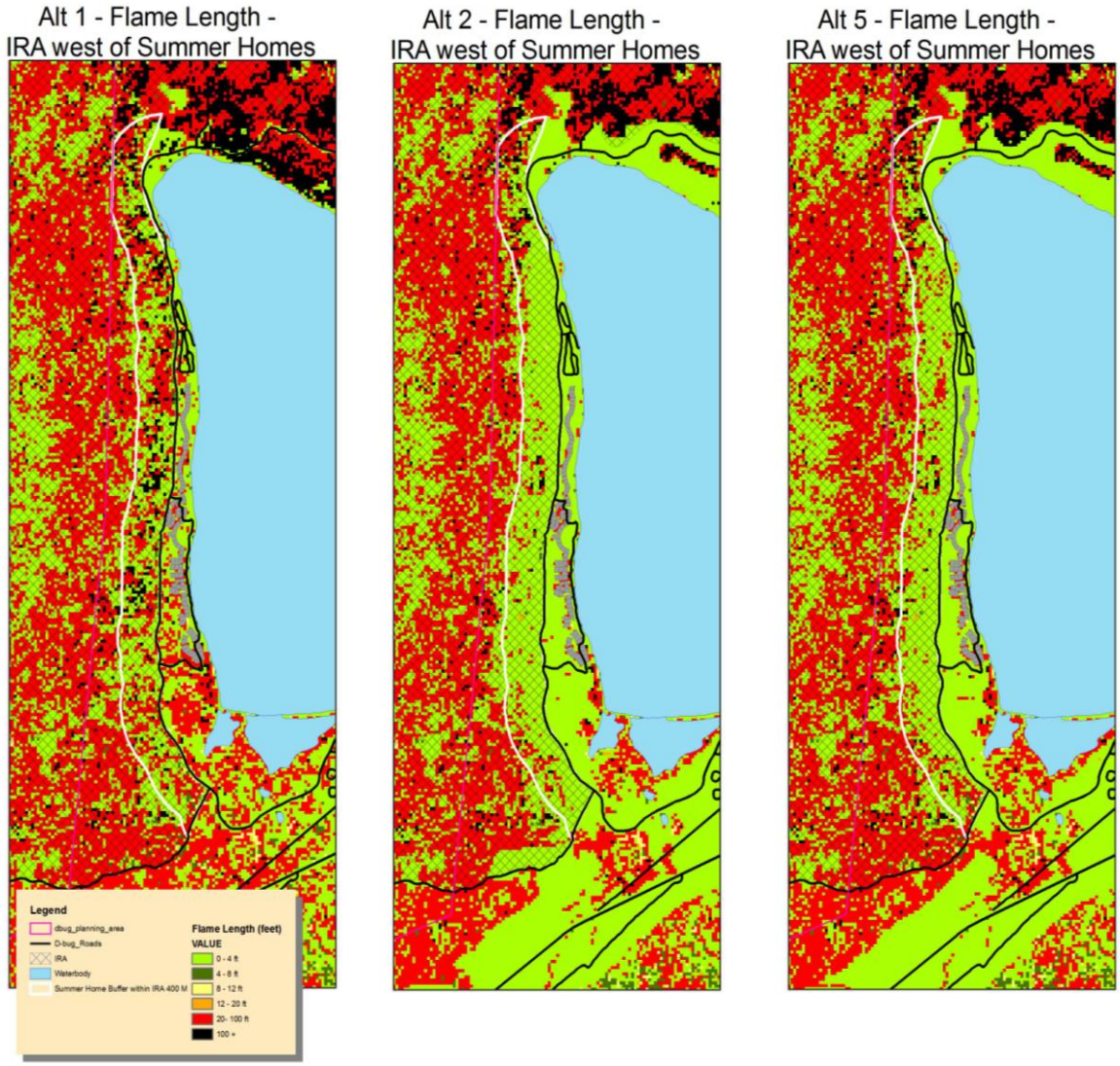


Figure 3-8D. Flame length classifications for each alternative with Summer Home analysis area identified in white.

Table 3-13. Number of acres within 400 meter analysis area under each Crown Fire Hazard classificiation for each alternative.

	Alt 1	Alt 2	Alt 5
0 (non-burnable)	1,343	1,343	1,343
1 – Surface Fire	5,503	8,228	8,139
2 – Passive Crown Fire	600	257	317
3 – Active Crown Fire	5,291	2,909	2,937
Total	**12,737**	**12,737**	**12,736**

Table 3-14. Number of acres within 400 meter analysis area under each flame length clasfficiation for each alternative.

	Alt 1	Alt 2	Alt 5
0-4 feet (low hazard, attack with firefighters on foot)	6,062	9,201	9,092
4-8 feet (moderate hazard, attack with equipment	651	306	312
8-12 feet (high hazard, attach with air resources and some equipment at flanks)	145	73	88
12-20 feet (very high hazard, firefighting has little effect)	21	12	14
20 – 100 feet (very high hazard, firefighting efforts not effective)	3,287	1,746	1,822
100 + feet (extreme hazard, firefighting efforts not effective).	2,571	1,399	1,410
Total	**12,737**	**12,737**	**12,738**

Each action alternative treats within the critical area adjacent to the summer homes west of Diamond Lake (figures 3-8C and 3-8D). Model output demonstrates the effectiveness of proposed treatments under the action alternatives in moderating fire behavior in this critical area. Because the commercial thinning component was reduced in Alternative 5

in response to public comments, a minor reduction in benefit is realized. In portions of this area where commercial thinning was dropped, Alternative 2 reduces crown fire hazard and flame lengths to a greater degree than Alternative 5. The isolated and patchy nature of the remaining hazard in Alternative 5 should mitigate this hazard. If surface and ladder fuels are effectively treated, and the continuity of canopy fuels is disrupted by natural openings, areas of relatively dense canopy can be tolerated. This is because an approaching crown fire, under most circumstances, will drop to the surface when it encounters an opening, and will not be able to climb back into the crowns because of a lack of insufficient surface and ladder fuels. It is important to note that this concession was made based on careful scrutiny of this particular area in the field and the unique circumstances within these stands. This logic does not apply elsewhere within the IRA analysis area where commercial thinning remains or in other units within the planning area.

Table 3-15. Number of acres within 400 meters of summer homes/IRA analysis area under each Crown Fire Hazard classification for each alternative.

	Alt 1	Alt 2	Alt 5
0 (non-burnable)	28	28	28
1 – Surface Fire	344	530	484
2 – Passive Crown Fire	15	22	44
3 – Active Crown Fire	302	109	134
Total	**689**	**689**	**690**

Table 3-16. Number of acres within 400 meters of summer homes/IRA analysis area under each Flame Length classification for each alternative.

	Alt 1	Alt 2	Alt 5
0-4 feet (low hazard, attack with firefighters on foot)	363	557	508
4-8 feet (moderate hazard, attack with equipment	7	2	4
8-12 feet (high hazard, attack with air resources and some equipment at flanks)	2	2	3
12-20 feet (very high hazard, firefighting has little effect)	0	0	3
20 – 100 feet (very high hazard, firefighting efforts not effective)	246	105	143

	Alt 1	Alt 2	Alt 5
100 + feet (extreme hazard, firefighting efforts not effective).	71	24	28
Total	**689**	**690**	**689**

Thinning under the action alternatives would have the indirect landscape effects of lowering the risk of crown fire and reducing uncharacteristic wildfire effects to the WUIs, evacuation routes, as well as adjacent landscapes, and creating fuelbreaks that provide firefighters operational advantages to safely manage an undesirable or dangerous wildfire that would otherwise continue to spread. These action alternatives would also reduce the risk of crown fire to areas outside WUI and treatment units even if firefighters fail to stop the fire at the fuelbreak because fire behavior would be subdued in treatment areas. As it passes back into untreated areas it takes time to rebuild momentum, leaving an area of lower fire effects that “shadows” the treatment areas (Figure 3-7) (Collins, et al., 2010).

Under the action alternatives, the fuelbreaks would help reduce the risk of uncharacteristic fire and the effects of those fires in adjacent landscapes, provide protection to structures and improvements, and provide safe evacuation opportunities for a period of between 10 and 30 years. Treatments proposed under the action alternatives would increase the chances for successful suppression of fires within treated areas, as well as stopping a large fire at the fuelbreak. As the treated stands develop larger diameter trees with thicker bark, the efficacy of the fuelbreaks is predicted to increase over the decades as long as maintenance treatments occur to keep surface and ladder fuels at acceptable levels.

Connected/Similar Actions

Of the connected/similar actions described in Chapter 2, only two are pertinent to fire and fuels. About 300 acres of precommercial thinning (PCT) is proposed to occur within the planning area in each action alternative. The direct effect of the PCT treatments would be a short-term increase in surface fuels for a period of about five years, resulting in an increased risk of higher intensity fire behavior for a short time, until the slash is broken down and decomposed. In the long run, the increased distance between the thinned sapling and pole-size trees would have the indirect effect of moderating future fire behavior (by slowing a fire down) by separating and reducing these ladder fuels. This would further lower the risk of tree and stand mortality, should a future wildfire occur.

The second connected action would be wildlife down log creation that would occur in each action alternative. This action would create between 800 and 1,164 downed logs through methods such as inoculation or girdling/felling. These logs would be retained on the landscape as wildlife habitat and are not expected to present a hazard for torching or fire spread due to the wide spacing of the logs, their large size, and the low density of these additional fuels.

Cumulative Effects

The area chosen for cumulative effects is the entire Diamond Lake and Lemolo Lake fifth-field watersheds and the Clearwater River Headwaters and Stump Lake sixth-field subwatersheds (see tables 3-1, 3-2, and 3-3). The time frame for analyzing cumulative effects is all past management since the early 1900s and for 30 years into the future.

This area was chosen because it fully encompasses all treatment units and any potential interactions in terms of fire behavior between treatment units or adjacent or nearby stands. The time frame was chosen as it represents the estimated earliest timeframe that could impact fuels concerns and the maximum useful lifespan of the fuelbreaks and defensible space treatments.

There have been numerous timber sales within the analysis area that have influenced stand conditions and fuel loadings such as the Lemolo Watershed Project and Diamond Lake Hazardous Fuels phases I and II (*see* tables 3-1 and 3-2). The impacts from these sales, and any other unlisted sales or management actions, are captured by current stand exam and fuel loading data collected following these actions. There are no reasonably foreseeable future timber sales (*see* Table 3-3) in the analysis area at this time.

Within the analysis area, numerous non-commercial thinning units have been thinned in the past (Table 3-1) and several are presently ongoing (Table 3-2) and scheduled to continue in the reasonably foreseeable future (Table 3-3). These thinnings were done as pre-commercial thins or specifically for fuels reduction purposes. Many of these units were hand piled and burned. Hundreds of acres have also been underburned in the analysis area. Burning had the beneficial effect of lowering surface fuel loads and thinning small diameter trees. These past practices have reduced fuel loadings over much of the area, have increased the distance between tree crowns (lessening the risk of crown fires), have lowered the risk of stand loss to potential wildfires within thinned areas and changed the current baseline surface fuel conditions in the managed stands. These previous, ongoing, or future activities will ultimately enhance the effectiveness of activities proposed under action alternatives.

Past thinning and burning in combination with either action alternative would have the beneficial incremental cumulative effect of further reducing crown fire potential by reducing fire hazard and lowering the probability of stand-replacement fire. The magnitude of this effect would not differ by alternative. Alternative 1 would not contribute to this beneficial cumulative effect of reducing fuels and associated fire hazard across the landscape, as no treatment would occur.

COARSE WOODY DEBRIS

Coarse woody debris (CWD) is defined here as standing dead trees (snags) and large down woody debris (≥6" diameter). These forest components provide essential habitat for many species of wildlife, plants, fungi, liverworts, mosses, lichens, and ecological processes. Coarse wood helps provide for the maintenance and eventual recovery of late-successional organisms in the matrix land allocation (NWFP ROD B-7).

Relevant Standards and Guidelines

Forest plans provide standards and guidelines to direct management. Standard and guidelines and management area prescriptions were considered "mitigation measures" as discussed in the LRMP FEIS (USDA 1990, II-23). The FEIS (USDA 1990, 11-23, IV-2) states that mitigation measures are an integral part of implementation and are taken to cause an action to be less harsh or severe. They may take the form of avoiding, minimizing, correcting, or compensating for adverse effects. This definition is similar to that described later in the Habitat Conservation Planning Handbook (USFWS/NOAA 1996), which defines mitigation as measures taken to avoid, minimize, rectify, reduce, eliminate or compensate for the expected impacts of a management action. The mitigation measures in the FEIS were designed to provide a continuous supply of snags

through time as well as providing snags on harvest areas in conjunction with timber harvest activities (USDA 1990, IV-78). The standards and guidelines and management area prescriptions for snags and down wood in the LRMP include:

Wildlife S&G#1 - Woody material to provide wildlife cover will be retained on ten percent of the area of all regeneration harvest units (D-22).

Wildlife S&G#2 - Down, dead woody material (20 feet or more in length) and a minimum of 12 inches in diameter at the small end) will be left at the rate of two per acre on each unit that is regeneration harvested. Additional material will be left when logs have little or no commercial value and do not produce an unacceptable fire hazard (D-22).

Wildlife S&G#18 - When possible, wildlife trees (snags and green culls) will be left standing in areas of timber harvest. This habitat will be in addition to that provided by implementing the snag habitat prescriptions (D-23).

Management Area 10 - Focus is to produce timber on a cost-efficient sustainable basis consistent with other resource objectives for wildlife habitat, riparian habitat and water quality, visual quality, and recreation. Adequate snag habitat must be provided in this management area to meet the 60 percent potential population capability (PPC) for cavity nesters (FEIS IV-128). A snag is defined by the FLMP as any dead, partially dead or defective (cull) tree at least ten inches in diameter at breast height and at least six feet tall (FEIS III-72). Modifications for snag habitat prescriptions (and down wood) were provided by the Northwest Forest Plan (1994), which led to watershed analyses (WA) and LSR assessments (LSRA). These modifications are based on site specific information and the latest scientific information. The standards and guidelines in the Northwest Forest Plan were designed, in part, to maintain [through time] ecological components such as down logs, snags, and large trees (ROD B-2). These CWD components account for two of the five structural elements of late-successional forest stands, described as:

1. Live old-growth trees
2. Standing dead trees (snags)
3. Fallen trees or logs
4. Multiple canopy layers
5. Canopy gaps

The ROD further states that desired late-successional and old-growth characteristics include (ROD B-5):

1. Multi-species and multi-layered assemblages of trees
2. Moderate-to-high accumulations of large logs and snags
3. Moderate-to-high canopy closure
4. Moderate-to-high numbers of trees with physical imperfections such as cavities, broken tops, and large deformed limbs
5. Moderate-to-high accumulations of fungi, lichens, and bryophytes

For coarse woody debris management within matrix lands, the ROD included a standards and guidelines to “develop models for groups of plant associations and stand types that can be used as a baseline for developing prescriptions” (ROD C-40). DecAID

(Mellen, et al., 2006) was developed to address this standard and guideline. The DecAID Advisor is a planning tool intended to advise and guide managers as they conserve and manage snags, partially dead trees, and down wood for biodiversity.

Coarse Woody Debris and Fuels Treatments

The action alternatives for the D-Bug project all aim to reduce fuels within identified wildland urban interface (WUI) areas and along identified evacuation routes and fuel breaks. Large, landscape-scale treatments were not practical for this planning area due to the unroaded and congressionally reserved land allocations within and adjacent to the planning area and proposed alternatives (See Figure 1-4 and Table 3-17). Wilderness areas and national parks provide "substantial dead wood habitat…for wildlife associated more with montane through alpine environments…this would favor species such as black-backed and northern three-toed woodpeckers" (Rose, et al., 2001).

Table 3-17. Reserved land allocations adjacent to the D-Bug planning area.

Reserved Land Allocation	Acres
Oregon Cascades Recreation Area	85,874
Crater Lake (Forested Portion)	183,224
Mt. Bailey Inventoried Roadless Area (IRA)	18,415
Mt. Thielsen Wilderness	22,168
Sherwood IRA	2,449
Thirsty Creek Appendage IRA	2,255
TOTAL	314,385

The majority of the treatments within all action alternatives occur within 400-meter buffer around structures, the WUI boundaries, evacuation routes and existing roads to be utilized as fuel breaks (80 percent in Alternative 2, 91 percent in Alternative 5). Additionally, all action alternatives contain units of lodgepole pine dominated stands which are being treated to reduce potential within stand mortality and the subsequent increase in fuel loading from the spread of the mountain pine beetle. These lodgepole stands are proposed for variable density thinning away from roadsides, primarily in Alternative 2 and would include small gaps and skips (areas of no treatment, preferably designed around existing snag patches) to retain within stand heterogeneity.

Consideration of the land use allocation of treatment units and their location in the greater landscape is appropriate for biologists to consider when determining the appropriate level of coarse wood retention level (Rose, et al., 2001). The land allocations within this project is primarily matrix and the purpose and need of this project is fuels reduction adjacent to homes, facilities and along evacuation routes or roads identified as fuel breaks. Retaining more coarse woody debris within these treatment units would not allow flame lengths to be short enough (≤4-8 foot) for firefighters to be able to directly engage flames. Therefore, for this analysis, lodgepole and roadside stands of mixed conifer will be compared with the 30% (low) tolerance levels (tolerance intervals are estimates of the percent of all sampled data that are within some specified range of values, therefore 30% tolerance levels incorporate 30% of all the data sampled (Mellon-McClean, et al., 2009)) for snag and downed wood cover described in DecAID.

Existing and Desired Conditions

Levels of snags and downed wood vary across landscapes and forest types. A snag and downed wood survey was completed in the general D-Bug planning area. The planning area stratified into four different forest conditions: (Table 3-18).

- Lower Elevation Mixed Conifer Forest: these stands were generally below 5,000 feet and white fir (*Abies concolor*) was the dominant tree species. Other tree species observed within this strata included lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii)*, and western hemlock (*Tsuga heterophylla*).
- Higher Elevation Mixed Conifer Forest: these stands were generally above 5,000 feet and Shasta red fir was the dominant tree species. Other tree species included lodgepole pine, Douglas-fir, mountain hemlock (*Tsuga mertensiana*), and sub-alpine fir (*Abies lasiocarpa*).
- Lodgepole Pine Forest with evidence of mountain pine beetle mortality: these stands were exclusively lodgepole pine, and were identified using regional insect and disease mapping flight data. For stands to be included within this stratum, confirmed evidence of mountain pine beetle mortality had to be found within at least 3 of the 5 stand exam plots.
- Lodgepole Pine Forest without evidence of mountain pine beetle mortality: These stands were also identified using the regional insect and disease flight mapping data, and subsequently confirmed by site specific stand exam plots.

The snag inventory followed methods described in Bate (1999), and downed wood was counted using the same method utilized for counting snags. For comparison to the DecAID, the landscape will be compared to two separate wildlife habitat types and structural conditions. The majority of the landscape (57 percent) falls within the montane mixed conifer wildlife habitat type, small/medium trees structural condition, while the remaining (43 percent) of the landscape falls within the lodgepole pine forests and woodlands habitat type, small/medium trees structural condition (Figure 3-2).

Table 3-18. Strata, strata size in acres, and the number of plots per strata measured for the Diamond Lake coarse woody debris inventory.

Strata	Acres of Strata	Percent of Entire Planning Area	Sample (# of plots)
Lodgepole Pine with Beetle Mortality	3,274	8%	4
Lodgepole Pine with No Beetle Mortality	14,418	36%	5
High Elevation Mixed Conifer	6,203	16%	4
Low Elevation Mixed Conifer	15,935	40%	6
Totals	39,830	100%	19

The snag and coarse woody survey documented variable levels of snags and downed wood by forest strata. A total of 736 pieces of down wood and a total of 654 snags were inventoried across all strata. Species composition of snags was very similar to the downed wood measured.

Table 3-19. Strata classified by the Interagency Vegetation Mapping Project (IVMP) vegetation class and the corresponding percentage of each vegetative class the lodgepole and mixed conifer forest types within the planning area.

Seral Stage	% of Lodgepole Habitat	% of Mixed Conifer Habitat
Recent harvest	0%	4%
Early Seral	34%	18%
Stem Exclusion	41%	8%
Mature	23%	36%
Late Seral	3%	34%

Table 3-20. Coarse woody debris (CWD) data from project inventory and DecAID tolerance levels (Figures MMC_S/L.sp-5, MMC_S/L.sp-7, MMC_L.sp-10, LP_S.inv-2, LP_S.inv-3 and LP_S.sp-10) for lodgepole small-medium trees and Montane Mixed Conifer small-medium trees.

		Lodgepole Small-Medium Trees		Montane Mixed Conifer Small-Medium Trees	
CWD CATEGORY	SOURCE OF INFORMATION	RANGE	AVERAGE	RANGE	AVERAGE
Snags ≥10" dbh (snags/acre)	Inventory Data*	7.8 - 30.6	12.1	11.5 - 17.9	13.2
	DecAID (Moderate)	10 - 13	12	13 - 25	24
	DecAID (Low)	7.1 - 12	10	10.1 - 11.3	10
Snags ≥20" dbh (snags/acre)	Inventory Data*	0 - .05	0.41	1.4 - 2.9	1.8
	DecAID (Moderate)	2.7 - 6	4	3 - 8	6
	DecAID (Low)	1.7 - 3.7	2	2.7 - 3.7	2.8
Down wood =5" diameter (% cover)	Inventory Data*	2.0 - 2.1%	2.0%	1.8 - 3.1%	2.0%
	DecAID (Moderate)	**	4.0%	3.9 - 17%	10.5%
	DecAID (Low)	**	2.0%	0.0 - 6.5%	2.0%

*Weighted by acreage of stratum
**Insufficient data to give range

2008 Diamond Lake / Lemolo Lake Watershed Analysis Iteration Recommendations for Downed Wood

There are no specific downed wood recommendations within the Watershed Analysis iteration, but under the Watchable Wildlife Habitats section contains recommendations for downed wood. It recommends that hazard trees should be left on-site where possible; otherwise they should be placed in small aggregations in more suitable locations around recreation sites.

Existing Conditions for Coarse Woody Debris

Snags

The distribution of lodgepole and mixed conifer snags are displayed in figures 3-9 and 3-10 documented from the Diamond Lake CWD survey effort and the distribution of snags in natural (unharvested) landscapes documented in DecAID. DecAID's description of unharvested lodgepole landscape snag densities is compared with planning area survey results in Figure 3-9. However, the survey data was taken from a small portion of the overall landscape, and lodgepole snag densities of the ≥10" dbh size class across the planning area are likely much higher than the survey data indicates due to the ongoing tree mortality resulting from the mountain pine beetle outbreak that has continued since the survey was originally completed. Though there are very few ≥20" dbh lodgepole pine trees living or dead in the planning area, the D-Bug planning area has a higher than unharvested distribution of ≥20" dbh lodgepole snags due to a century of fire suppression on the Umpqua NF which has resulted in a higher proportion of the landscape existing as late seral lodgepole stands than would be found in a natural fire and insect regime (Figure 3-9). However, this may be due in part to the small sample size of lodgepole data DecAID contains to calculate the landscape distribution of snags in lodgepole habitats. DecAID's recommendations for snag densities are higher for lodgepole snags >20" dbh than is reported in the landscape distribution data.

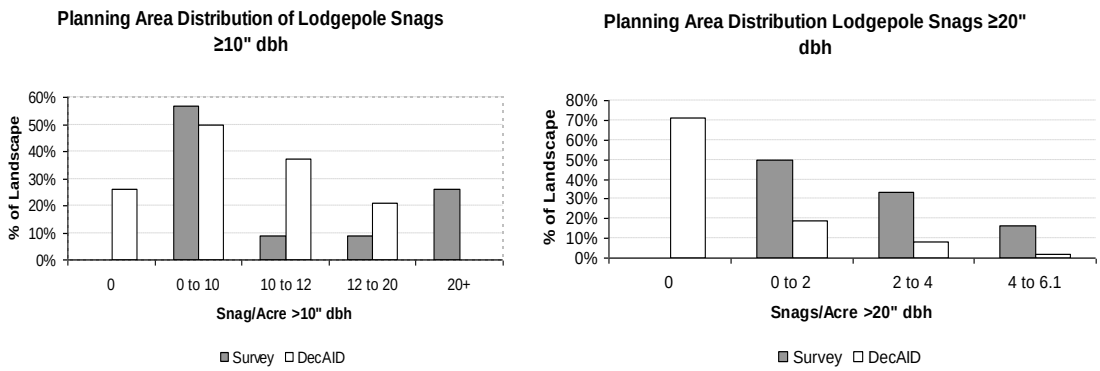


Figure 3-9. Distribution of lodgepole snags ≥10" and ≥20" dbh documented from coarse woody debris surveys across the D-Bug planning area as compared to DecAID's description of snag densities in unharvested stands of lodgepole forest.

Mixed conifer stands surveyed within the planning area had slightly higher densities of ≥10" dbh snags across the landscape than natural (unharvested) montane mixed conifer landscapes documented in DecAID. Surveyed stands of mixed conifer had similar levels of ≥20" dbh snags distributed across the landscape compared to DecAID data, with the exception of the lower percentage of 4-6 snags per acre in the surveyed stands.

For both lodgepole and mixed conifer snag densities current Umpqua National Forest LRMP and Northwest Forest Plan standards and guidelines for snag retention are being met, and will be met after the implementation of any alternative.

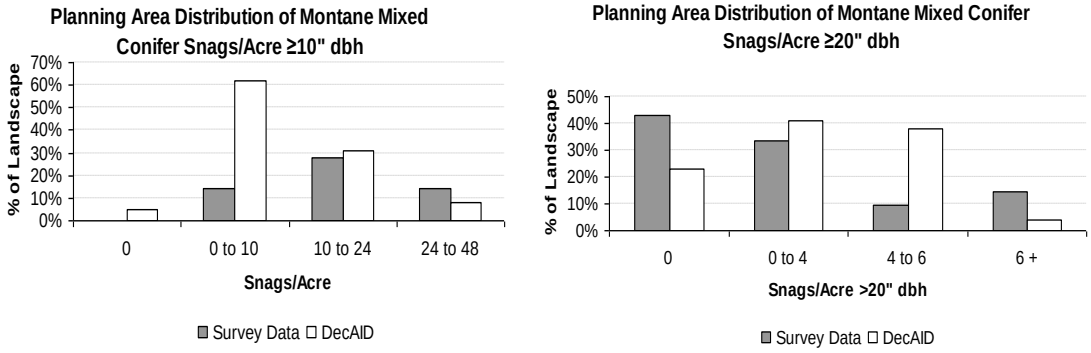


Figure 3-10. Distribution of mixed conifer snags ≥10" and ≥20" dbh documented from coarse woody debris surveys across the D-Bug planning area as compared to DecAID data for snag densities in unharvested stands of montane mixed conifer forests (figures MMC_L.inv-14 and MMC_L.inv-15).

Percent Downed Wood Cover

Downed wood cover for both lodgepole and the mixed conifer stands surveyed averaged lower rates of cover than data from DecAID with both averaging two percent, which falls within the 30 percent (low) tolerance level. However, within lodgepole stands with mountain pine beetle mortality, the downed wood cover is likely to increase as the current snags begin to fall and new snags are recruited. The mixed conifer stands downed wood cover was comprised of 66 percent lodgepole logs. The Umpqua National Forest LRMP standards and guidelines for downed woody material are being met, and will be met after the implementation of any alternative for both lodgepole and mixed conifer percent downed wood cover in non-nesting roosting and foraging habitat.

Desired Condition

The desired condition for CWD across the landscape is an increase in heterogeneity within the lodgepole stands and the distribution of CWD across the planning area by allowing natural disturbance agents such as insects and fire to create larger pockets of snags and downed wood cover, as well as an increased diversity of stand age classes. The increase in disturbance would allow for higher levels of downed wood cover in stands with beetle activity and lower levels of downed wood but increased snag densities in areas experiencing wildfire, but these patches would be spread across the landscape. The current high levels of stem exclusion across lodgepole stands in the planning area would be decreased. Thinning of some lodgepole stands will increase the heterogeneity of stand structure across the planning area.

Within mixed conifer stands across the landscape the desired condition is an increase in smaller scale low to moderate severity fire disturbances recruiting snags and downed wood material across the landscape. Increased low to moderate severity fire disturbance at smaller scales would increase the current amount of early seral habitat across the landscape, but retain higher levels of snags and downed within burned stands. Thinning of portions of the mixed conifer stands across the planning area will allow for more effective containment and management of future naturally ignited fires to increase snag densities and stand heterogeneity but decreasing the chance for large scale (10,000 acre or more) wildfires.

Desired conditions are for lower densities of snags and coarse wood in both habitat types in treated units than surrounding untreated stands that are farther away from

evacuation routes, fuel break roads, WUI boundaries and structures. The presence of moderate to high levels of coarse woody debris and snags can increase the probability of crowning, torching and spot fires due to the increased susceptibility of burning during wildfires due to high heat generation (Stephens and Moghaddas, 2005). Moderate to high levels of snags and coarse woody debris can also pose a hazard and increase difficulties to firefighters during suppression activities as snags can weaken and topple, and coarse woody debris can increase flame length and fire residency time, making fire suppression more difficult (Stephens and Moghaddas, 2005). These lower levels of coarse wood and snags would be maintained by two entries of non-commercial maintenance treatments, approximately five years apart in order to retain the effectiveness of the fuels treatments in modifying fire behavior.

Direct and Indirect Effects

The direct and indirect effects to CWD are analyzed at two scales: 1) within the stands being thinned (stand-scale) and 2) within the landscape of the greater Diamond Lake and Lemolo Lake planning area. The direct effects are the immediate changes that occur at these two scales and the indirect effects focus on how the alternatives would modify the stand CWD dynamics over the next 100 years (as modeled by the Forest Vegetation Simulator (FVS) for representative stands proposed for harvest). For the purposes of the FVS modeling of snags and coarse wood ground cover, it was assumed, that under all alternatives about 90 percent of all lodgepole pine would die within a few years, as predicted by Goheen (2008). The actions that would have the largest effect on CWD over the next 100 years are thinning in conjunction with post -harvest fuel reduction and biomass removal as they remove small diameter trees (<7” dbh) which would be recruited as future snags and downed wood. Since thinning and fuels treatments focus on treating smaller diameter trees and down wood impacts would be greatest on the smaller diameter snags and CWD. Roadside mastication drops both lodgepole and montane mixed conifer stands below the 30 percent (low) tolerance levels for snag densities and coarse woody debris cover in all action alternatives. This is required to extend the effectiveness of roadside treatments to function as fuel breaks and therefore no mitigation will be required in these units as it would be at odds with the purpose and need of reducing roadside fuel loadings.

Commercially thinned lodgepole pine units being would have varying levels of snag retention. Mastication along roadsides would reduce future snag recruitment by removing small diameter trees which would become future snags. However, the current densities of small trees along roadsides would recruit small diameter snags in the future. The interior, unmasticated portions of lodgepole dominated units would have slightly higher short- (20-30 years) and long-term (80-100 years) ≥10” dbh snag densities, but the units would drop below DecAID 30 percent tolerance levels (Figure 3-11). However, across the planning area snag densities would continue to increase as a result of mountain pine beetle mortality and other sources of tree mortality and the overall landscape distribution of snags in the lodgepole vegetative class would be higher than documented within unharvested stands by DecAID. In the action alternatives, the snag species composition would shift over time in units with conifer species other than lodgepole, as prescriptions 1-4 remove all lodgepole >5”dbh and retain other conifer species to be recruited as future snags.

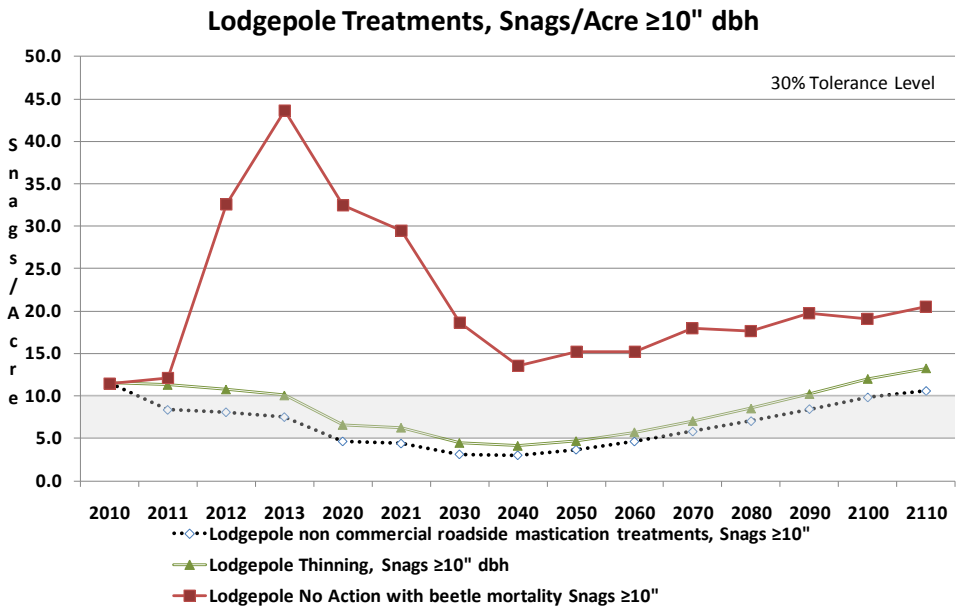


Figure 3-11. Snags per acre ≥10” dbh in the no action alternative and within lodgepole dominated units with prescriptions 1-4 in the action alternatives with and without mastication. Snags of all species are included.

Currently densities of larger diameter lodgepole snags within units are within the 30 percent tolerance levels for snags ≥20” dbh in the planning area prior to harvest and this does not change with the implementation of any of the action alternative prescriptions. Lodgepole within the planning area rarely grow to ≥20” dbh, therefore there are low levels of larger diameter lodgepole snags. Figure 3-12 shows the modeled recruitment of ≥20” dbh snags, but the increase in larger diameter snags is due to the increase of snags of other conifer species rather than lodgepole snags as the lodgepole will be thinned more heavily under the action alternatives.

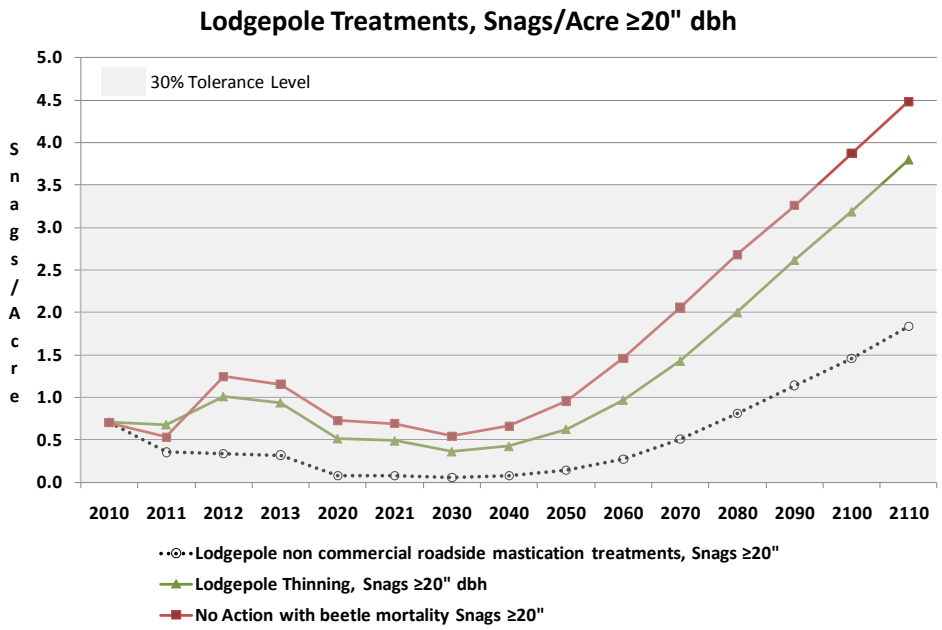


Figure 3-12. Snags per acre ≥20" dbh in the no action alternative and within lodgepole dominated units with prescriptions 1-4 in the action alternatives with and without mastication. Snags of all species are included.

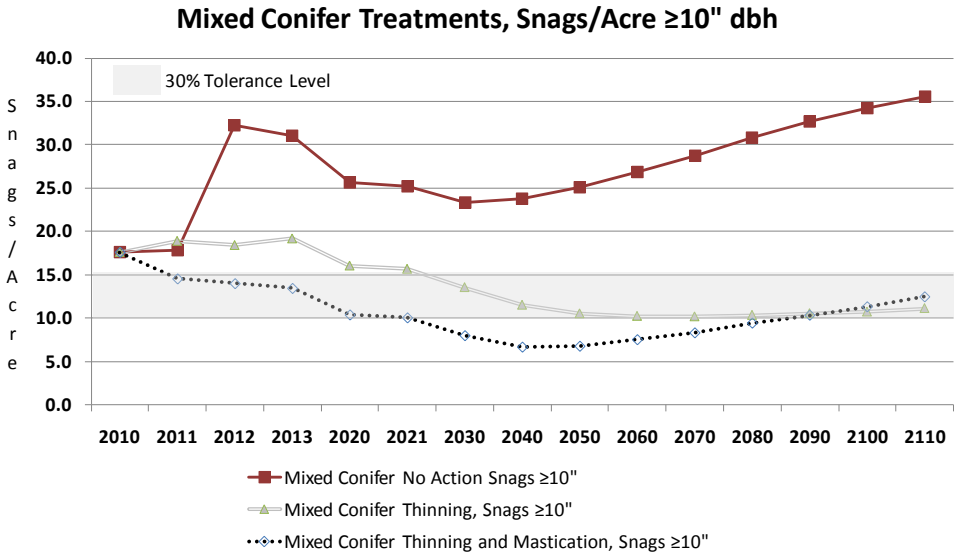


Figure 3-13. Snags per acre ≥10" dbh in the no action alternative and within mixed conifer units with prescriptions 9-13 in the action alternatives with and without mastication. The grey shading represents the DecAID 50% (moderate) tolerance level.

Mixed conifer thinning stands being would drop slightly below the 30 percent tolerance level in DecAID for montane mixed conifer forests with mastication. Across the unharvested mixed conifer landscape however, snag densities of ≥10" dbh mixed conifer snags would continue to increase as lodgepole within mixed conifer stands would continue to die and be recruited as snags as observed in the no action alternative (Figure 3-13).

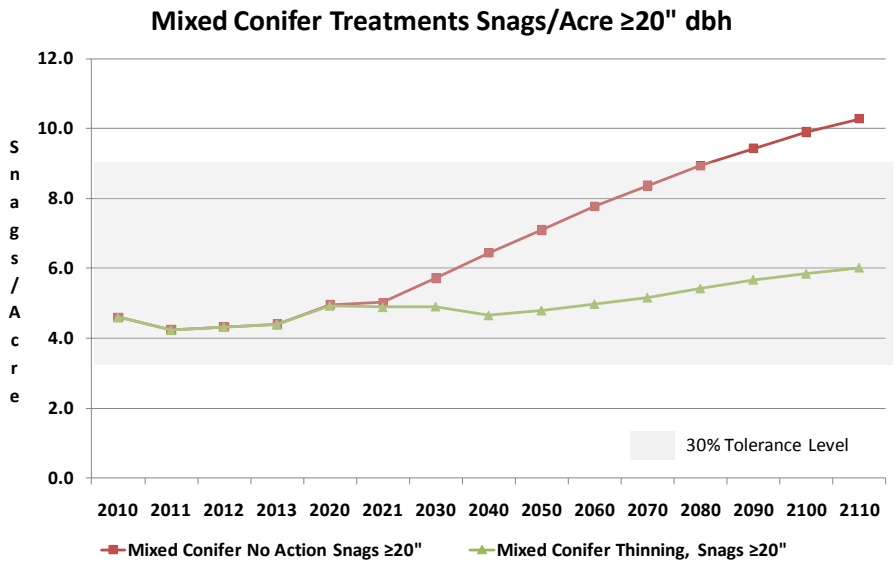


Figure 3-14. Snags per acre ≥20" dbh in the no action alternative and within mixed conifer units with prescriptions 9-13 in the action alternatives with and without mastication. The grey shading represents the DecAID 30% (low) tolerance level.

Larger diameter snags within the mixed conifer units ≥20" dbh would remain within the 30 percent (low) tolerance levels within all portions of units (Figure 3-14). Underburning within the two units with prescription 13 would recruit up to two snags per acre. Roadside units with sections of mastication would fall below 30 percent tolerance levels in order to be as effective for as long as possible as fuel breaks.

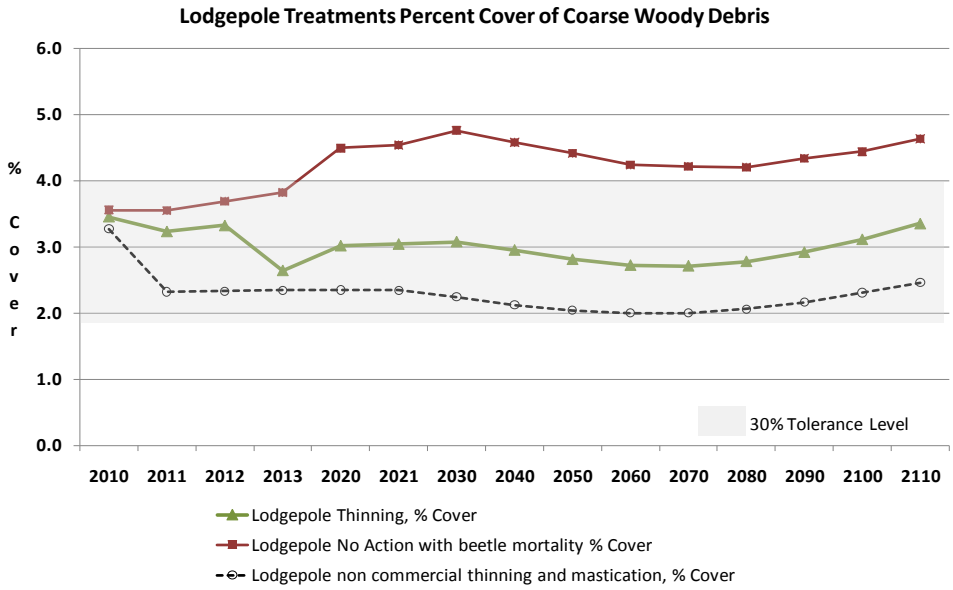


Figure 3-15. Percent ground cover of coarse woody debris in the no action alternative and within lodgepole dominated units with prescriptions 1-4 in the action alternatives with and without mastication. All species of downed wood were counted. The grey shading represents the DecAID 30% (low) tolerance level.

Ground cover of coarse woody debris within lodgepole harvested units would remain above the 30 percent (low) tolerance levels (Figure 3-15). Ground cover within mixed conifer units documented from both on the ground survey and FVS modeling are currently at the low end of the 30 percent tolerance level (Figure 3-16).

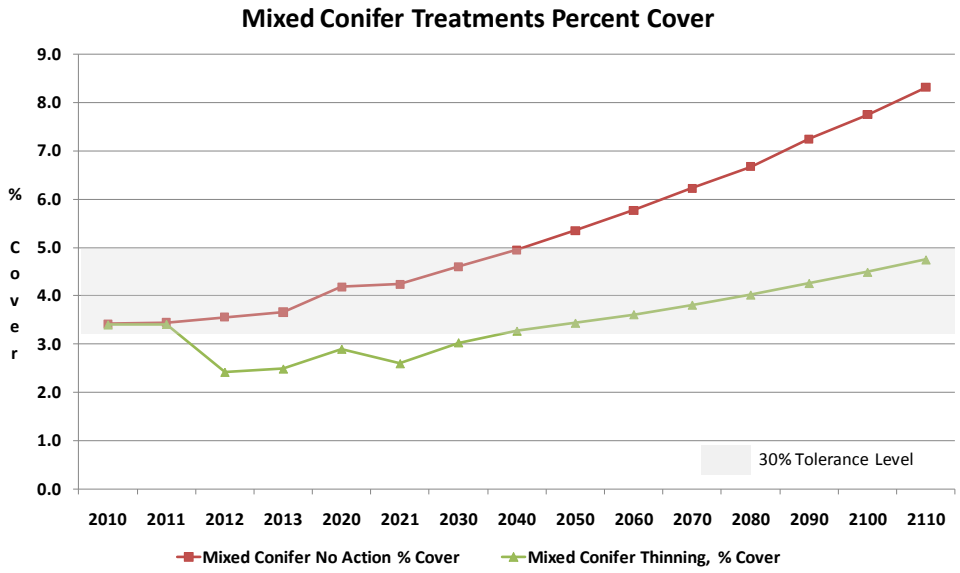


Figure 3-16. Percent ground cover of coarse woody debris in the no action alternative and within mixed conifer units with prescriptions 9-13 in the action alternatives with and without mastication.

Landscape-Level Effects

The D-Bug Planning Area is a narrow area bounded by the Mount Bailey Inventoried Roadless Area to the west, Crater Lake National Park to the south and Oregon Cascades Recreation Area and Mount Thielsen Wilderness to the east and northeast (Figure 1-1). These areas are managed or are wilderness or reserved land allocations that restrict commercial harvest of trees. Crater Lake has an active wildfire use program, allowing naturally ignited fires to be managed rather than suppressed which has and will continue to create areas with high levels of snags and CWD within them. Crater Lake National Park has had two recent wildland fire use fires, the Bybee Complex (2006) which burned 3,100 acres and is ten miles south of the planning area and an unnamed fire in 1994 which burned 155 acres and is one-half mile south of the planning area. In 2009, the Whitney fire burned 91 acres in Crater Lake National Park and was a one-quarter mile south of the D-Bug planning area. On the Umpqua National Forest, the Kelsay fire (2003) burned 1,440 acres and is two miles north of the planning area. However, less than 250 acres of this was salvaged. These recent fires are current sources of high snag and CWD densities (though less in the Kelsay fire due to the salvage). Mountain pine beetles are allowed to disperse on their own throughout these areas and are also creating pockets of high-snag densities and CWD accumulations.

Levels of snags and downed wood vary across landscapes and forest types. The landscape for the CWD analysis area (130,000 acres) was broadly stratified into three DecAID wildlife habitat types: lodgepole pine, montane mixed conifer and western lowland conifer and hardwood forest. Approximately 53 percent of the landscape is montane mixed conifer, 30 percent is lodgepole, and 17 percent is western lowland conifer and hardwood forest. To determine the landscape distribution of snag densities,

based on tolerance levels, the landscape was also stratified (within each habitat type) into open, small/medium and large tree structural stages. The percentage of structure stage and habitat types was then used to prorate the snag density distribution for the landscape. The desired future condition (DFC) was determined by utilizing the Fire Regime Condition Class potential natural vegetation reference conditions (FRCC website), prorating the landscape for the amount of California red fir (which corresponds to the montane mixed conifer in DecAID), lodgepole, and mixed conifer groups that occur in the 130,000 acre CWD analysis area. Acres of silvicultural prescriptions by alternative were used to adjust the landscape distributions for snags ≥10" dbh and results are shown in Figure 3-17.

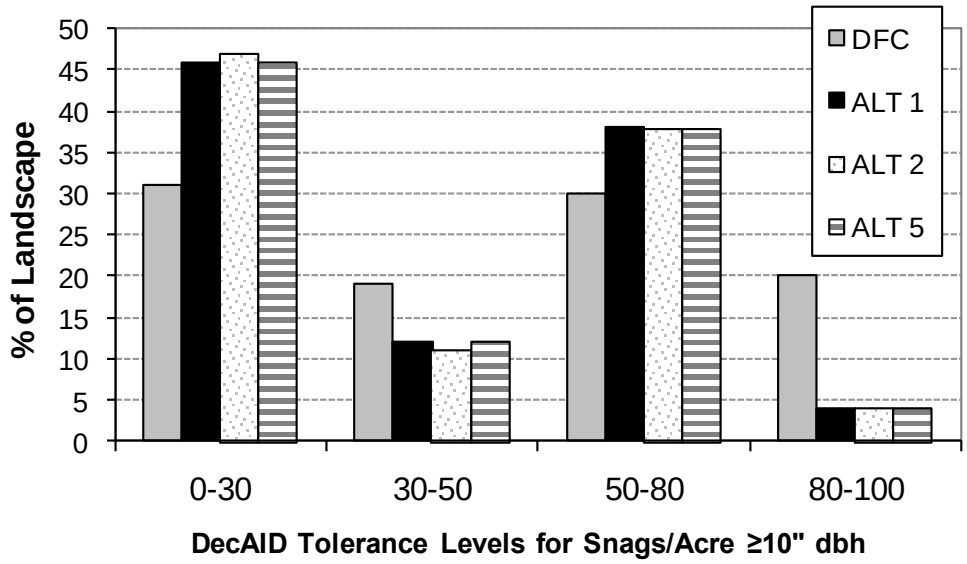


Figure 3-17. The existing distribution of snags ≥10" dbh (Alternative 1) in terms of DecAID tolerance levels, compared with the desired future condition (DFC) and the resulting distribution post implementation of the action alternatives considered for the D-Bug project.

Due to the relatively small percentage of the landscape being treated under any alternative, differences among alternatives is very small. The existing and post treatment landscape under all alternatives has higher levels of the landscape with low snag levels (0-30 percent tolerance levels) and a low percent of the landscape with high numbers of snags (80-100 percent tolerance level). However, within the planning area the amount of the landscape with no snags is higher in the DecAID descriptions of the landscape-scale distribution of snags than the planning area currently has (13 percent of the DecAID landscape has no snags ≥10"dbh, compared with four percent in the analysis area, and 31 percent of the DecAID landscape has no snags ≥20"dbh, compared with four percent of the analysis area). The amount of high density snag habitat (80-100 percent TL) is expected to increase with the spread of the mountain pine beetle and the likelihood of a wildfire within the planning area and surrounding landscape of reserved land allocations. Alternatives 2 contains 325 acres of salvage harvest of standing dead beetle killed lodgepole (Rx 4), while Alternative 5 has 285 acres, both of which will reduce approximately one percent of the landscape within the 30-50 percent to 0-30 percent tolerance levels.

The existing, desired and resulting densities of snags per acre ≥20” dbh related to DecAID tolerance levels are shown in Figure 3-18. There is a low percent of the landscape with high tolerance levels (80-100 percent) compared to desired conditions. This is due in part to past timber harvest activities and past and ongoing fire suppression efforts. However, the likelihood that there would be a wildfire in the near future within the planning area is high and this will result in an increase in the amount of the landscape with high amounts of snags per acre ≥20” (80-100 percent). Additionally, the large amount of reserved land allocations in the analysis area will increase the likelihood that areas with lower snag densities (0-30 percent) will move to the 30-50 percent tolerance levels in the future. Due to the negligible numbers of lodgepole snags ≥20” within the planning area and the overall small percent and similar amount of mixed conifer harvest (the source of ≥20” snags) occurring in any action alternative; there is no difference among action alternatives in the landscape distribution of ≥20” snags per acre.

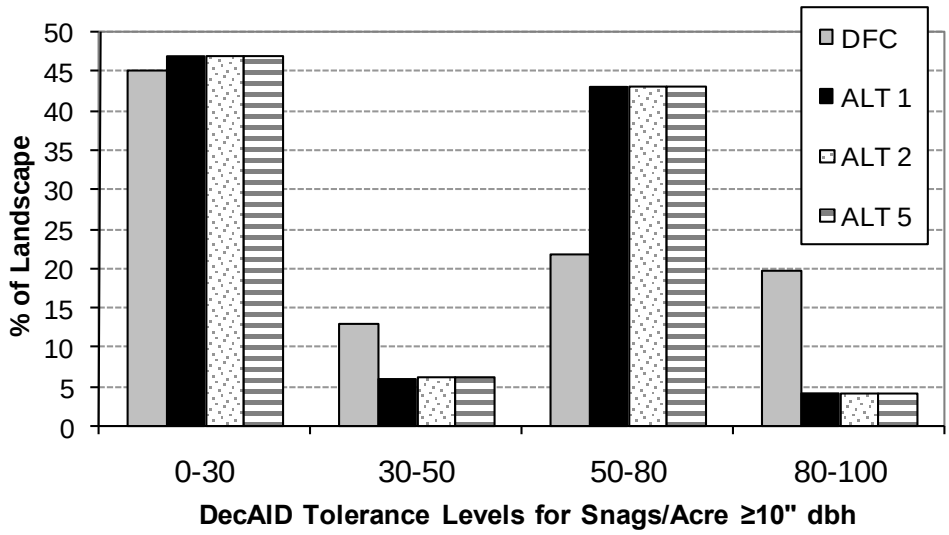


Figure 3-18. The existing distribution of snags ≥20” dbh (Alternative 1) in terms of DecAID tolerance levels, compared with the desired future condition (DFC) and the resulting distribution post implementation of the action alternatives considered for the D-Bug project.

Determinations for Coarse Wood

At the stand level in the action alternatives, the snag species composition would shift over time in units with conifer species other than lodgepole, as thinning would remove all live lodgepole >5”dbh while retaining other conifer species. The stand species composition will shift to conifer species with the potential to grow larger diameter snags than lodgepole can; therefore future snags will be larger in diameter than those currently in the units. Alternative 1 will maintain current snag and CWD densities, and would increase snag densities and CWD densities (of primarily small diameter lodgepole pine due to pine beetle mortality) more than any other alternative. Of the action alternatives, Alternative 5 will retain the most snags and downed wood cover (primarily lodgepole snags) in the short term as it will have less thinning and overstory removal of lodgepole pine than Alternative 2; while Alternatives 2 has the most acres of mixed conifer harvest and mastication.

The action alternatives would have very little effect to overall snag recruitment or downed wood levels at the landscape scale, due to the scale of the proposed treatments. There are over 314,000 acres of reserved land allocations directly adjacent to the D-Bug planning area that contain areas of moderate to high snag and CWD densities, while the D-Bug project, at most, will manage 8,943 acres, or approximately four percent of that area. However, Alternative 2 moves the landscape slightly away from DFC with respect to ≥10" snags, by slightly increasing the amount of 0-30 percent tolerance levels of snag densities and slightly decreasing the amount of 30-50 percent tolerance levels of snag densities. Alternatives 1 and 5 maintain the same, slightly higher levels of 30-50 percent TL snag densities.

Refer to tables 3-1 through 3-3 in this chapter for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Over time the amount of the landscape with low densities of snags (0-30 percent) will decrease as existing clearcuts age. Conversely, the amount of the landscape within 30-50 percent tolerance levels will increase due to growth of existing clearcuts. The amount of 50-80 percent tolerance level areas of the landscape are expected to stay relatively stable as the snags age and increase in densities over time while existing 50-80 percent areas increase in snag densities to 80-100 percent tolerance levels. The amount of the landscape with high snag densities (80-100 percent TL) will continue to increase, especially in reserved land allocations with the continued spread of the mountain pine beetle and the likelihood of a large-scale wildfire.

All action alternatives will allow fire managers to better manage fire across the landscape. The action alternatives would decrease the potential for large-scale, high-severity fire and increase the potential for smaller scale fires to create snag patches and areas of future downed wood recruitment from fallen snags. At the landscape-scale, the action alternatives would have very little effect to overall snag recruitment or downed wood levels due to the small area of the proposed treatments in the landscape of land allocations allowing mountain pine beetle and other disturbances to play out on their own. However, Alternative 5 will retain the highest number of snags and downed wood cover in the short term due to less thinning and overstory removal of lodgepole pine than Alternative 2. Within mixed conifer units, Alternative 5 contains the least amount of thinning and mastication which will leave the highest levels of snags and downed wood, while Alternative 2 contains a higher number of acres of mixed conifer harvest and mastication. The no action alternative would allow for the most snag and coarse woody debris to be retained on the landscape. Between the action Alternatives 2 and 5, Alternative 5 will retain the highest levels of snags and coarse woody debris across the planning area as it treats fewer acres, while at the same time still meeting the purpose and need.

RARE AND UNCOMMON SPECIES

The Great Gray Owl (*Strix nebulosa*) is considered to be a regionally Rare and Uncommon wildlife species whose known range includes the Umpqua National Forest and the D-Bug planning area. The Great Gray Owl is not included on the Regional Forester's Sensitive Species list for the Umpqua National Forest (updated January 2008), but it is included on the Regional Forester's sensitive species in Washington State. Great Gray Owls have been observed in the greater Lemolo Lake area and at the southern end of Diamond Lake within the planning area. Treatments around meadow habitat south of Diamond Lake have been buffered by 300 feet. However, the harvest units proposed in the action alternatives are not of an age/size class or positioned within

200 meters of openings greater than ten acres to meet stand criteria for suitable nesting habitat (i.e., 38-42" dbh trees); therefore, none of the action alternatives would be expected to cause a consequential negative impact on the species habitat or the persistence of the species at the site (Quintana-Coyer, et al., 2004).

Surveys for terrestrial mollusks occurred in the fall of 2010 in suitable habitat for Chace sideband (*Monadenia chaceana*) in all units utilizing the protocol written by Duncan (2003). No Chace sidebands were found. All suitable Crater Lake tightcoil (*Pristiloma arcticum crateris*) habitat was buffered by more than 10 meters, so suitable habitat was not surveyed, and all known sites were buffered. Red tree vole (*Arborimus longicaudus*) surveys were carried out to protocol in mixed conifer stands at or below 5,800 feet in elevation (Biswell, et al., 2002). Two potential nest trees were identified and climbed in Unit 118, south of Highway 138, but they were determined to be a corvid and squirrel nest respectively. No other potential red tree vole nests were found. Standards and guidelines for White-headed woodpeckers (*Picoides albolarvatus*), Black-backed woodpeckers (*Picoides arcticus*), Pygmy nuthatches (*Sitta pygmaea*) and Flammulated owls (*Otus flammeolus*) identified within the 2001 Survey and Manage ROD will be met by exceeding the 100 percent potential population levels for these four species (for White-headed woodpeckers the 100 percent population potential is 0.60 snags per acre ≥15" dbh and the Black-backed woodpecker population potential is 0.12 conifer snags/acre ≥17" dbh which will be exceeded in each action alternative (see CWD and MIS analysis). There are no Canada lynx (*Lynx canadensis*) or lynx Critical Habitat in the project area, thus Canada lynx are not discussed further in this analysis.

SENSITIVE SPECIES

The National Forest Management Act (16 U.S.C. 1600) requires the Forest Service to maintain viable populations of existing native and desired non-native wildlife in the planning area (36 CFR 219.19). Guidelines for each planning area must provide for a diversity of plant and animal communities based on the suitability of the specific land area. The Forest Service established a Sensitive Species Program and a Biological Evaluation process (FSM 2672.4) to ensure species population viability. Regional foresters are responsible for identifying and maintaining a list of sensitive species occurring within their region. This list includes species for which there is a documented concern for viability within one or more administrative unit within the species' historic range (FSM 2670.22, WO Amendment 2600-95-7). These species may require special management emphasis to ensure their viability and to preclude trends toward endangerment that would result in the need for Federal listing. This regional list was last updated on January 31, 2008.

The Forest Service Manual (FSM 2672.4) requires a biological evaluation to determine potential effects of proposed ground-disturbing activities on sensitive species. This evaluation analyzes the alternatives and discusses the potential effects on the population or its habitat within the area and on the species as a whole, and makes recommendations for removing, avoiding, or compensating for adverse effects. In addition, the Umpqua National Forest's Land Management Plan standard and guidelines for wildlife (USDA 1990) states:

> *6. Any management activity that will negatively affect plant or animal species listed on the Regional Forester's Sensitive Species list, or their habitat will be modified to either avoid (preferable) or minimize the impact. Activities will not be permitted if they will result in the loss of a colony or subpopulation that is important in the natural distribution of the species.*

A pre-field review was performed to determine which sensitive species are most likely to be impacted by the proposed alternatives. Table 3-21 summarizes the presence or absence of sensitive wildlife species and/or their habitat within or adjacent (in terms of potential impacts – e.g., noise) to the actual proposed ground disturbance areas. It is based on the latest documented survey and occurrence data, scientific literature review and GIS analysis. Impact or effect determinations are made on each species based on this review. If an impact or effect is anticipated, further analysis and discussion of the direct, indirect and cumulative effects is provided in the following sections. Direct effects are defined as those effects that would occur immediately as a result of implementation. Indirect effects are those that would typically occur over longer time periods. Cumulative effects are the effects of the alternatives that would incrementally add to other past, present, or reasonably foreseeable activities that may result in additive effects to the various species.

Table 3-21. List of the sensitive species and their habitats on the Umpqua National Forest.

Common Name	Scientific Name	Habitat Description and Information
Johnson's hairstreak	*Callophrys johnsoni*	Conifer forests; larvae feeds on mistletoe growing on western hemlock and other conifers. Ranges from 2,000-6,000 ft elevation; suspected on the Umpqua
Coronis fritillary	*Speyeria coronis*	Various habitats, grasslands, shrubland/chaparral, conifer and hardwood woodlands; larvae feed on violet, adults on bull thistle, other composites and chokecherry; suspected on the Umpqua
Mardon skipper	*Polites mardon*	Isolated populations in grasslands within mixed conifer forests in SW OR; larvae feed on fescue bunchgrasses, adults feed on flower nectar; suspected on the Umpqua
Siskiyou short-horned grasshopper	*Chloealtis aspasma*	Grasslands, associated with elderberry plants; may feed on grasses and forbs; Siskiyou mountains; Ranges from 4,000-6,000 ft suspected on the Umpqua
Evening fieldslug	*Deroceras hesperium*	Perennially wet meadows in forested habitats, found in areas where soil and vegetation are constantly saturated; Ranges from low to mid-elevations; found in both western and eastern cascades; suspected on the Umpqua.
Salamander slug	*Gliabates oregonius*	Leaf litter under bushes in coniferous forests; some specimens found in Lane county; suspected on the Umpqua
Oregon shoulderband	*Helminthoglypta hertleini*	Rocky areas with deciduous leaf litter and/or woody debris, generally adjacent to areas with grass or herbaceous vegetation. Documented on Tiller Ranger District.
Chace sideband	*Monadenia chaceana*	Rocky forested habitats are preferred, but can be associated with large woody debris or leaf litter. Klamath province and southwestern Oregon Cascades. Documented on the western side of Diamond Lake RD.
Crater lake tightcoil	*Pristiloma arcticum crateris*	Perennially wet areas in mature conifer forests within 10 m of open water. Generally in areas that remain under snow for long periods in the winter. Ranges from 2,000-6,500 ft. Documented within the planning area on the Diamond Lake RD.
Pristine springsnail	*Pristinicola hemphilli*	Aquatic snail; small undisturbed cold springs or seeps with coarse gravel/cobble substrate; suspected on the Umpqua

Common Name	Scientific Name	Habitat Description and Information
Foothill yellow-legged frog	*Rana boylii*	Found near larger streams and rivers, primarily in shallow stream edges with large gravel/cobble substrate. Ranges from northwest Oregon to Baja California from sea level to <3,000 ft. Documented on North Umpqua and Tiller RD.
Oregon spotted frog	*Rana pretiosa*	Marshes, lakes and ponds with warm shallow water; Ranges from sea level to 5,000 ft elevation; suspected on the Umpqua, but not documented on Diamond or Lemolo Lakes in over 5 years of surveys.
Northwestern pond turtle	*Actinemys marmorata marmorata*	Inhabits marshes, ponds, lakes or slow-moving portions of rivers and streams. Large amounts of emergent logs, vegetation or rock are needed for basking and cover, and sandy banks for nesting. Ranges from sea level to 4,500 ft. Documented on the Diamond Lake RD at Toketee Reservoir.
Horned Grebe	*Podiceps auritus*	Selects small ponds and lake inlets with mix of emergent vegetation and open water for breeding; forages in open fresh or salt water; Rare breeder east of the Cascades; Uncommon winter resident of Umpqua valley in areas of open, ice-free water; documented Diamond Lake.
Red-necked Grebe	*Podiceps grisegena*	Winters on the Pacific and Atlantic oceans, breeds on freshwater lakes. Consistently breeds only at Klamath Lake. One summer record for Diamond Lake (1931); extremely rare in winter away from the coast; would be a rare migrant on Diamond lake.
Harlequin Duck	*Histrionicus histrionicus*	Swift, rocky, large streams or rivers. Nest under rock overhangs, vegetation or streamside debris. Late spring migrant or summer visitor. Documented on Fish Creek and North Umpqua River on Diamond Lake RD.
Bufflehead	*Bucephala albeola*	Nest in tree or snag cavities near high Cascade lakes and ponds. Uncommon spring migrant and common fall migrant. Nesting has been documented on Diamond Lake.
Bald Eagle	*Haliaeetus leucocephalus*	Nest on cliff face ledges or large trees in close proximity to large bodies of water. There are currently 2 breeding pairs on Diamond Lake and one pair on Lemolo Lake.
American Peregrine Falcon	*Falco peregrinus anatum*	Vertical rock cliffs with ledges or potholes. Often nests near prominent riparian habitat such as rivers or wetlands. Currently one known eyrie on the Diamond Lake RD.
Yellow Rail	*Coturnicops noveboracensis*	Wet meadows and freshwater marshes. Considered a very local summer resident of the Klamath Basin and a vagrant elsewhere. Suspected on the Umpqua
Northern Spotted Owl	*Strix occidentalis caurina*	Old growth conifer forests or younger forests with old growth remnant structures such as large trees, snags and down wood. There are 7 historic owl cores within 2 miles of the D-Bug planning area.

Common Name	Scientific Name	Habitat Description and Information
Lewis's Woodpecker	*Melanerpes lewis*	Open pine forests and oak woodlands near water; Primary cavity excavator; Migrant in Douglas county; documented on Diamond Lake RD in summer and fall.
White-headed Woodpecker	*Picoides albolarvatus*	Open ponderosa pine stands or mixed conifer forests dominated by ponderosa pine; primary cavity excavator; Permanent resident in upper reaches of Umpqua River basin.
Purple Martin	*Progne subis*	Aerial feeding habitat generalist, found in open areas and prefer open water source nearby foraging habitat; Rare breeder in Douglas county (Sutherlin, Canyonville); suspected on the Umpqua
Black Swift	*Cypseloides niger*	Aerial; forages over forests and open areas. Nests behind waterfalls in wet cliffs. Forages over several square kilometers, and larger. Documented occurrences on North Umpqua and Diamond Lake RDs.
Pacific pallid bat	*Antrozous pallidus pacificus*	Open, arid habitats, oak and ponderosa pine forests. Roosts in caves, mines, man-made structures, trees and snags. Ground feeder. There are no records for this species on the Forest; however it is documented in Douglas County.
Pacific fringed myotis	*Myotis thysanodes vespertinus*	Grasslands, conifer and oak woodlands. Uses caves, mines, buildings, bridges, trees and snags. Aerial feeder, but can glean from foliage and ground. Maternal roosts sensitive to human disturbance. One documented record on Diamond Lake RD.
Townsend's big-eared bat	*Corynorhinus townsendii*	Pine-fir-hemlock-broadleaf forested areas, and areas with mosaic of woodland, grassland or shrubland. Aerial feeder. Uses caves and mines for breeding and hibernaculum; observed in breeding caves on Umpqua National Forest.
Pacific fisher	*Martes pennanti*	Late-successional forests with high canopy closure. Associated with riparian areas. Large dead wood important, dens usually within cavities of large trees and snags. Documented occurrence on the DL Ranger District.
Wolverine	*Gulo gulo*	Remote, high elevation subalpine and alpine forests to above timberline. Found in a variety of habitats, do not avoid open areas. Several anecdotal observations on the Diamond Lake RD.

Table 3-22. Umpqua National Forest sensitive species pre-field review and summary.

Sensitive Species	Is species or habitat in or adjacent?	Is impact or effect expected?	Loss of viability or trend?
Johnson's hairstreak	Yes, conifers with mistletoe are present in planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Coronis fritillary	Yes, conifer woodlands with violets are present within the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Mardon skipper	Yes, patches of fescue exist in the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Siskiyou short-horned grasshopper	No known locations of elderberry within the planning area.	No.	No
Evening fieldslug	Yes, there perennially wet meadows within the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Salamander slug	Low probability, habitat is present; no specimens have been detected in mollusk surveys	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Oregon shoulderband	No, suitable rocky habitat with deciduous leaf litter not present within the planning area.	No.	No
Chaces sideband	Yes, there are limited patches of talus or rocky outcrop habitat in planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Crater Lake tightcoil	Yes, habitat and populations present in planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Pristine springsnail	Low probability, habitat is extremely limited	Low potential – see discussion	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Foothill yellow-legged frog	No, planning area is above the elevational distribution of this species.	No	No
Oregon spotted frog	Low probability, suitable warm water pond habitat does not occur in the planning area.	No	No
Northwestern pond turtle	No, planning area is above the elevational distribution of this species.	No	No
Horned grebe	Yes, the species has been documented on Diamond and Lemolo Lakes.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Red-necked grebe	Yes, the species has been documented on Diamond and Lemolo Lakes.	Low potential – see discussion	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Harlequin duck	Low probability, streams adjacent to units are too small and not suitable for nesting.	Low potential – see discussion	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Bufflehead	Yes, they have been observed on Diamond Lake.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Bald eagle	Yes, three known pairs are nesting around Diamond and Lemolo Lakes.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
American peregrine falcon	No nesting habitat in planning area.	No	No
Yellow rail	Yes, limited wet meadow habitat is present within the planning area	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.

Sensitive Species	Is species or habitat in or adjacent?	Is impact or effect expected?	Loss of viability or trend?
Northern spotted owl	Yes, there are 7 historic owl cores within 2 miles of the planning area and 14 NSOOM points in the planning area	No impact is expected.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Lewis's woodpecker	Yes, suitable pine forest occurs within the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
White-headed woodpecker	Yes, suitable pine and mixed conifer forest occurs within the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Purple martin	No, habitat does not occur in planning area.	No	No
Black swift	Low probability; forested habitat occurs, but there are no waterfalls in the planning area.	Low potential – see discussion	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Pacific pallid bat	No, suitable arid habitat does not occur in planning area.	No	No
Pacific fringed myotis	Probable, habitat occurs within the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Townsend's big-eared bat	Yes, an occupied cave is adjacent to the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Pacific fisher	Yes, suitable habitat does occur, and the species has been documented in the planning area.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.
Wolverine	Yes, suitable winter habitat does occur.	May impact individuals or habitat.	No loss of population viability or trend towards Federal listing would occur as a result of any alternative.

Johnson's Hairstreak (Callophrys johnsoni)

This species is a small (1-1 3/8"), brownish butterfly that depends on coniferous forests that contain mistletoes of the genus *Arceuthobium* which is found primarily on western hemlock, though they can also utilize dwarf mistletoe which grows on ponderosa pine (Black and Lauvray, 2005). Johnson's hairstreaks prefer late-successional forests with high levels of mistletoe, but they may also be found in younger forests with dwarf mistletoe (Black and Lauvray, 2005). Mistletoe serves as the host plant for their eggs, and larvae feed on mistletoe and chrysalids hibernate in mistletoe masses. Timber harvest activities that select trees with mistletoe for removal have reduced foraging habitat for this species, in particular areas of harvest within mixed conifer stands (as opposed to pure lodgepole stands). Additional threats to Johnson's hairstreaks include pesticides, in particular Btk (*Bacillus thuringiensis* var. *kurstaki*) a Lepidoptera specific insecticide used to control spruce budworm (*Choristoneura occidentalis*).

Affected Environment

Johnson's hairstreak was not observed during field reconnaissance for this project. However, suitable late-successional conifer forest with western hemlock stands containing dwarf mistletoe does exist with the planning area, and within harvest units. Therefore, it is assumed that the species occurs within the planning area. Johnson's hairstreaks have been documented four miles west of the D-Bug planning area on the Diamond Lake Ranger District and elsewhere on the Umpqua and in Douglas County (Opler, et al., 2006).

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct or indirect effects as no trees hosting dwarf mistletoe would be removed. Alternatives 2 and 5 would all result in some direct mortality to Johnson's hairstreak larvae as lodgepole trees containing mistletoe are proposed to be removed in favor of retaining trees without mistletoe. Alternative 2 would result in the most indirect effects as it proposes harvesting the most late successional habitat with Alternative 5 harvesting 459 acres less lodgepole. Alternative 2 harvests 725 more acres mixed conifer than Alternative 5, and it is these stands that are most likely to contain Johnson's hairstreak due to their higher moisture content, increased forest floor diversity of flowering plants and higher densities of western hemlock. However, much of the mistletoe in planned units is in the older trees, in particular the older mountain hemlock (a species that is less likely to be harvested due to poor market demand). Indirect effects include a potential reduced rate of spread of mistletoe in stands adjacent to harvest unit as source populations of mistletoe would be removed, reducing future availability of mistletoe as a food source across all action alternatives. All action alternatives contain the same units of underburning, which would have a short term impact to nectar producing flowers. The connected and similar actions associated with the action alternatives will have no effect to the Johnson's hairstreak butterfly.

Cumulative Effects

Alternative 1 would have no cumulative impact as no timber harvest or fuel reduction activities would take place. Cumulative effects for the Johnson's hairstreak are analyzed over the entire planning area, encompassing fifteen sixth-field watersheds, (151,806 acres as mistletoe is spread throughout the planning area. Over the past 60 years, approximately nine percent of the nine sixth-field watersheds have been harvested (regeneration, shelterwood, and commercially thinned) which would have removed most of the mistletoe present within harvested stands (Table 3-1). Alternative 2 increases harvest by six percent within the nine sixth-field watersheds, and Alternative 5 by harvesting five percent over past amounts. These acres, when considered together, contribute to a minor loss of mistletoe across the landscape because at least 58 percent of the watersheds would have no additional harvest as there are no future activities planned for removing vegetation due to their protected land allocations, thus maintaining mistletoe across the landscape and limiting the potential for cumulative effects.

Determination of Impact

All action alternatives would result in the loss of trees harboring mistletoe, **therefore it is determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of Johnson's hairstreak.** This is because of the limited extent of the loss of mistletoe when compared to the range of this species and the amount of adjacent reserved land allocations. There would be sufficient unharvested areas within the fifteen sixth-field watersheds (including the Oregon Cascades Recreation Area and the Mt. Bailey and Thirsty Creek Appendage IRAs) to harbor mistletoe host trees to maintain population viability of Johnson's hairstreak. Alternative 1 would have no impact to individuals or habitat for Johnson's hairstreak.

Coronis fritillary (Speyeria coronis)

This is relatively large (~3") yellow-orange butterfly with black markings on the upperside of the wing, with silver spots on the underside of the hindwing (Scheuering, 2006; Opler, et al., 2006). They are found in a variety of habitats, including conifer forests and grasslands where violets (*Viola* spp.), the principle food source of larvae, are present (Scheuering, 2006). Adults would feed on a variety of other flower species nectar. Loss of grassland or montane meadow habitat is the primary threat to this species.

Affected Environment

Coronis fritillary were not observed during field reconnaissance for this project. However, suitable montane meadow and coniferous forest exists in the planning area, therefore it is assumed that the species occurs within the planning area. Coronis fritillaries have been documented in Douglas County (Opler, et al., 2006).

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct or indirect effects as no grasslands, meadows or nectar-producing flowers would be impacted. No meadows with the potential to have violets in them would be impacted due to timber harvest or other associated activities in any alternative. Mixed conifer stands within all alternatives do have some *Viola* species present, but they fall within the no-harvest buffers (Helliwell, personal communication), therefore no action alternatives would impact the primary food source of Coronis fritillary larvae, so no direct effects would occur from any alternatives.

Indirect effects include the potential loss of other nectar-producing flower species by mechanized harvest equipment and temporary road construction, primarily within mixed conifer stands which have moist understory microclimates suitable for flower growth. Alternative 2 contain 2,225 acres of mixed conifer harvest, while Alternative 5 would have less indirect effects to Coronis fritillary nectar sources as it proposes to harvest about 725 acres less mixed conifer habitat. All action alternatives contain the same units of underburning, which would have short-term impact to nectar-producing flowers. The connected and similar actions associated with the action alternatives will have no effect to the Coronis fritillary.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Coronis fritillary are analyzed over the entire planning area, encompassing 15 sixth-field watersheds, (151,806 acres) where suitable grasslands, meadows or mixed conifer habitat occurs. Alternative 1 would have no cumulative impact as no timber harvest or fuel reduction activities would take place. Alternative 2 would add the most cumulative impact to the past, present and foreseeable impacts to mixed conifer stands with nectar-producing flowers for up to ten years through harvest related activities (equipment trampling flowers in treatment units), with Alternative 5 adding less cumulative than Alternative 2. No alternative would add to the cumulative impacts to grasslands or meadows which are most important to this species.

Determination of Impact

All action alternatives would result in the loss of some nectar producing flowers through harvest in mixed conifer stands, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of the Coronis fritillary.** This is because of the small amount of impact to nectar-producing flowers throughout the range of the species and the amount of adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the Coronis fritillary.

Mardon Skipper (Polites mardon)

The Mardon skipper is a small (<1") tawny-orange butterfly with a hairy body (Kerwin and Huff, 2007). Larvae feed on native bunchgrasses including Idaho fescue (*Festuca idahoensis*), while adults feed on a variety of flower nectar sources. It is a Federal candidate for listing under the ESA due to habitat destruction or degradation of its obligate grassland habitats, encroachment of non-native vegetation, and successional loss of grasslands to forest (USDI 2004a).

Affected Environment

Mardon skipper were not observed during field reconnaissance for this project. However, there are limited amounts of suitable grassland habitat containing Idaho fescue within the planning area; therefore it is assumed the species occurs within the planning area. Mardon skipper have been documented on the southern portion of the Rogue River National Forest.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct or indirect effects as no grassland habitats or nectar-producing flowers would be impacted. No meadows with the potential to have Idaho fescue in them would be impacted due to timber harvest or other associated activities in any alternative. Indirect effects include the potential loss of other nectar-producing flower species by mechanized harvest equipment and temporary road construction, within mixed conifer stands which have moist understory microclimates suitable for flower growth, as well as lodgepole stands which contain phlox (*Phlox diffusa*), which is a source of nectar used by Mardon skippers. Alternative 2 contains 2,225 acres of mixed conifer harvest, while Alternative 5 would have less indirect effects to Mardon skipper nectar sources as it proposes to harvest 725 acres less mixed conifer habitat. Alternative 2 would have the most indirect effects to Mardon skipper as it contains more than 1,000 additional acres of lodgepole than proposed in Alternative 5. All action alternatives contain the same two units of underburning, which would have short term impact to nectar-producing flowers. The connected and similar actions associated with the action alternatives would have no effect to the Mardon skipper.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Mardon skipper are analyzed over the entire planning area, encompassing 15 sixth-field watersheds, (151,806 acres) where suitable grasslands, meadows or mixed conifer habitat occurs adjacent to harvest units . Alternative 1 would have no cumulative impact

as no timber harvest would take place. Alternatives 2 would add the most cumulative impact to the past, present and foreseeable impacts to mixed conifer stands with nectar-producing flowers for up to ten years through harvest related activities (equipment trampling flowers in treatment units), with Alternative 5 adding less cumulative impact than Alternative 2. No alternative would add to the cumulative impacts to grasslands or meadows which are the most important to this species.

Determination of Impact

All action alternatives would result in the loss of some nectar-producing flowers through harvest in mixed conifer stands, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of the Mardon skipper.** This is because of the small amount of impact to nectar-producing flowers throughout the range of the species and the amount of adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the Mardon skipper.

Evening Fieldslug (Deroceras hesperium)

The evening fieldslug is a medium-sized slug (>1/2" long) with a brown mantle and light spots. It is associated with perennially wet meadows in coniferous forests in microsites containing herbaceous vegetation edging water or under damp litter (Burke and Duncan, 2005). They feed on microorganisms and plant matter. Threats to this species include loss or degradation of wetland habitat, especially activities that alter moisture regimes on the edges of wet meadows, as well as fire of any severity (Burke and Duncan, 2005).

Affected Environment

Evening fieldslugs were not observed during field reconnaissance for this project. However, there are perennially wet meadows in and adjacent to coniferous forest within the planning area; therefore it is assumed the species occurs within the planning area. Evening fieldslugs have been documented on the Western Cascades of Oregon.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects as no timber harvest would take place; indirectly, increased fire hazard resulting from untreated fuels may intensify fire severity near wetlands, which would be a detriment to evening fieldslugs. No wetland habitats would be directly impacted by timber harvest or fuels reduction activities as all wetlands are buffered by a minimum of 50 feet from where the wetland transitions to forest (most are buffered by 150 feet). Therefore, there would be no direct effects to the evening fieldslug as a result of timber harvest or fuels reduction activities. Indirect effects of thinning adjacent to wetlands (primarily the eastern shore of Lemolo Lake and the southern meadows adjacent to Silent Creek south of Diamond Lake) include some level of increased desiccation along wetland edges through increased solar penetration and wind which may reduce the amount of suitable moist microclimates for evening fieldslugs. Alternatives 2 and 5 contain the same amount of thinning adjacent to wetlands. While there is no treatment directly adjacent to potentially occupied wetlands, the treatments adjacent to wetlands will benefit the wetlands indirectly by creating a "shadow effect" where fire behavior is reduced in adjacent areas of untreated stands or habitat. This "shadow effect" is estimated to be 1.5 times the size of the treatment unit, thus many of the buffered wetlands would encounter minimized fire behavior as a result

of thinning in adjacent stands (*see* Fuels section of this chapter). No underburning would occur in stands with suitable habitat, so there would be no direct or indirect effects from underburning. No temporary roads would be constructed through wetlands or moist meadows in any alternative. The connected and similar actions associated with the action alternatives will have no effect to the evening fieldslug.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the evening fieldslug are analyzed over the entire planning area, encompassing 15 sixth-field watersheds, (151,806 acres) where suitable wetlands or wet meadows within conifer habitat occur adjacent to harvest units. Alternative 1 would have no cumulative impact as no timber harvest would take place. Alternative 2 would add the most cumulative impact to the past, present and foreseeable impacts to wetlands and wet meadows for up to ten years during project implementation in units adjacent to wet habitat, with Alternative 5 adding less cumulative impact than any other action alternative.

Determination of Impact

All action alternatives would result in the desiccation of some wetland or wet meadow habitats within or adjacent to mixed conifer units, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of the evening fieldslug.** This is because of the minimal amount of wetland habitat impacted and the adjacent reserved land allocations which are managed to preserve wetland habitats. Alternative 1 would have no impact to individuals or habitat for the evening fieldslug.

Salamander Slug (Gliabates oregonius)

The salamander slug, also known as the “axe tail” slug, is a small slug (< 0.5” long), with a mantle that is almost as long as its entire body (Duncan, 2008). They are associated with Douglas-fir needle litter without shrub cover in conifer forests in moderate elevations in the Western Cascades, where Douglas-fir (Pseudotsuga menziesii) is a dominate overstory. This species is not associated with seeps or wetlands, but rather in areas where water can collect or areas that will become saturated as the rainy season develops. The salamander slug is a predatory slug, thus they prefer habitats with an abundance of other slugs to predate on. Threats to this species include activities that lead to a loss of microhabitat through desiccation resulting from alteration of moisture regimes or loss of deciduous leaf cover which also alters microhabitat moisture. Like most terrestrial mollusk species, fire is also a threat.

Affected Environment

Salamander slugs were not observed during field reconnaissance for this project. However, there are conifer forests with limited shrub cover to provide habitat for this species in the planning area, therefore it is assumed the species occurs within the planning area, primarily in the lower elevation mixed conifer units along Highway 138. There are no known locations of salamander slug populations on the Umpqua National Forest, the closest known populations are to the north in the Willamette National Forest and Eugene District Bureau of Land Management.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects as no timber harvest would take place indirectly, increased fire hazard resulting from untreated fuels may intensify fire severity near wetlands, which would be a detriment to salamander slugs. Both action alternatives contain the same amount of harvest within the suitable mixed conifer habitat along Highway 138 though the unit boundaries are slightly different. Mechanical harvest and mastication, as well as temporary road construction in these lower elevation mixed conifer stands would disturb the coarse wood and needle litter distribution and would therefore have the potential for direct mortality to salamander slugs by being crushed by harvesting equipment. However, the majority of high-quality, moist habitat more likely to harbor an abundance of other slug prey is within the riparian reserve portions of units which contain buffers of 50 to 300 feet. Indirect effects from all action alternatives could include microsite desiccation along the edges of riparian buffers which could reduce the amount of suitable moist habitat for foraging salamander slugs. There would be no direct or indirect effects from underburning, as no underburning would occur within potentially suitable stands. While there is no treatment directly within riparian areas, the treatments adjacent to riparian areas will benefit the riparian areas indirectly by creating a “shadow effect” where fire behavior is reduced in adjacent areas of untreated stands or habitat. This “shadow effect” is estimated to be 1.5 times the size of the treatment unit, thus many of the buffered riparian areas would encounter minimized fire behavior as a result of thinning in adjacent stands (*see* Fuels section in this chapter). The connected and similar actions associated with the action alternatives will have no effect to the salamander slug.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the salamander slug are analyzed over the Lake Creek, Clearwater Creek Headwaters and Stump Lake sixth-field watersheds (36,584 acres), which encompass the potentially suitable lower elevation mixed conifer habitat with harvest units in the D-Bug planning area. Alternative 1 would have no cumulative impact as no timber harvest would take place. Alternatives 2 and 5 would add the same minor cumulative impact to the past, present and foreseeable impacts to suitable deciduous understory habitat over the approximately ten years of implementation in treated units.

Determination of Impact

All action alternatives would result in disturbance to suitable shrubby herbaceous understories within lower elevation mixed conifer units, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of the salamander slug.** This is because of the minimal amount of treatment proposed in mixed conifer habitat throughout the planning area and the amount of mixed conifer habitat in adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the salamander slug.

Chace Sideband (Monadenia chaceana)

The Chace sideband is medium sized snail (18-26mm) with a brownish yellow shell comprised of 5.2-5.8 whorls (Weasma and Duncan, 2005). They are found on the lower portions of talus slopes and in and around rocky outcrops. They feed on foliage, fruit, mold and fungi. During the summer and winter, when climatic conditions are not conducive for foraging, they will burrow down into rock crevices as protection from desiccation, protection, and potential impacts from wildfire (Weasma and Duncan, 2005).

Affected Environment

Suitable mixed conifer habitat with rock outcrops was surveyed throughout the D-Bug project area (Duncan, et al., 2003). No Chace sidebands were encountered. It is believed that the D-Bug project area is above the elevation bounds of this species, but that has not yet been confirmed with a range-wide habitat analysis.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects as no timber harvest would take place. Indirectly, increased fire hazard resulting from untreated fuels may intensify fire severity near rock outcrops, but this will not likely affect Chace sideband. All action alternatives contain the same units with rock outcrop habitat, though each unit's boundaries are slightly different. Mechanical harvest and mastication, as well as temporary road construction in lower elevation mixed conifer stands would disturb the coarse wood and needle litter distribution and would therefore have the potential for direct mortality to Chace sideband if they are operating when conditions are suitable for sideband dispersal.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Chace sideband are analyzed over the Lake Creek, Clearwater Creek Headwaters and Stump Lake sixth-field watersheds (36,584 acres), which encompass the potentially suitable lower elevation mixed conifer habitat with harvest units in the D-Bug planning area. Alternative 1 would have no cumulative impact as no timber harvest would take place. Alternatives 2 and 5 would add the same minor cumulative impact to the past, present and foreseeable impacts to suitable rock outcrop/talus habitat over the next ten years of project implementation in treated units.

Determination of Impact

All action alternatives would result in disturbance to suitable coarse wood dispersal habitat within lower elevation mixed conifer units, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability for the Chace sideband.** This is because of the minimal amount of treatment proposed in mixed conifer habitat throughout the planning area and the amount of mixed conifer habitat in adjacent reserved land allocations, as well as the lack of observed individuals during surveys completed to protocol. Alternative 1 would have no impact to individuals or habitat for the Chace sideband.

Crater Lake Tightcoil (Pristiloma arcticum crateris)

The Crater Lake tightcoil is a very small (2mm diameter) snail with its shell having a low conic spire and very tight coils, like its name suggests. They are found in scattered wetland areas above 2,000 feet throughout the Oregon Cascades in perennially wet areas among rushes, mosses, or under rocks or woody debris no more than 33 ft from water (Gowan and Burke, 1999). They graze on microscopic bacteria, yeasts and other microscopic organisms. Threats to this species include loss or degradation of wetland habitat from activities including heavy equipment use, off road vehicles, snowmobiles, recreational fishing/hiking, fire or any action that alters the normal moisture regime of their habitat or compacts soil in occupied habitat (Gowan and Burke, 1999; Curry, et al., 2008). This species has been included in a petition to the Secretary of the Interior by the Center for Biological Diversity to list 32 mollusk species in the Pacific Northwest under the ESA (Curry, et al., 2008).

Affected Environment

Surveys for this species have occurred in portions of the planning area, and they have been documented in surveys along Lake Creek, Thielsen Creek and Crystal Spring off of Lemolo Lake in surveys from 2000-2003. There is additional suitable wetland and streamside habitat throughout the planning area. Three sites along Lake Creek and the Crystal Spring site were re-surveyed in the summer of 2007, but no Crater Lake tightcoils were documented at these locations. However, as they are very difficult to find, it does not mean they are extirpated from these sites. All suitable habitats within the D-Bug planning area would be buffered by a minimum of 50 feet, with riparian buffers ranging from 50 to 300 feet.

Environmental Effects

Direct and Indirect Effects

There would be no direct effects to the Crater Lake tightcoil by any alternative as no harvest, fuels treatments or road building would occur in any suitable or occupied habitat for this species. Alternative 1 would result in no indirect effects as no harvest or associated activities would occur. The no action alternative contains units closer than 100 feet from any historically occupied sites. There are no expected impacts to stream flow regimes as a result of harvest or fuels reduction activities (*see* Aquatic section of this chapter), therefore there would be no indirect effects to the Crater Lake tightcoil or their habitats as result of any action alternative. While there is no treatment directly adjacent to potentially occupied wetlands, the treatments adjacent to wetlands will benefit the wetlands indirectly by creating a “shadow effect” where fire behavior is reduced in adjacent areas of untreated stands or habitat. This “shadow effect” is estimated to be 1.5 times the size of the treatment unit, thus many of the buffered wetlands would encounter minimized fire behavior as a result of thinning in adjacent stands (*see* Fuels section in this chapter). The connected and similar actions associated with the action alternatives will have no effect to the Crater Lake tightcoil.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. As there are no direct or indirect effects, there are no cumulative effects as the result of the selection of any alternatives considered for the D-Bug project.

Determination of Impact

There would be no harvest or fuels reduction activities adjacent to historically occupied sites and there are no expected impacts to stream flow regimes as a result of any alternative **there would be no impact to the Crater Lake tightcoil as a result of the D-Bug project**.

Pristine Springsnail (Pristinicola hemphilli)

The pristine springsnail is a small (2-3mm tall) aquatic snail with a white, elongate shell with 5 ½ whorls and an unpigmented body with small eyespots (Duncan, 2008). They are found primarily within small undisturbed cold springs or seeps in coarse gravel or cobble substrates in dense Douglas-fir forests. They feed by scraping algae, yeast, bacteria and diatoms from rock and woody surfaces (Duncan, 2008). Threats to this species include any actions resulting in hydrologic changes to flow in their habitat, including road construction and logging in occupied habitat (Duncan, 2008).

Affected Environment

Pristine springsnails were not observed during field reconnaissance for this project. However, there are suitable cold spring and seep habitat for this species in the planning area. Therefore, it is assumed the species occurs within the planning area. There are no known occupied sites on the Umpqua National Forest, and the closest occupied site is in the Rogue River National Forest.

Environmental Effects

Direct and Indirect Effects

There would be no direct effects to the pristine springsnail by any alternative as no harvest, fuels treatments or road building would occur in any suitable or occupied habitat for this species. Alternative 1 would result in no indirect effects as no harvest or associated activities would occur. All potentially suitable seeps and springs would be buffered by a minimum of 50 feet, and no harvest or fuels reduction activities would take place within these buffers, therefore there are no direct effects expected from any action alternative. There are no expected impacts to stream flow regimes as a result of harvest or fuels reduction activities (*see* stream flow analysis in this chapter). Therefore, there would be no indirect effects to the pristine springsnail or their habitats as a result of any action alternative. While there are no treatments directly adjacent to potentially occupied habitat, the treatments will benefit suitable habitats indirectly by creating a “shadow effect” where fire behavior is reduced in adjacent areas of untreated stands or habitat. This “shadow effect” is estimated to be 1.5 times the size of the treatment unit, thus many of the buffered seeps would encounter minimized fire behavior as a result of thinning in adjacent stands (*see* Fuels section in this chapter). The connected and similar actions associated with the action alternatives will have no effect to the pristine springsnail.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the pristine springsnail are analyzed over the entire planning area, encompassing 15 sixth-field watersheds, (151,806 acres) where suitable stream or wet seep habitat occurs adjacent to harvest units. Alternative 1 would have no cumulative impact as no timber harvest would take place, and as all action alternatives would not impact stream flow regimes

nor operate in any occupied habitat there would be no additional cumulative effects as a result of the D-Bug project.

Determination of Impact

There would be no harvest or fuels reduction activities adjacent to potentially suitable spring and seep habitats and there are no expected impacts to stream flow regimes as a result of any alternative **there would be no impact to the pristine springsnail as a result of the D-Bug project**.

Horned Grebe (Podiceps auritus)

The Horned Grebe is a small black and white waterbird with a short, pale bill, and red eye. During the breeding season the male develops a yellow patch behind the eye, and the neck and belly turn rufous in color. They breed in the northern U.S. (including the Malheur National Wildlife Refuge), Canada, and Alaska in small-to-moderate sized freshwater ponds and marshes with emergent vegetation (Stedman, 2000). They over-winter on coastal estuaries, inland lakes, rivers and reservoirs (Stedman, 2000). They feed by diving, and their prey is mainly aquatic arthropods in the summer, fish and crustaceans in the winter. Threats to this species include degradation of habitat, primarily through oil spills and pesticide accumulation in prey items (Stedman, 2000).

Affected Environment

There are no records for Horned Grebe on Diamond or Lemolo lakes from point-count monitoring of these locations from 1996-2006, suggesting that Horned Grebes do not nest at these lakes (Umpqua Valley Audubon, 2006). Fix (1990) calls the Horned Grebe very uncommon, but a regular migrant in the spring and fall on Diamond and Lemolo lakes. He observed Horned Grebes both in October (1989) and May (1988).

Environmental Effects

Direct and Indirect Effects

No Horned Grebe nests have been documented nor are they suspected of nesting adjacent to Diamond and Lemolo Lakes, and timber harvest or fuels reduction activities would not affect either lake. Therefore, there would be no direct effects from any alternative. Alternative 1 would result in no indirect effects as no harvest or associated fuels reduction activities would occur. There are no expected impacts to water quality or stream flow as a result of any harvest or fuels reduction activities, therefore there would be no indirect effects to Horned Grebes as a result of any action alternatives. The connected and similar actions associated with the action alternatives will have no effect to the Horned Grebe.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. As there are no direct or indirect effects, there are no cumulative effects as the result of the selection of any alternatives considered for the D-Bug project.

Determination of Impact

There would be no harvest or fuels reduction activities that would impact either Diamond or Lemolo Lakes, and there is no evidence to suggest that Horned Grebes nest in the

project **there would be no impact to the Horned Grebes as a result of the D-Bug project**.

Red-necked Grebe (Podiceps grisegena)

The Red-necked Grebe is large for a grebe, with a long, stout, yellowish bill and drab grey coloration with a pale breast during winter. Males in breeding plumage have a black cap, white cheek extending around the head, rufous neck and brown body. They breed on shallow freshwater lakes in the northern U.S., Canada and Alaska, while they winter along coastal estuaries and to a lesser extent interior freshwater lakes and saturated marshes (Stout and Neuchterlein, 1999). They feed by diving, and their prey consists of a variety of fish, aquatic invertebrates and occasionally amphibians. Threats to this species include degradation of habitat, including pollution (oil spills and bioaccumulation of pesticides and heavy metals in prey items) in wintering grounds, and loss of breeding habitat through draining of potholes for agriculture and road building (Stout and Neuchterlein, 1999).

Affected Environment

Red-necked Grebes have been observed on Diamond and Lemolo lakes in the fall, September through November (Fix, 1990; Umpqua Valley Audubon, 2006). It is likely that they are a regular visitor to Diamond and Lemolo lakes in the fall, but do not occur in large numbers.

Environmental Effects

Direct and Indirect Effects

No Red-necked Grebe nests have been documented nor are they suspected of nesting adjacent to Diamond and Lemolo lakes, and timber harvest or fuels reduction activities would not affect either lake, therefore there would be no direct effects from any alternative. Alternative 1 would result in no indirect effects as no harvest or associated fuels reduction activities would occur. There are no expected impacts to water quality or stream flow as a result of any harvest or fuels reduction activities therefore there would be no indirect effects to Red-necked Grebes as a result of any action alternatives. The connected and similar actions associated with the action alternatives will have no effect to the Red-necked Grebe.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. As there are no direct or indirect effects, there are no cumulative effects as the result of the selection of any alternatives considered for the D-Bug project.

Determination of Impact

There would be no harvest or fuels reduction activities that would impact either Diamond or Lemolo Lakes, and there is no evidence to suggest that Red-necked Grebes nest in the planning area **therefore there would be no impact to the Red-necked Grebes as a result any alternative for the D-Bug project**.

Harlequin Duck (Histrionicus histrionicus)

The Harlequin Duck is a medium-sized diving duck, with males being identified by their small bill and very distinctive white markings on the face and head, with white stripes on

the neck, chest and wings. The female has a similar small bill, with a dusky brown body and small white ear spots (Stone, 2007b). Harlequins summer along fast flowing mountain streams and rivers adjacent to forests and winter along rocky coastal shores (Stone, 2007b). Their diet is aquatic invertebrates in their breeding habitats while the feed on snails, limpets and mussels off of coastal rocks. They are ground nesters who generally nest less than 17 feet away from water. Threats to Harlequins include degradation of breeding streams through damming, human disturbance, logging, roads and ocean pollution, including oil spills.

Affected Environment

There are no known occurrences of Harlequins in the planning area. They have been observed during the breeding season on the North Umpqua River, approximately six miles west of the planning area. Lake Creek, Thielsen Creek, Lava Creeks and the Clearwater River represent low quality habitat due to their smaller size than typical breeding streams and rivers. In 2003, two surveys for Harlequins on Lake Creek did not detect the species (USDA, 2004).

Environmental Effects

Direct and Indirect Effects

All potentially suitable nesting creeks and rivers (Lake, Thielsen and Lava creeks and Clearwater River) adjacent to harvest units would be buffered by a minimum of 50 feet, well beyond the less than 17 foot distance from water that Harlequin's typically follow. Therefore, there would be no direct effects from any alternative. Alternative 1 would result in no indirect effects as no harvest or associated fuels reduction activities would occur. There are no expected impacts to water quality or stream flow as a result of any harvest or fuels reduction activities to any creeks or rivers, therefore there would be no indirect effects to Harlequin ducks as a result of any action alternatives. The connected and similar actions associated with the action alternatives will have no effect to the Harlequin duck.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Harlequin duck are analyzed across their potential range, extending from the Pacific Coast throughout the interior Pacific Northwest of North America. No alternative would result in any additional cumulative impact to the Harlequin as there would be no direct or indirect impacts associated with the D-Bug project.

Determination of Impact

There would be no harvest or fuels reduction activities that would impact Lake, Thielsen and Lava creeks or the Clearwater River, and there is no evidence to suggest that Harlequin ducks nest in the planning area therefore there would be no impact to the Harlequin duck as a result of any alternative for the D-Bug project.

Bufflehead (Bucephala albeola)

The Bufflehead is the smallest diving duck in North America, and males are identified by their rounded black head with white patch behind the eye that extends around the entire head. Females are identified by their rounded head with white cheek patch posterior to their eye. They are cavity nesters who frequent freshwater permanent ponds in

woodlands throughout North America during the breeding season and over winter in both fresh and saltwater along coastal areas (Gauthier, 1993). They nest in the abandoned tree cavities created by Northern Flickers, and will nest over 1,300 feet away from water (Gauthier, 1993). These ducks are monogamous and females often reuse the same nest site in successive years. In the summer they feed on insect larvae and amphipods while in the winter they feed on crustaceans and mollusks (Gauthier, 1993). Threats to Buffleheads include lack of nest sites (loss of trees or absence of cavities), and competition for food with fishes in wetlands with low nutrients.

Affected Environment

Buffleheads have been observed on Diamond Lake and the Diamond Lake Resort sewage ponds regularly in May through September (Umpqua Valley Audubon Society, 2006). In 1989 and 1990, they were documented nesting at the Diamond Lake sewage ponds (Fix, 1990). As Bufflehead are regularly observed on Diamond Lake and the sewer ponds during the breeding season it is likely that they nest nearby, though no nests have been documented. There are no recorded observations of Bufflehead at Lemolo Lake, but it is likely that this lake may also be frequented by Bufflehead.

Environmental Effects

Direct and Indirect Effects

There would be no direct or indirect effects to Bufflehead as a result of Alternative 1 as no timber harvest or fuels reduction activities would take place. All action alternatives include harvest of units adjacent to Diamond Lake, the sewage ponds and Lemolo Lake in mixed conifer habitats that contain Northern Flicker cavities. As timber harvest activities would be occurring during the breeding season, all action alternatives may cause direct mortality to nesting Bufflehead through nest site disturbance (causing nest abandonment), or hazard tree falling of snags containing cavities used by nesting Bufflehead. Additionally, proposed underburning in units 53 and 82, contained in all action alternatives, may result in the consumption of snags containing nesting Bufflehead, resulting in direct mortality. Indirect effects common to all action alternatives include non-lethal disturbance of nesting or roosting Bufflehead, alteration of nest microclimate due to reduced canopy closure, and reduction of snags that could be utilized in the future for nesting cavities. There would be no indirect effects to Bufflehead foraging habitat as a result of any action alternative as there is not expected to be any impact to water quality or streamflow quantity. Timber harvest and fuels reduction activities may provide a long term benefit to suitable Bufflehead nesting habitat within treatment units by reducing the risk of high severity fire in treated stands and stands directly adjacent to treatment units (*see* Fuels section in this chapter). The connected and similar actions associated with the action alternatives will have no effect to the Bufflehead.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for Bufflehead are analyzed across their potential range, extending from the Pacific Coast throughout the interior Pacific Northwest of North America. Alternative 1 would result in no additional cumulative effects as no harvest or fuels reduction activities would occur. All action alternatives would add the same minor level of cumulative impact to Bufflehead breeding habitats across its range over the next ten years of project implementation by

treating within some potential nesting habitat, but would not add any impacts to foraging habitats.

Determination of Impact

Timber harvest and fuel reduction activities adjacent to Diamond Lake, the sewage ponds and Lemolo Lake may impact Bufflehead nest cavities or roosting sites, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of Bufflehead.** This is because the amount of habitat impacted is minimal when compared to the amount of available habitat across the Diamond Lake Ranger District and adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the Bufflehead.

Bald Eagle (Haliaeetus leucocephalus)

The Bald Eagle is a wide-ranging raptor, easily identified by its large size, white head, brown body and yellow bill and legs. They nest close to large bodies of water, including lakes, rivers and oceans. They require large trees and snags with stout limbs to support their large platform nests and roosting sites. They feed primarily on fish, but they are opportunistic predators of waterfowl and shorebirds, and also scavenge on carrion. They have a long breeding season, extending from January through the end of August.

The Bald Eagle was listed as Threatened under the ESA from 1978 through 2007, when they were delisted (USDI, 2007b). Their population declines were due in large part to the agricultural pesticide DDT which caused a thinning of egg shells, severely limiting reproduction (USDI, 2007b). In 1974 Oregon was estimated to have 63 breeding pairs of Bald Eagles; in 2007 it was estimated to have 470 breeding pairs (USDI, 1978; USDI, 2007b).

While the Bald Eagle is no longer listed under the ESA, it was originally, and continues to be, protected by the Bald Eagle Protection Act (1940) which was amended to include Golden Eagles in 1962 to become the Bald and Golden Eagle Protection Act. Additionally, the Bald Eagle is covered under the Migratory Bird Treaty Act (MBTA).

Affected Environment

Bald Eagles have been documented nesting along Diamond and Lemolo lakes since the early 1980s. They have been observed throughout the year, and there are currently two nests on Diamond Lake and one active nest on Lemolo Lake (Table 3-23). The two nests on Diamond Lake are in large Shasta red firs, but they roost along the lake on larger diameter snags of several different species including white fir, Doug-fir, and ponderosa pine. The Rocky Point nest is on the northern shore of Diamond Lake, above and to the east of Forest Road 4795, while the Silent Creek nest is located on the southwest side of the lake, above Forest Road 4795. No eagles were observed using the Silent Creek nest site in 2007. The Lemolo Lake nest is in a large diameter ponderosa pine, and this pair also utilizes larger diameter snags along Lemolo Lake as roosts to forage from. This nest is located north of Lemolo Lake on Bunker Hill.

Table 3-23. Reproductive history of Bald Eagles at Diamond and Lemolo Lakes from 2000-2009.

Diamond Lake		
Site Name	Time Period	Young Fledged
Rocky Point	2000-2004	6 Total
	2005-2007	3* Total (1* in 2005) (2 in 2007)
	2008	None
	2009*	2
Silent Creek	2000-2004	6 Total
	2005-2007	1* (1* in 2005)
	2008-09	Not Occupied
Lemolo Lake		
Site Name	Time Period	Young Fledged
Lemolo Lake	2000-2004	4 Total
	2005-2007	1* (1* in 2005)
	2008	None
	2009	1

*****Eagle nest moved to new tree in unit 83 and the nest will be buffered by 330 ft.

2008 Diamond Lake / Lemolo Lake Watershed Analysis Iteration Recommendations for Bald Eagle Nesting and Foraging Habitat

The desired condition is uneven-aged, moderately dense forests with abundant large-diameter potential nest trees. Ponderosa pine is the most desirable species, followed by Douglas-fir and Shasta fir. These species all can provide a relatively open crown that allows large bodied birds like eagles to access nest locations. A moderately stocked understory would also discourage some human uses and would provide screening of nest activities. Foraging habitat was identified as the 100 yard band around both Lemolo Lake and Diamond Lake. Within this area the desired future condition is to have frequent large diameter trees and snags that provide perch sites. On the north, south and west sides of the lake there are abundant sites that provide some security and suitable perch locations. The concentration of recreational developments on the east side of the lake offers less seclusion and fewer perch sites.

Stands containing large legacy trees from the historic fire regime are high priority for thinning to alleviate the risk of premature mortality from excessive competition, insects, disease, and fire. Retain snags wherever feasible unless they constitute an immediate public safety hazard. Retain dense shrubs within and around areas that have large trees that could be used as eagle perch sites. In areas where these trees don't presently occur but they are desired, a long-term solution may be to plant suitable species (Douglas-fir, white pine, ponderosa pine) such that they will lean over the water.

Environmental Effects

Direct and Indirect Effects

The direct, indirect and cumulative effects discussions are predicated upon the following of the Recommendations from the National Bald Eagle Management Guidelines (USDI, 2007a),

<u>Category C: Timber Operations and Forestry Practices.</u>

- Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season (January 1 through August 31) within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.
- Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season without consulting the planning wildlife biologist to check nesting status of eagles prior to treatment.

Alternative 1 would have no direct or indirect effects as no timber harvest or fuels reduction activities would take place. Alternative 2 has more non-commercial fuels reduction treatments proposed adjacent to the Silent Creek nest. While there would be more short-term disturbance (i.e., noise from chainsaws) adjacent to the Silent Creek nest site during the non-breeding season, the increased unit width would increase the fire resiliency of the nest stand to wildfires moving from Diamond Lake westward post-treatment in Alternative 2, with slightly less benefits in Alternative 5 due to the shallower unit as a result of the leverage gained from thinning done in adjacent stands (the larger the area of treatment, the farther the reduction in fire behavior extends outside of the stand; *see* Fuels section in this chapter).

The Rocky Point nest site is surrounded by the same units with the same prescriptions in both action alternatives. However, Alternative 2 contains 18 more acres of thinning than Alternative 5, as the unit boundaries extend to the north into the Mt. Bailey IRA. The nest, which moved in 2009, has a 330-foot no-harvest buffer around it in both alternatives, as specified by the National Bald Eagle Management Guidelines (USDI, 2007a). Silvicultural prescriptions for the adjacent stands have been written to favor the retention of Shasta red fir and ponderosa pine, preferred species for nest trees. As harvest treatments would occur outside of the breeding season, short-term disturbance in the form of noise and smoke resulting in short-term displacement may affect eagles roosting nearby, but no direct mortality would take place as a result of these disturbances. Fuels reduction treatments may occur during the breeding season only if the eagles are not breeding to minimize potential disturbance to nesting or fledging

eagles. Territorial occupancy has been documented to continue without adverse effects to productivity after selective harvest in the fall adjacent to other Bald Eagle nest sites in Oregon (Arnett, et al., 2001). In 2007, the area comprised of unit 84 was non-commercially thinned (all trees 5" dbh and less) and pile burned after the breeding season. In 2008 the pair returned to this area.

Table 3-24. Units common to all action alternatives adjacent to the Rocky Point Bald Eagle Nest by harvest method, post harvest canopy cover, fuels treatment and acres of each unit. Canopy cover is defined by all trees 7" dbh and greater.

Unit	Harvest Method	Post Harvest Canopy Cover	Fuels Treatment	Acres
82	Skyline	41%	Underburn	57
83	Mechanical	41%	Grapple Pile (burned or hauled off)	45
84	Mechanical	28%*	Masticate or handpile along roads	48
86	Mechanical	41%	Grapple Pile (burned or hauled off)	57

*This is likely to be higher in Unit 84 as it contains a vigorous understory of mixed conifer (non-lodgepole) trees that will not be removed. The 28% figure comes from a composite of all units containing the same prescription.

The Lemolo Lake nest site is located on Bunker Hill on the north side of the lake. There are no harvest units within one-half mile of the nest site under either action alternative. Due to the distance of the proposed units from the Lemolo nest site there should be no direct effects to the eagles nesting at this site. Short-term indirect effects include disturbance of roost sites adjacent to Lemolo Lake near the Lemolo Lodge area during logging or fuels reduction activities. As there are no harvest units directly adjacent to the nest stand, there is no expected reduction in the probability of crown fire entering the Lemolo Lake nesting stand as a result of any alternative.

As there are no expected impacts to water quality or streamflow as described in the Aquatics section ofof this chapter, there would be no effects to the foraging habitat in Diamond or Lemolo lakes from any action alternative. The connected and similar actions associated with the action alternatives will have no effect on the Bald Eagle.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Bald Eagle are analyzed across their potential range, extending from the Pacific Coast throughout the interior Pacific Northwest of North America. Alternative 1 would result in no additional cumulative effects as no harvest or fuels reduction activities would occur. Alternative 2 may result in a slight increase in fire resiliency of the nest stands within the planning area as compared to Alternative 5, but the difference would be very small. Both action alternatives would add the same minor level of cumulative impact to Bald Eagle breeding habitats across its range over the next ten years of project implementation in units in suitable nesting habitat, but would not add any impacts to foraging habitats.

Determination of Impact

Timber harvest and fuel reduction activities adjacent to Diamond Lake and Lemolo Lake may result in short-term noise and smoke disturbance outside of the nesting season, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of the Bald Eagle.** This is because of the small scale of disturbance and the long-term benefit to Bald Eagles as a result of the action alternatives improving the resiliency to crown fire within nest stands adjacent to Diamond Lake. Alternative 1 would have no impact to individuals or habitat for the Bald Eagle.

Yellow Rail (Coturnicops noveboracensis)

The Yellow Rail is an incredibly secretive bird who is generally only identified by the insect-like ticking vocalizations of males at night (Audubon Society Watchlist, 2007). They are a small bird with a yellow bill, buffy yellow breast, and buff and black streaked back. They breed in large wet meadows or marshes with sedges and grasses, while they over winter in salt marshes, rice fields and wet meadows. They feed on freshwater snails, insects, small crustaceans and seeds (Audubon Society Watchlist, 2007). Threats to Yellow Rails include loss of wetland habitats required for breeding through the draining of wetlands for agriculture and flood control. They are on the Audubon Society's Watchlist as a red species, meaning that their population is declining rapidly/and or they have small populations, face major conservation threats, and are typically threatened in their global distribution (Audubon Society Watchlist, 2007).

Affected Environment

There are no observations of Yellow Rail within the planning area, or on the Umpqua National Forest. The closest known detection of this species is approximately 12 miles northeast of the planning area at Big Marsh on the Deschutes National Forest. There is some potential, low-quality habitat along the Silent Creek marshes below Diamond Lake, and in Toolbox Meadow. However, in volunteer point count surveys from 1996-2006 the species was not detected in these locations (Umpqua Valley Audubon Society, 2006). Additional surveys by Forest Service personnel were conducted in 2003 in the Silent Creek marshes and no Yellow Rails were detected (USDA, 2004). The Yellow Rail is a notoriously difficult bird to survey for, and as a result its presence within the planning area cannot be discounted without having completed multiple years of species specific nocturnal call-response surveys (Conway and Nadeau, 2005).

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct or indirect effects as no timber harvest or fuels reduction activities would take place. There would be no direct effects to this species as no suitable nesting habitat would be harvested or affected by fuels treatments due to the wetland buffers common to all action alternatives. Indirect effects common to all action alternatives include noise disturbance as the result of mechanical timber harvest and mastication of fuels which could result in short term displacement. The treatments adjacent to wetlands will benefit the wetlands indirectly by creating a "shadow effect" where fire behavior is reduced in adjacent areas of untreated stands or habitat. This "shadow effect" is estimated to be 1.5 times the size of the treatment unit, thus many of the buffered wetlands would encounter minimized fire behavior as a result of thinning in

adjacent stands (*see* Fuels section in this chapter). There would be no indirect effects to Yellow Rail foraging habitat as a result of any action alternative as there is not expected to be any impact to water quality or streamflow quantity. The connected and similar actions associated with the action alternatives will have no effect to the Yellow Rail as they occur outside of potential rail habitat.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Yellow Rail are analyzed across their potential range in Oregon, extending from the Diamond and Lemolo lake areas to Klamath National Wildlife Refuge to the coast of northern California. The cumulative impacts of both action alternatives over the next ten years of project implementation on increased fire resiliency of wetland habitats would be insignificant across the range of the Yellow Rail in Oregon and northern California.

Determination of Impact

There is a possibility that there could be some short-term disturbance to Yellow Rail's through noise and smoke disturbance, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of the Yellow Rail.** This is because of the small scale of disturbance and small amount of habitat associated with the project as compared to the overall range of the species. Long term, there would be a benefit to Yellow Rails as a result of the action alternatives decreasing the risk of a high severity wildfire which could impact water quality in foraging habitat. Alternative 1 would have no impact to individuals or habitat for the Yellow Rail.

Northern Spotted Owl (Strix occidentalis caurina)

The Northern Spotted Owl was listed as Threatened under the Endangered Species Act in 1990 and Critical Habitat was designated in 1992 (USDI, 1990, 1992). They are associated with mature and old-growth coniferous and mixed conifer-hardwood forests that have structures and characteristics suitable for nesting, roosting and foraging (USDI, 2008). Nesting, roosting, and foraging habitat (NRF) for the spotted owl is strongly associated with late-successional forests containing large conifers with broken tops or cavities for nesting, multiple canopy layers for thermal regulation and protection from predation and adequate amounts of large dead wood on the forest floor to support populations of prey (Thomas, et al., 1990). Northern Spotted Owls prey upon flying squirrels (*Glaucomys sabrinus*) and woodrats (*Neotoma* spp.) preferentially, but they will consume other rodents (Zabel, et al., 1995).

In May of 2008, the recovery plan for the Northern Spotted Owl was finalized (USDI, 2008). According to the recovery plan, "the most important range-wide threats to the spotted owl are competition with barred owls, ongoing loss of suitable habitat as a result of timber harvest and catastrophic fire, and loss of amount and distribution of suitable habitat as a result of past activities and disturbances" (USDI, 2008). The recovery plan created a series of reserves, known as Managed Owl Conservation Areas (MOCA) within Federal lands, as well as Conservation Support Areas (CSAs) outside of Federal lands to support the MOCA network and assist in achieving the Recovery Criteria. The recovery plan created three Recovery Criteria, as well as 32 Recovery Actions, which are actions deemed necessary to achieve the Recovery Criteria or to determine whether the Recovery Criteria have been met.

Affected Environment

There are 17 Northern Spotted Owl Occupancy Map (NSOOM) points within 1.2 miles of units proposed for the D-Bug action alternatives, 12 of which are computer-generated (USDI, et al., 2007). According to the recovery plan, old lodgepole pine forests within the planning area do not contain trees of sufficient diameter and are "likely not important Northern Spotted Owl habitat" (USDI, 2008). Seven of the computer generated points and two documented pairs contain lodgepole pine habitat in treatment units within their 1.2 mile home range and/or 0.5 mile core area. As lodgepole pine is "likely not important" habitat, harvest units within lodgepole will not be considered to be adversely affecting spotted owl habitat (USDI, 2008b).

Much of the mixed conifer habitat proposed for treatment within the action alternatives are in units designed to serve as fuel breaks and evacuation routes along major roads (Highway 138, State Route 230, Lemolo-Birds Point Road (FR 2610), Windigo Pass (FR 6000), Thirsty Creek Road (FR 6000-99) and the Diamond Lakeshore Road (FR 4795). Male spotted owls have been documented to have 'statistically significantly' higher levels of stressor hormones when their home range was within 0.41 km (410 m) of a major logging road (Wasser, et al., 1997).

Table 3-25. Acres of NRF and Dispersal habitat treated by alternative for the D-Bug Project.

	Alternative 2 (Acres)	**Alternative 5 (Acres)**
NRF Treated and Maintained	290	0
NRF Degraded to Dispersal (Commercial)	1,440	1,140
NRF Degraded to Dispersal (Non-Commercial)	212	332
Total NRF Degraded to Dispersal	***1,652***	***1,472***
Total Dispersal Treated and Maintained	***309***	***316***

The closest Critical Habitat Unit (CHU), OR-28, is 2.4 miles to the northwest of the planning area and 2.6 miles from the nearest unit. OR-28 is greater than 120,000 acres and contains portions of the Umpqua and Willamette national forests. The closest MOCA, OMOCA12 (Oregon MOCA), is 6.5 miles to the northwest of the planning area. MOCA 12 is 69,000 acres, contains portions of OR-28 and portions of the Umpqua and Willamette national forests. Both CHU OR-28 and OMOCA12 are more than a spotted owl home range away (>1.2 miles, the average home range size of a spotted owl in the Oregon Cascades (USDI, et al., 2008)), therefore they will not be considered in the effects analysis for this project as owls utilizing the project area likely will not utilize the CHU or MOCAs.

Consistency with the 2008 Recovery Plan Actions

Of the 32 Recovery Actions in the recovery plan, four pertain to the D-Bug Project:

*Recovery Action 6 (*Pertains to the Eastern Cascades of Oregon*): Identify, maintain, and restore approximately 30–35 percent of the total dry forest (ponderosa pine, Douglas-fir, and dry grand fir plant association group) habitat-capable area as spatially dynamic high quality spotted owl habitat patches, and approximately 50–75 percent of the total moist forests (moist grand fir, western hemlock, and Pacific silver fir plant association groups) habitat-capable area as high-quality spotted owl habitat patches.*

The alternatives include up to 1,652 acres of commercial mixed conifer thinning of suitable NRF habitat within the action area. This represents six percent of the total suitable habitat present within the action area and all treatment acres are located adjacent to Highway 138 and Lemolo Lake-Birds Point Road which are identified as evacuation routes. As 94 percent of the suitable habitat will remain in its current suitable state, the D-Bug project is consistent with Recovery Action 6.

*Recovery Action 7: Manage lands in these Provinces (*Eastern Cascades*) outside of the high quality habitat patches to restore ecological processes and functions, and to reduce the potential for significant losses by stand-replacement fires, insects, and disease.*

The action alternatives are consistent with this Recovery Action, as the intention of all fuel and silvicultural treatments is to reduce the within-stand risk of stand-replacement fire and to limit the within-stand spread of the mountain pine beetle. By treating alongside existing roads the Umpqua National Forest will have greater flexibility to manage wildfire suppression/management activities by utilizing these roadside fuel break treatments as holding and containment lines, reducing the need to build suppression lines into unmanaged habitat away from roads. Currently the Umpqua does not have a fire management plan authorizing us to manage fire as a natural disturbance process, but current fire management policy (USDA/USDI, 2009) allows for the application of a full range of management responses, from full suppression to monitoring wildfires. These treatments will increase future opportunities to manage fire as a natural disturbance process by providing areas to hold fires to existing roads. This will also address the following statement in the 2008 Recovery Plan:

> "*Treatments to reduce risks of fires and insect outbreaks in spotted owl habitat should be done in the larger context of restoring broader ecological functions and processes. In the dry-forest environments, there are three components of an integrated landscape strategy that need to be implemented at the Provincial scale: identification of existing high-quality spotted owl habitat, strategic placement of fuel-reduction treatments, and management for sustainable ecosystem processes and functions*.
>
> *This strategy could have short-term local impacts on spotted owl habitat in order to achieve the long-term landscape strategy goal of creating a more sustainable, resilient landscape. The goal of the fire strategy is to reduce the risk of large scale habitat loss to uncharacteristic high-severity wildfire while restoring ecosystem processes and functions*." *p. 20*

The D-Bug project is being proposed primarily to reduce risk of wildfire around WUIs and to improve the ability of the public to safely evacuate in case of a wildfire. However, it will also have benefits to spotted owl habitat by placing treatments alongside roads, which reduces the need to treat away from roadsides in areas which have more values as spotted owl habitat (as they have less disturbance), and will allow Umpqua National Forest fire managers increased operational flexibility to suppress fires at the fuel breaks or manage wildfires by using the fuel breaks to check fire spread. Roadside suitable habitat will be adversely impacted by being degraded from suitable NRF to dispersal habitat in the short term, but the treatments may minimize large-scale habitat loss by allowing fire managers to hold fires at the roadside treatment units. More spotted owl habitat has been lost as a result of wildfire than from timber harvest, with the trend increasing towards more frequent and larger wildfires consuming more owl habitat since the establishment of the Northwest Forest Plan (see Davis and Lint, 2005; Healey, et al., 2008; USFWS, 2008a; and Spies, et al., 2010).

Recovery Action 32: Maintain substantially all of the older and more structurally complex multi-layered conifer forests on Federal lands outside of MOCAs in the Olympic Peninsula, Western Washington Cascades, Western Oregon Cascades, Oregon Coast Range, Oregon and California Klamath, and California Coast Provinces, allowing for other threats, such as fire and insects, to be addressed by restoration management actions. These forests are characterized as having large diameter trees, high amounts of canopy cover, and decadence components such as broken topped live trees, mistletoe, cavities, large snags, and fallen trees.

There are no stands that are proposed to be treated by the D-Bug project that meet the Recovery Action 32 definition of high-quality owl habitat. The stands with suitable habitat do not contain multiple layers (at the most there are two layers in some stands), and there are very few stands proposed for treatment that have large-diameter trees (trees >30" dbh), and high amounts of decadence components.

Recovery Action 33: Assess how climate change may affect spotted owls and their habitat over time, and adjust protection and management of spotted owl habitat relative to these projected changes.

There is uncertainty around the specific effects climate change will have on spotted owls and spotted owl habitat (USDI, 2008b). Fire seasons, size and severity have been increasing over the past two decades (when looked at averages over the last century) as a result of less over-winter snow pack, earlier arrival of spring, and hotter seasonal temperatures (Westerling, et al., 2006; Littell, et al., 2009). Proposed treatments are designed to increase stand resiliency to wildfire in an attempt to better assure live tree persistence in case of a wildfire. The removal of lodgepole from current mixed conifer stands containing an understory of lodgepole, as well as the species preference in the thinning prescriptions are designed to increase stand resiliency by favoring fire-tolerant species and removing lodgepole, a fire-intolerant species (though a fire-adapted species, lodgepole utilizes fire to re-initiate stand development, and does not survive low-to-moderate intensity fire events).

Vegetative species compositions are also likely to shift, with conifer species distributions shifting to higher elevations in response to warming temperatures while alpine species distributions are predicted to narrow (Lenihan, et al., 2003; Schwartz, et al., 2006). By removing lodgepole from mixed species stands, the prescriptions proposed for treatment units in the D-Bug project will help the mixed conifer-lodgepole forests transition to become mixed conifer only, increasing their resilience to fire, as well as helping move species distributions slightly higher in elevation. Carroll (2010) suggests that higher elevation habitat in current reserves (e.g., wilderness areas) will likely become more important as habitat for spotted owls as vegetation communities shift to higher elevations. The D-Bug project area is currently at the periphery of the owls' distribution historically, and may become more important habitat in the future as a result of climate change.

Therefore the effects of the proposed treatments to spotted owl habitat in the face of climate change is twofold: 1) increase resiliency of existing stand structure to wildfire effects, and 2) assist in species distribution shifts of treated stands towards a more fire-resilient species composition which will provide better spotted owl habitat in the future (more mixed conifer habitat will be developed and maintained as result of the proposed treatments, which will reduce the prevalence of lodgepole, a non-preferred habitat component).

Environmental Effects

Direct and Indirect Effects

The direct and indirect effects are analyzed at two scales: 1) stand scale and 2) the planning area. There would be no direct effects to the Northern Spotted Owl as a result of either alternative, as both action alternatives proposing harvest in NRF habitat will be prohibited from conducting any timber harvest or road construction operations from March 1 to July 15, the breeding season for the spotted owl. Alternative 1 would have no direct effects as no timber harvest or fuels reduction activities would take place. Indirectly, this alternative does not improve stand resiliency to crown fire, which if it occurred, would degrade spotted owl habitat in the short term.

The units identified for this project are focused along roadsides and structures to function as fuel breaks, therefore it was determined that these treatments within and outside of NRF habitat are needed to modify within stand fire behavior, and the only means to do so and effect the ability of the stands to carry a crown fire is to reduce the canopy closure to 40 percent, which reduces the within-stand likelihood of crown fire initiation from high to low (*see* Fuels section in this chapter). This level of treatment would substantially increase the within-stand resiliency to crown-replacing fire, which would provide some level of long-term benefit to spotted owls within the treatment units. Therefore, if these stands encounter wildfire post treatment, the structural components of spotted owl habitat, primarily larger diameter trees and larger diameter mid-story trees will be more likely to survive than untreated stands encountering the same fire. Additionally, there is a documented “shadow” effect of reduced fire severity on stands directly adjacent to treated stands. The treated stand burns at a lower severity, which in turn, slows or moderates fire behavior. This benefits approximately half of the width of the treated stand into the adjacent untreated stand (Loehle, 2004).

Mixed conifer stands within 400 meters of a major road would be thinned to approximately 41 percent overstory canopy closure. These areas are unlikely to be heavily used by spotted owls due to their proximity to roads and the associated disturbance from passing vehicles. This level of treatment would substantially increase the within-stand resiliency to crown-replacing fire, which would provide some long-term benefit to spotted owls. In the portions of units with NRF habitat beyond 400 meters of a roadside in Alternative 2 (Table 3-24), canopy cover would be only slightly reduced, retaining 60 percent overstory canopy cover to be maintained as NRF. Though the treatment will not be as effective as reducing crown fire behavior as the more intense 40 percent canopy cover treatment, it will still lessen the ability of these stands to withstand crown -eplacing fire. Neither treatment would appreciably reduce the average stand tree diameters. No road building, mastication or underburning would occur in suitable NRF habitat. The connected and similar actions associated with the action alternatives will have no effect to the Northern Spotted Owl as they will occur outside of suitable owl habitat.

Treatments in NRF habitat will have immediate short-term adverse effects by degrading 1,652 acres of NRF habitat to dispersal habitat in Alternative 2 and 1,472 acres in Alternative 5 (Table 3-25). However there are long term benefits to NRF habitat in that post treatment, these stands will develop with downed wood levels and understory more typical of a natural disturbance regime and will be able to better withstand wildfire in the future (Lee and Irwin, 2005).

There are125 acres of underburning planned within current NRF stands that would be degraded to dispersal habitat. They are in units 82 and 194, both located adjacent to the

Diamond Lake Lodge, an area of high recreation use year-round (summer camping and fishing, winter snowmobile and cross country skier use). Underburning has been targeted specifically for these units as a restorative treatment due to the higher density of fire-dependent ponderosa and white pine, as well as the south aspects of these units. The underburning would take place in the fall, targeting smaller diameter surface fuels for consumption.

Effects to Spotted Owls due to Disturbance

All treatments within the action area will be subject to seasonal restrictions to reduce the potential for direct effects and disturbance impacts to spotted owls during the breeding season. The historic owl pair nest patch locations are all located more than three-quarters of a mile away from any treatment unit. There are three computer-generated NSOOMs within one-quarter mile of treatment units, though all are along Highway 138. There are no helicopter units proposed for this project, so helicopter noise or flights will not be a source of disturbance. The temporary roads will be an increased source of disturbance until harvest actions have been completed and the roads have been decommissioned after use. Temporary roads will provide additional access for unauthorized OHVs and snowmobiles while they remain open, which will be an additional source of disturbance to spotted owls.

Effects to Spotted Owl Critical Habitat as a result of the D-Bug Project

There is no Critical Habitat located within the action area; therefore, there would be no effect to either 1992 or 2008 Critical Habitat (USDI, 1992 and 2008).

Effects to Spotted Owl and Barred Owl Habitat Use/Competition

The effect of thinning and fuels reduction treatments on spotted and barred owl interactions is not well studied. In Washington State, studies of radio telemetry marked barred owls indicate that barred owls have smaller home range sizes than spotted owls, and that they prefer older contiguous forested habitat with low-slope positions and gentle gradients, high amounts of canopy closure (Hamer, et al., 2007; Singleton, et al., 2010). There are also indications that barred owls are competitively displacing spotted owls from larger patches of older and larger diameter forest habitat (Pearson and Livezey, 2003; USDI, 2008b; Singleton, et al., 2010). Recent studies and evaluations of habitat use between the two species indicate that barred owls are preferentially packing into larger patches of older forest, low-slope and gentle topography and displacing spotted owls to areas of higher slope position and younger, smaller diameter and more fragmented forests (Buchanan, et al., 2004; Hamer, et al., 2007; Singleton, et al., 2010). However, barred owls are also documented to use a wider variety of habitat types and successional classes than are spotted owls, suggesting that fragmentation of habitat may not impact barred owls as much as it would spotted owls (Courtney, et al., 2004). There are potential implications of these findings to the post-treatment use of habitat by both spotted and barred owls.

It is unknown if there are barred owls in the D-Bug action area. However, if present, it may be that barred owls could vacate stands treated as a result of the D-Bug project as the treatments would reduce canopy cover and increase habitat fragmentation, decreasing their suitability as NRF habitat for both species. There may be potential for the displacement of spotted owls using adjacent non-treated stands by barred owls dispersing from treated stands, but this has not been documented before in scientific literature. Barred owls are a larger, more aggressive owl, and have been documented to be more dominant and aggressive when interactions between the two species take place

(USDI, 2008; Van Lanen, 2010). However, thinning treatments could result in a lesser impact to barred owls than to spotted owls, as barred owls are able to exist in a wider range of habitat types and successional classes (Courtney, et al., 2004). Any benefits to stand resiliency as a result of these treatments would equally benefit barred owls and spotted owls, as their habitat niches are very similar.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Northern Spotted Owl are analyzed across their potential range in Oregon, Washington and Northern California. Past clearcut timber harvesting of late-successional and old growth forests is the management action that has had the largest cumulative impact on spotted owls through the removal of NRF habitat. Commercial thinning would also cumulatively add to past and future commercial thinning and past, ongoing and future pre-commercial thinning. There is potential additional impact to spotted owl habitat north of Lemolo Lake on Bunker Hill, with the proposed commercial thinning of 400 acres, which would impact a known nest site. However, none of the proposed D-Bug units alter the amount of NRF or dispersal habitat present within the home range of this pair. Projects that are designed to accelerate the development of future habitat would also lower the risk of future loss of habitat to wildfire, by making the stands more fire resilient. Thus, the minimal effects of the action alternatives, when considered in the context of past, present, and foreseeable actions across the species range, it is determined that there are no consequential negative cumulative effects associated with any alternative considered for the D-Bug Project.

Determination of Impact

There would be the loss of up 1,652 acres of NRF in Alternative 2 and 1,472 acres in Alternative 5, therefore either action alternative is **likely to adversely affect the Northern Spotted Owl** because of the loss of suitable NRF habitat and decreased amounts of downed wood and canopy layering important to spotted owl prey. Both action alternatives would have a long-term benefit to spotted owl habitat by the increased within-stand fire resiliency the treatments would provide. There is no Critical Habitat within the action area; therefore, alternatives considered for the D-Bug project will have "***no effect***" on either the 1992 or 2008 Critical Habitat. Seasonal restrictions and project design features will be in place in all suitable habitat within the planning area for all alternatives, therefore the project "***may affect, but is not likely to adversely affect***" spotted owls through disturbance mechanisms.

Lewis's Woodpecker (Melanerpes lewis)

Lewis's Woodpecker is a medium-sized woodpecker with a red face, green head, grey chest, green body and rosy belly. They are associated with open woodland habitats near water, and breeding habitats include an open canopy with large diameter dead or dying trees (Marshalls, et al., 2003). They are a secondary cavity nester, utilizing previously excavated cavities of Northern Flickers (*Colaptes auratus*) and Hairy Woodpeckers (*Picoides villosus*). They forage on insects during the spring and summer, while in the fall and winter they forage on fruit and acorns (Marshall, et al., 2003). During the fall, Lewis's Woodpeckers move to lower elevations in eastern Oregon. This species has undergone "drastic" declines in its breeding range in the state, possibly due to a loss of suitable habitat, loss of nest and food storage trees, competition for cavities,

and pesticides (Marshall, et al., 2003). It is a “red” listed species on the Audubon Society Watchlist (Audubon Society, 2007c).

Affected Environment

This species is regularly detected in the fall migrating through the planning area. Surveys from 1996-2006 regularly detected Lewis’s Woodpecker along the Lemolo Lake Road and South Shore Meadow in September (Umpqua Valley Audubon Society, 2006). Fix (1990) considers Lewis’s Woodpecker a scarce, but regular fall migrant. It is likely that the species is in the planning area during fall migration.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects as no timber harvest or fuels reduction activities would take place, however it would have the most beneficial indirect effects to Lewis’s Woodpecker of any alternative as it would allow for the most snag recruitment by not limiting the spread of mountain pine beetles or decreasing the risk of wildfire. No action alternatives would have direct effects to Lewis’s Woodpecker as this species does not nest within the planning area, and it is a highly mobile species and able to move away from harvest or fuels reduction related activities. Lewis’s Woodpeckers preferentially forage off of snags for winged insects, therefore indirect effects to Lewis’s Woodpecker common to all action alternatives include a decrease in snags within harvest units and the potential to decrease the scale of future fire disturbances as a result of timber harvest and fuels reduction activities which reduces the number and availability of snags in the future (Tobalske, 1997).

Lewis’s Woodpecker likely benefits from mountain pine beetle disturbance as they increase lodgepole pine snag densities which they forage off of and result in more open canopies which they prefer to forage in; however mountain pine beetles are not a preferred food source. Therefore Alternative 2, as it contains the most harvest and road building of all alternatives, would have the most indirect adverse effects to Lewis’s Woodpecker, followed by Alternative 5 which has the least adverse effects to snag densities, loss of lodgepole pine foraging habitat and least road densities of the action alternatives. Additional indirect effects of the action alternatives includes short-term disturbance of foraging within stands being actively harvested or treated for fuels reduction. The underburning common to all alternatives would provide limited benefits to foraging Lewis’s Woodpeckers by potentially increasing snag densities and stirring up flying insects and providing additional short term foraging opportunities. The connected and similar actions associated with the action alternatives will have no effect to the Lewis’s woodpecker or its habitat.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for Lewis’s Woodpecker are analyzed across their potential range in Oregon, extending from the D-Bug planning area to southern British Columbia and Alberta in Canada. Mountain pine beetle activity is increasing throughout northwestern North America, with large levels of snag recruitment occurring. The limited scale of harvest proposed in both action alternatives compared to the current and predicted spread of mountain pine beetles and overall current and predicted increases in the size of wildfires (Westerling, et al., 2006;

Skinner, 2007) throughout the range of Lewis's Woodpecker results in an insignificant cumulative loss of snags for foraging habitat.

Determination of Impact

There would be a reduction of current and future snag recruitment as a result of implementation of any of the action alternatives, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of Lewis's Woodpecker.** This is because it is at an insignificant scale compared to the range of the Lewis's Woodpecker and because of the amount of protected habitat in the adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the Lewis's Woodpecker.

White-headed Woodpecker (Picoides albolavartus)

The White-headed Woodpecker is a stunning woodpecker, unmistakable for any other woodpecker species by its mostly white head and fully black body. They inhabit mostly open ponderosa pine or mixed conifer forests with a strong ponderosa pine component (Marshall, et al., 2003). They prefer a relatively open canopy with a sparse understory and larger trees and snags for nesting and foraging. They readily use habitat that has been burned or thinned if sufficient numbers of larger trees and snags are retained (Audubon Society Watchlist, 2007d). They are primary cavity excavators who feed on seeds, invertebrates and sap (Marshall, et al., 2003). Threats to this species include silvicultural practices which remove larger trees and snags, and habitat fragmentation and fire suppression which allow for an increase in shrub cover removing foraging habitat and reduces snag recruitment (Audubon Society Watchlist, 2007d).

Affected Environment

Point count surveys from 1996-2006 failed to detect any White-headed Woodpeckers in the planning area (Umpqua Valley Audubon Society, 2006). Fix (1990) considered the species a casual visitor to the Diamond Lake RD, but never actually observed the species on the District himself. The nearest Breeding Bird Survey route closest to the planning area (approximately seven miles to the west), Clearwater (#69051) has no detections for the White-headed Woodpecker (Sauer, et al., 2006). The species may be present in planning area in very low numbers.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects as no timber harvest or fuels reduction activities would take place, however it would have the most beneficial indirect effects to the White-headed Woodpecker of either alternative as it would allow for the most snag recruitment by not limiting the spread of mountain pine beetles or decreasing the risk of wildfire. White-headed Woodpeckers likely benefit from mountain pine beetle disturbance as they increase lodgepole pine snag densities; and will result in more open canopies which they prefer to forage in; however mountain pine beetles are not a preferred food source. Neither action alternative is likely to cause direct effects (mortality) to White-headed Woodpeckers as it does not appear that this species nests within the planning area, and it is a highly mobile and able to move away from harvest or fuels reduction related activities. There is limited suitable ponderosa pine habitat within the D-Bug planning area, but the units with the most ponderosa pine are proposed to be

underburned and thinned to release existing ponderosa pine from encroachment of other smaller, less fire-tolerant conifer species. White-headed Woodpeckers, if present, would benefit from the increased openness of treated stands containing ponderosa pine. Both action alternatives contain the same amount of thinning and underburning.

Alternative 2, as it contains the most harvest and road building of either alternatives, would have the most indirect adverse effects to White-headed Woodpecker. Alternative 5 would have the least adverse effects to snag densities, loss of lodgepole pine foraging habitat and least road densities. Additional indirect effects of the action alternatives includes short-term disturbance of foraging within stands being actively harvested or treated for fuels reduction. The connected and similar actions associated with the action alternatives will have no effect to the White-headed woodpecker or its habitat.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for White-headed Woodpeckers are analyzed across their potential range in Oregon, extending from the D-Bug planning area to southern British Columbia and the southern Sierras in California. Mountain pine beetle activity is increasing throughout northwestern North America, with large levels of snag recruitment occurring. The limited scale of harvest proposed in all action alternatives compared to the current and predicted spread of mountain pine beetles and overall current and predicted increases in the size of wildfires (Westerling, et al., 2006; Skinner, 2007) throughout the range of White-headed Woodpeckers results in an insignificant cumulative loss of snags for foraging habitat.

Determination of Impact

There would be a reduction of current and future snag recruitment as a result of implementation of all action alternatives, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability of White-headed Woodpecker.** This is because it is at an insignificant scale compared to the range of the White-headed Woodpecker and the amount of adjacent reserved land allocations which allow for insect disturbances to spread without management. Alternative 1 would have no impact to individuals or habitat for the White-headed Woodpecker.

Black Swift (Cypseloides niger)

The Black Swift is a neotropical migrant black bird identified by its cigar shaped body, short notched tail, and its acrobatic aerial foraging. It is a colony breeding bird that nests behind waterfalls, in caves, deep gorges or on sea cliffs (Stone, 2007a). They migrate from North America to winter in South America. They forage over forests and open areas on aerial insects and ballooning spiders, often at high elevations (Stone, 2007a). The Black Swift has never been documented to occur at high densities, but threats to the species include disturbance of breeding habitats of caves and waterfalls by recreationists and application of pesticides that limit their insect prey availability (Audubon Watchlist, 2007b).

Affected Environment

Black Swifts have been observed at Lemolo Falls, Warm Springs Falls, Toketee Falls and foraging above south shore meadows below Diamond Lake (Umpqua Valley Audubon Society, 2006; Levad, 2007). They likely regularly forage over the entire

planning area at high elevations during the summer breeding season, May through September.

Environmental Effects

Direct and Indirect Effects

There are no nesting Black Swifts within the planning area, and though they likely forage above the planning area there would be no direct or indirect effects resulting from either alternative. This is because Black Swifts rarely land when foraging, and no activities associated with either alternative would affect their winged insect prey (Lowther and Collins, 2002). The connected and similar actions associated with the action alternatives will have no effect to the Black Swift or its habitat.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for the Black Swift are analyzed across their potential range from southeast Alaska to central California east of the Sierras. Neither alternative would add any cumulative effects to the range of the Black Swift as no nesting or foraging habitat would be affected.

Determination of Impact

There would be no harvest or fuels reduction activities adjacent to nest sites, and these activities would not impact their insect prey populations therefore **there would be no impact to the Black Swift as a result of any alternative considered for the D-Bug project**.

Pacific Fringed Myotis (Myotis thysanodes vespertinus) and Townsend's Big-eared Bat (Corynorhinus townsendii)

The fringed myotis is a small-bodied bat with long ears and a fringe of hairs along the posterior edge of the tail membrane (Kays and Wilson, 2002). The sub-species of the Pacific fringed myotis occurs west of the Cascades in Washington, Oregon, and northern California (Weller, 2005). They occupy a wide variety of habitats, including oak woodlands and ponderosa pine and mixed conifer forests from sea level to above 9,000 feet. The utilize a variety of different types of roosts, including caves, mines, bridges, crevices in buildings, and underneath bark in a number of tree species (Keinarth, 2004; Weller, 2005). Their diet consists mainly of beetles and moths (Keinarth, 2004).

Townsend's big-eared bat has, as its name implies, big, long ears and is identified from other vespertilionids by prominent bumps on either side of its nose. They occur across the western United States, and their distribution is correlated to the distribution of caves and abandoned mines, but they would utilize buildings, bridges or hollow trees for roosting (Piaggio and Sherwin, 2005). Townsend's big-eared bats can utilize a variety of habitats from coniferous forests, deserts, prairies, riparian areas, agricultural areas, and coastal habitats, in elevations from sea level to 11,000 feet (Piaggio and Sherwin, 2005). They specialize in feeding on moths, which comprise over 90 percent of their diet.

Threats to both species include roost loss and modification through human manipulation or disturbance; habitat alteration through loss of large snags used for roosting by timber harvest practices; loss of riparian habitat; and agricultural use of pesticides which can directly cause mortality, reduce reproduction and reduce insect prey populations (Keinarth, 2004; Piaggio and Sherwin, 2005).

Affected Environment

Pacific fringed myotis have been observed on the Diamond Lake RD in 1983 on the bridge to Toketee Falls. In the Oregon Natural Heritage Information Center database, Pacific fringed myotis detections fall mainly along the western front of the Cascades, and on the Umatilla and Wallowa Whitman national forests in northeastern Oregon. There is a cave occupied by Townsend's big-eared bat approximately 3 ½ miles west of the planning area. The cave is used for both winter hibernacula and summer roosting by Townsend's big-eared bat. The entire planning area represents suitable foraging habitat for both species, and the mixed conifer portions of the planning area represent suitable roosting habitat for the Pacific fringed myotis.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects to either species as no timber harvest or fuels reduction activities would take place. Pacific fringed myotis may roost in larger diameter lodgepole snags, as they use a variety of tree species for roosting. Any falling of larger diameter (>10" dbh) snags that occurs under any alternative may lead to direct mortality to either bat species. Alternative 2 contains the most harvest of any action alternative, thus it has the highest potential for direct mortality, followed by Alternative 5. Indirect effects include noise disturbance from timber harvest, road building and fuels reduction activities to roosting bats. Underburning common to both action alternatives may create additional snags for future use as roost sites, but also may result in the loss of existing snags, in particular older, more decayed snags. Timber harvest and fuels reduction activities may result in a slight impact to populations of prey species for fringed myotis as they eat will eat mountain pine beetles; therefore Alternative 2 may have slightly more impact to prey populations as it treats more lodgepole stands to reduce the within-stand spread of mountain pine beetles than Alternative 5. Riparian buffers would also limit impacts to both species foraging, as riparian areas are often preferentially used for foraging due to higher insect prey levels. The connected and similar actions associated with the action alternatives will have no effect to the Pacific fringed myotis or Townsend's big-eared bat.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for both species span their potential ranges throughout the western United States. The limited size and intensity of harvest with the action alternatives would be minimal when added to the range wide existing impacts to these species as no maternity dens would be impacted by the D-Bug project.

Determination of Impact

There would be a reduction of current and future snag recruitment as a result of implementation of either action alternatives, therefore it is determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability for the Pacific fringed myotis or Townsend's big-eared bat. This is because it is at an insignificant scale compared to the range of both bat species and the amount of reserved land allocations adjacent to the planning area. Alternative 1 would have no impact to individuals or habitat for the Pacific fringed myotis or Townsend's big-eared bat.

Pacific Fisher (Martes pennanti)

The Pacific Fisher is a small carnivore (6-13 lbs) with brown fur, a long bushy tail, and occasional white markings on their chest. They are found primarily in low-to-mid-elevation coniferous forests. They require large live trees, snags and downed logs for denning and resting, along with abundant physical structure near the ground for their small mammal prey (Aubry and Lewis, 2003; Powell, et al., 2003). Fishers generally avoid clearcuts and forested habitats with less than 40 percent canopy cover (Aubry and Lewis, 2003). Fisher are believed to have been extirpated from Oregon in the early 1950s by a combination of trapping (for their pelts), poisoning from predator control measures, and a loss of habitat as a result of timber harvest and human development. From 1961-1981 fishers were reintroduced to the southern Cascades from populations in south-central British Columbia and northern Minnesota to control porcupine populations, which were damaging forest plantations in the area (Aubry and Lewis, 2003). Fisher captured in southwestern Oregon were more genetically similar to fisher in British Columbia and Minnesota than to fishers captured in the northern Siskiyou mountains of California (Aubry and Lewis, 2003).

In a study of radio-collared fisher on the Rogue River National Forest and Crater Lake National Park, approximately six miles to the southwest of the planning areas, fisher were found to prefer stands of unmanaged forests (with no signs of past timber harvest); they denned primarily in live and dead Douglas-fir and incense-cedar; and preferred trees with mistletoe brooms for resting (Aubry and Raley, 2006). Scat collections showed that diet consisted of mainly larger rodents (primarily various squirrel species), as well as rabbits, but also included insects, skunks, and porcupines (Aubry and Raley, 2006). Fishers in this study rarely used habitat above 5,100 feett, and the authors did not consider habitat above that elevation to be suitable for denning or resting (Aubry and Raley, 2006).

The fisher has been petitioned to be listed under the ESA three times in the past 16 years. In June of 2005, the U.S. Fish and Wildlife Service (USFWS) found the fisher in the West Coast Distinct Population Segment (DPS) warranted to be listed but was precluded by other higher priority listings (USDI, 2004b). The USFWS found that the primary threat to the fishers and their habitat include: destruction or modification of its habitat including activities like timber harvest, fuels reduction activities, large-scale forest disease or insect outbreaks, or stand-replacing fire; over-utilization for commercial, recreational, scientific or educational purposes; disease or predation; and the inadequacy of existing regulatory mechanisms including the Northwest Forest Plan (USDI, 2004b).

Affected Environment

Fisher have been detected throughout the planning area through photo bait station monitoring and through Aubry and Raley's (2006) telemetry study where they tracked a dispersing juvenile male across the Diamond Lake RD to the Big Marsh area on the Deschutes National Forest. In the summer/fall of 2007, 63 track plate stations were deployed and monitored to document small carnivore presence in the planning area. Pine marten were detected, but fisher were not detected (Davis and Chapman, 2007). During the winter of 2007-2008, four camera bait stations were deployed in the planning area for a minimum of one month each. Again, pine marten were detected but no fishers were detected (Hadwen and Chapman, 2008). Within the past 18 years there have been six documented sightings of fisher within the general planning area (Figure 3-19). The mean elevation of the treatment units is 4,918 feet, with a minimum elevation of 3,927 feet and a maximum elevation of 5,908 feet, so the planning area is on the higher end of the observed habitat use for fisher on the Rogue-Siskiyou. Home ranges for males averaged (~147 km^2) in breeding season and ~62 km^2 during the non-breeding season and females averaged ~25 km^2 (Aubry and Raley, 2006).

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects to fisher as no timber harvest or fuels reduction activities would take place. Indirectly, a stand replacement wildfire that may result if no action is taken to reduce fuels would degrade or eliminate suitable habitat for the fisher.

There should be no direct effects (mortality) as the result of any action alternative as the most suitable habitat for natal denning within the planning area is the same habitat that contains suitable Northern Spotted Owl nesting, roosting and foraging habitat. Therefore these units would have seasonal harvest restrictions, preventing harvest from occurring until after July 15th, by which time juveniles are mobile and able to travel with their mothers and disperse away from harvest or fuel reduction activities (Aubry and Raley, 2006).

Indirect effects would occur primarily in the mixed conifer stands, as lodgepole stands within harvest units below 5,100 feet do not contain trees of sufficient diameter (average diameters in lodgepole stands are 12" dbh, Table 3-26), nor sufficiently closed canopy (averaging below 30 percent in pure lodgepole stand; Morrison, 2008) to support maternal denning or resting sites. Fishers on the Rogue-Siskiyou NF utilized den and rest sites with canopy covers of 80 percent or higher and with snags averaging 44" dbh (ranging from 11" to 77" dbh) (Aubry and Raley, 2006). The mixed conifer stands within the D-Bug project have canopy closures between 50-60 percent currently, and would be reduced to ≥40 percent canopy closure after treatment. The fishers studied on the Rogue-Siskiyou NF utilized cavities in large live trees and snags, as well as hollow logs for maternal dens. The average dbh for maternal dens was 38", but ranged from 14-54" dbh. As there are no diameter caps associated with the mixed conifer thinning, potential future maternal den trees could be removed. Thinning to canopy covers to 40 percent would also increase the amount of snow that accumulates on the forest floor, resulting in fishers potentially avoiding these areas as they are a heavier-bodied animal who would sink in deep snow (Rainer, 1983; Weir and Harestad, 2003). Fishers also utilize mistletoe brooms in fir and cedar species as preferred rest sites. As both action alternatives prescriptions call for preferentially harvesting trees with mistletoe brooms

within lodgepole stands, potential fisher rest sites would be removed by each action alternative. Therefore, Alternative 2 would impact the most denning and resting habitat as it impacts the most mixed conifer habitat, while Alternative 5 would impact over 600 acres less of mixed conifer habitat (Table 3-26).

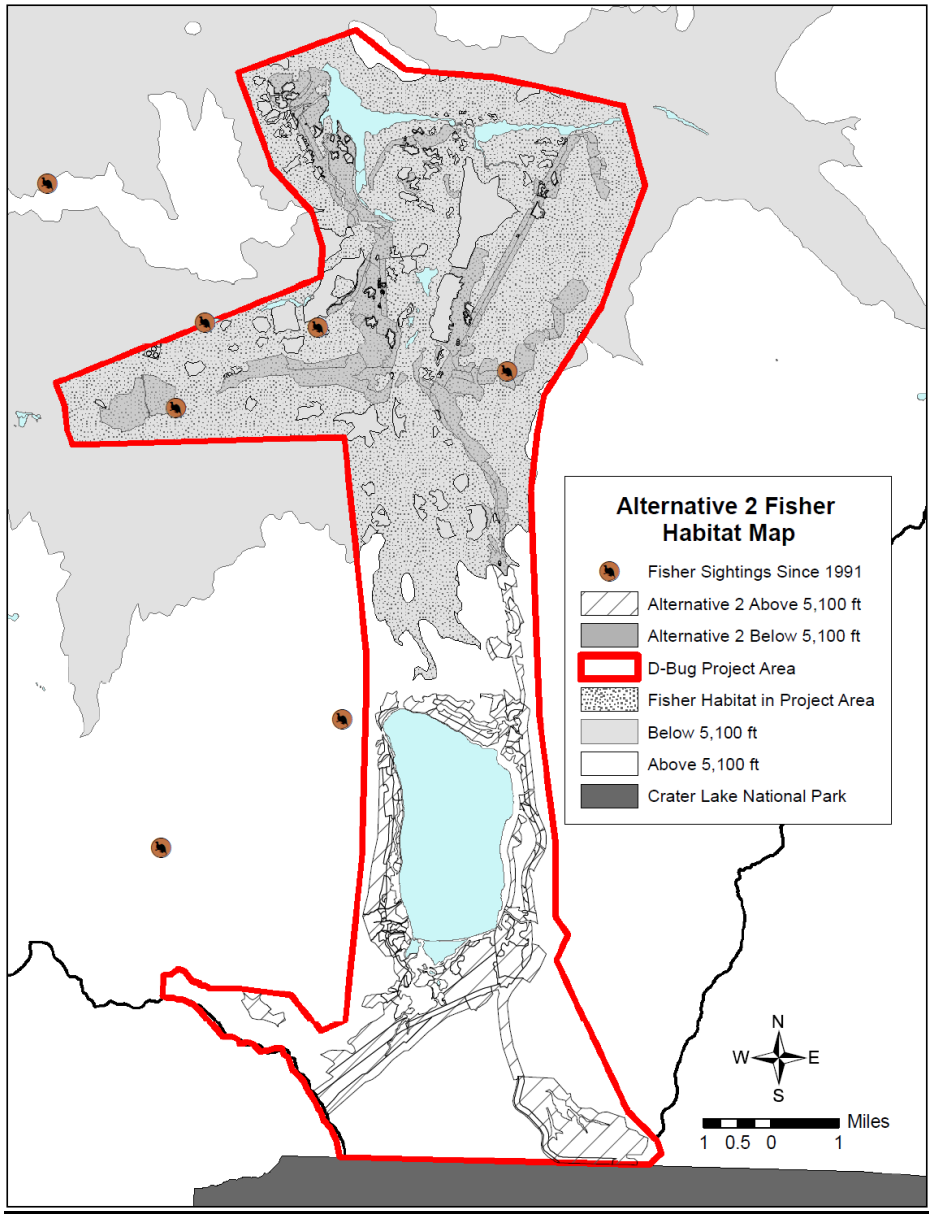
Table 3-26. Table documenting the acres of potential Fisher habitat (harvest units below 5,100 ft in elevation containing mixed conifer habitat) impacted by each action alternative considered for the D-Bug Project.

	Alternative 2	% of Mixed Conifer <5,100 ft in Planning Area	Alternative 5	% of Mixed Conifer <5,100 ft in Planning Area
Total Acres of Mixed Conifer Harvest <5,100 ft	1,688	12%	1,061	8%
Miles of New Temp Road <5,100 ft	6.5	---	5.6	---

Fishers have been documented to travel across the planning area to the Deschutes National Forest (Aubry and Raley, 2006). While timber harvest, fuels reduction and road-building activities proposed in both alternatives may not benefit fisher habitat, neither of the alternatives proposed would preclude fisher from moving through the planning area. On the Rogue River-Siskiyou National Forest both male and female fisher were observed denning, resting and moving through areas with >66 percent of the overstory trees removed, though males used a wider variety of habitats than females (Aubry and Raley, 2006). Though fisher will use cut over habitat, they used unmanaged forests more often for denning and resting (Aubry and Raley, 2006).

Fishers can be adversely affected by roads, OHVs and snowmobiles. Within this portion of the planning area temporary roads (which will be obliterated after use) will likely be utilized as snowmobile and illegal OHV trails prior to removal, thus disturbance would continue after logging operations cease until the roads have been fully obliterated and blocked off. Snowmobile use in thinned mixed conifer stands will continue for up to ten years after project implementation. Increased traffic would result in fisher avoiding habitat adjacent to roads or areas utilized by snowmobiles, and would increase the mobility of fur trappers who use the area to trap pine marten, which could lead to fisher being trapped as well. Additionally, roadside fuels reduction treatments would remove key pieces of fisher habitat like hollow log structures, and downed wood cover. Alternative 2 has the most new temporary road construction planned, while Alternative 5 has the least amount of any action alternative (Table 2-7).

Figure 3-19. Map of potential Fisher habitat in the D-Bug Planning area in Alternative 2, based upon elevation. Any harvest unit below 5,100 ft is considered to be potential Fisher habitat in all alternatives. Alternative 2 is displayed here as it encompasses the units of all other action alternatives.



All harvest within suitable mixed conifer fisher habitat would serve to reduce the within-stand risk of stand-replacing crown fire. Though harvest would reduce canopy cover below preferred densities, remove potential denning and resting sites, and temporarily increase road densities, there would be a long-term benefit to fisher habitat by increasing the treated stands resiliency to stand-replacement crown fire. Timber removal and thinning prescriptions may fragment or degrade habitat in the short term in order to prevent catastrophic fire that would eliminate habitat altogether for decades (USDI, 2004b). The treatment areas within suitable fisher habitat in the D-Bug planning area represent the maximum of 16 km^2 of treatment (Alternative 2) and 15 km^2

(Alternative 5) which is less than one average female home range (25 km^2) as observed on the Rogue-Siskiyou National Forest. The connected and similar actions associated with the action alternatives will have no effect to the Pacific Fisher.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Fishers that occur within the D-Bug planning area are likely genetically distinct and geographically isolated by I-5 from fisher found west of I-5 near Mt. Ashland (Aubry and Raley, 2006). Cumulative effects for fisher are analyzed at the current range of the genetically distinct sub-population extending from the Rogue-Siskiyou National Forest east of I-5 through Crater Lake National Park, through the Umpqua National Forest and north and east to the Willamette and Deschutes national forests. Ongoing timber sales and reasonably foreseeable timber sales within the adjacent forests are meant to improve treated stands fire resiliency as well as accelerate the development of older forest structure. There is no reasonably foreseeable project that will result in a substantial loss of fisher habitat, thus no negative cumulative effects are anticipated.

Determination of Impact

There would be a reduction of current and future snag recruitment, a decrease in canopy closure within treatment units below preferred levels, a loss of resting structures, and an increase in vehicle and trapper access to fisher habitat as a result of implementation of both action alternatives, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability for the Pacific fisher.** This is because of the limited amount of suitable fisher habitat impacted as a result of either action alternative and the amount of protected fisher habitat in adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the Pacific fisher.

Wolverine (Gulo gulo)

The wolverine is the rarest carnivore in North America, with stout limbs, long thick brown fur with two lighter brown stripes that extend from the should to the rump (Aubry, et al., 2007; Stone, 2007). The current range of the wolverine is not well understood. Aubry (2007) analyzed occurrence data throughout the U.S. and determined that through current records (1995-2005) the range of the wolverine was reduced to Washington, Idaho, Montana and Wyoming and the wolverine was likely extirpated in Oregon. However, recently a wolverine has been repeatedly photographed on the Tahoe National Forest, when the last known sighting of a wolverine in California was 1922, though the origins of that wolverine are now in question due to genetic analysis of hair which identified it to be more similar to wolverines located in the Rocky Mountain than to historical Sierra Nevada wolverines (Fimrite, 2008). Wolverines are a wide ranging species, but their primary habitat is high elevations with alpine vegetation and deep snow cover that extends well into spring. They utilize talus cirques for maternal denning in areas with deep snow cover. They are a wide ranging species with males having home ranges up to 400 mi^2 while females with young have much smaller home ranges from 40-160 mi^2 (Stone, 2007c). Wolverines can feed on a variety of prey including deer, small mammals, berries, etc. (Stone, 2007c). Threats to the wolverine are primarily activities that influence sub-alpine and alpine communities including timber harvesting, backcountry skiing and snowmobiling, roads, predator trapping, and high road densities (Stone, 2007c).

Affected Environment

Surveys to detect wolverines and other forest carnivores occurred from 1994-2000 in the greater Diamond Lake area, but they did not detect any wolverines. Helicopter surveys to detect wolverines occurred over the Mt. Thielsen Wilderness, Sky Lakes Wilderness (on the Rogue River-Siskiyou NF) and Crater Lake National Park from 2001-2004, but no wolverines were detected (potential den sites were investigated, but no sign of wolverines were found). However, Mt. Bailey, Mt. Thielsen and Crater Lake National Park still provide suitable wolverine habitat, and there may be wolverines present. The last documented wolverine sighting in Oregon was in 1992. Wolverine may still be present within the planning area during any part of the year.

Environmental Effects

Direct and Indirect Effects

Alternative 1 would have no direct effects to either species as no timber harvest or fuels reduction activities would take place. There may be limited road maintenance related activities during the wolverine breeding season, in May or June (the wolverine breeding season is January to June), and there is no suitable habitat within treatment areas for wolverine maternal denning, therefore there should be no direct effects to wolverines as a result of the implementation of either alternative proposed for the D-Bug project.

Indirect effects to wolverine habitat include increased short-term road densities, fragmentation of forested landscapes, and disturbance through increased human presence in potential foraging habitat from both action alternatives. Wolverines are adversely affected by roads as they avoid areas with higher road densities and increased human presence (Copeland, et al., 2007; Ruggiero, et al., 2007). Within the planning area, these temporary roads, though planned for obliteration would be utilized as snowmobile and OHV trails prior to removal, thus disturbance would continue after logging operations cease until the roads have been fully obliterated and blocked off. Increased traffic may result in wolverine avoiding habitat adjacent to roads, and would increase the mobility of fur trappers who use the area to trap pine marten, which could lead to wolverine being trapped, and increases the likelihood of being killed by vehicles. Alternative 2 has the most new temporary road construction planned, while Alternative 5 has the least amount of new road construction. Additionally Alternative 2 proposes an additional 1,206 acres of prescriptions 1 and 2 in lodgepole stands as compared to Alternative 5, which will result in tree spacing large enough to make these stands available for cross-country travel by snowmobiles. Increased presence of human disturbance can cause wolverine to avoid areas of suitable foraging or dispersal habitat.

Increased timber harvest, particularly within lodgepole pine dominated units with prescriptions 1 and 2 would result in increased habitat fragmentation for wolverines due to decreased canopy covers, decreased snag abundance, decreased ground cover abundance in areas with mastication and grapple piling of slash, and increased road densities. Alternative 2 has the most acres of harvest, including the most acres of prescription 1 and 2 lodgepole harvest, with Alternative 5 having the least amount of harvest. Timber harvest and fuels treatments would also result in increased human use of the areas, both during harvest and fuels reduction activities, but also in terms of cross-country snowmobile use during the winter in heavily thinned stands. Wolverines have been described to be very sensitive to human disturbance and avoiding areas used by humans, but it is not well understood if this is a cause-effect relationship or an artifact resulting from wolverine habitat preferences for places unable to be developed by

humans (Copeland, et al., 2007). Wolverine avoidance of disturbance results in less available habitat for foraging and resting.

All harvest units in the D-Bug planning area are in suitable wolverine habitat and would serve to reduce the within-stand risk of stand-replacing crown fire. Though harvest would reduce canopy cover below preferred densities, remove potential maternal denning and resting sites, and temporarily increase road densities, there would be a long-term benefit to wolverine habitat by increasing the treated stands resiliency to stand-replacement crown fire. Timber removal and thinning prescriptions in response to insects outbreaks may fragment or degrade habitat in the short term in order to prevent catastrophic fire that would eliminate habitat altogether for decades. The connected and similar actions associated with the action alternatives will have no effect to the Wolverine.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Wolverine that may occur within the D-Bug planning area may have home ranges extending over 1,000 km^2. The lack of certainty of the current range of the wolverine, coupled with their ability to disperse over wide areas require that cumulative effects be considered throughout their potential range, extending southward from the Sierra Nevadas of California, to the north Cascades of Washington State to the Rockies of Montana and Wyoming and central Idaho (Aubry, 2007). Of all species discussed, wolverine may be the most immediately affected by climate change. Due to their preference for high-elevation alpine vegetation and deep snow depths, warming winter temperatures and receding glaciers may already be having an effect on wolverine natal denning, but this has not been studied adequately (Ruggiero, et al., 2007). Action alternatives for the D-Bug project would not incrementally add to the past, present and reasonably foreseeable future actions to impact wolverine habitat as no natal denning habitat is likely to be affected and such a small portion of a potential wolverine's home range would be affected by either action alternative.

Determination of Impact

There would be an increase in short-term road densities, fragmentation of forested landscapes, and disturbance through increased human presence in potential foraging habitat, therefore it is **determined that the action alternatives may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability for the Pacific Wolverine.** This is because of the large range of individual wolverines in comparison to the limited amount of habitat affected by either action alternative and the large amount of wolverine habitat in adjacent reserved land allocations. Alternative 1 would have no impact to individuals or habitat for the Wolverine.

ROAD IMPACTS TO WILDLIFE

The impacts of roads to wildlife occur on several different levels. Roads are an obvious source of mortality for all types of wildlife, both directly by vehicle collisions, and indirectly by increased habitat fragmentation which leads to increased energetic expenses and increased access to hunters, poachers, and predators (Forman, et al., 2003; Gaines, et al., 2003; Glista, et al., 2007). Roads can cause displacement or avoidance resulting in animals altering their use of habitats in response to roads (Forman, et al., 2003; Gaines, et al., 2003). Road traffic and vehicular noise can be a

stressor to wildlife, increasing stress hormones which can decrease survival and reproductive fitness (Wasser 1997; Creel, et al., 2002; Gaines, et al., 2003).

Roads, especially new temporary roads and existing forest roads can result in increased use by passenger vehicles, as well as OHVs and snowmobiles. OHV sales have increased 174 percent from 1993-2003 in the United States, and 22 percent of the population of Oregon participate in OHV recreation (USDA, 2005). These vehicles are able to travel farther and faster than passenger vehicles on forest roads which can increase disturbance to wildlife. Snowmobiles and OHVs have been demonstrated to cause avoidance of roads and roadsides by animals such as elk, deer, wolverine, and amphibians (Gaines, et al., 2003; Rowland, et al., 2004). Increases in OHV traffic can also increase illegal user-created OHV trails in areas where timber harvest has reduced tree densities to spacing that allow for OHVs to travel cross-country. User-created OHV trails have the same fragmentation effects as roads do, but their greater density can worsen impacts (Gaines, et al., 2003). See the Recreation section in this chapter for specific locations for use and area closures for OHVs. Snowmobiles produce similar effects to wildlife as vehicles, but can also cause additional impacts. However, the Umpqua National Forest allows for cross-country travel in snowmobiles across much of the planning area (*see* Recreation section in this chapter). Snowmobile trails increase access to trappers, cause higher levels of stress to elk than do vehicles, and can compact subnivean zones (open spaces underneath snow), which provide habitat for the small mammal prey of marten, fisher and bobcats (Trotchta, 1999; Creel, et al., 2002; Gaines, et al., 2003). For a generalized documentation of effects of roads to wildlife see Table 3-27.

Table 3-27. Table of generalized road, trail, and snowmobile impacts by species or group of species found within the D-Bug planning area. Table modified from Gaines (2003).

Species or Group	Road-Associated Factors	Motorized Trail Factors	Snowmobile Route Factors
Northern Spotted Owl	Snag reduction Edge Effects Disturbance at a specific site Vehicle collision mortality Increased stressor hormones	Disturbance at specific sites	N/A
Cavity Nesters	Snag reduction Edge effects CWD reduction	N/A	N/A
Fisher	Snag reduction Edge effects CWD reduction Increased trapping Vehicle collision mortality Habitat loss or fragmentation Movement barrier or filter Displacement or avoidance	Increased trapping	Increased trapping Displacement or avoidance

Species or Group	Road-Associated Factors	Motorized Trail Factors	Snowmobile Route Factors
American Marten[a]	Snag reduction Edge Effects CWD reduction Increased trapping Vehicle collision mortality Habitat loss or fragmentation Movement barrier or filter	Increased trapping	Increased trapping Subnivean habitat alteration resulting in reduced prey
Elk	Increased Hunting & poaching Vehicle collision mortality Displacement or avoidance Disturbance at specific site	Increased Hunting Poaching Displacement or avoidance Disturbance at specific site	Displacement or avoidance Disturbance at a specific site Increased stressor hormones
Amphibians[b]	Avoidance Edge Effects Movement Barrier or filter Vehicle collision mortality	Avoidance Movement barrier or filter	N/A

[a]Gaines, et al., 2003; Trochta, 1999
[b]Forman, et al., 2003

Conversely, roads can provide benefits and increase habitat quality for some wildlife species. They can create new microhabitat (e.g., drainage ditches as areas of water retention) that can be used as breeding habitat for some amphibian species (Forman, et al., 2003). Roadside populations of small mammals can increase as a result of increased seed production from nitrogen run-off which can increase the vigor of roadside grass, as well as the lack of competition for forage from large herbivores who avoid roadsides (Forman, et al., 2003). Ravens, some raptor species, and herons can congregate along roadsides for increased foraging opportunities on roadkill, and roadside small mammal and amphibian populations (Forman, et al., 2003).

Overall, road densities will drop slightly as a result of the selection of either of the action alternatives. However, increased openness in stand conditions, particularly in units with prescriptions 1 and 2, will result in an increased ability for cross-country travel for OHVs and snowmobiles. Areas of current high OHV and snowmobile use, particularly in the Lemolo Lake area, are likely to increase in cross-country travel under Alternative 2 with the additional units containing prescription 1 that are not found in Alternative 5. Prescription 1 will leave 20 trees per acre and leave 46 feet between trees, which will allow for additional OHV and snowmobile cross-country travel.

Unroaded Areas and Inventoried Roadless Areas

Roadless areas are important areas ecologically for wildlife, as habitat fragmentation and habitat loss is the leading cause of global wildlife population declines (Strittholt and Dellasala, 2001). The Forest Service (2001) in the Roadless Area Conservation Final

Rule stated, "Roadless areas are more likely than roaded areas to support greater ecosystem health, including the diversity of native and desired nonnative plant and animal communities due to the absence of disturbances caused by roads and accompanying activities. Inventoried roadless areas also conserve native biodiversity by serving as a bulwark against the spread of nonnative invasive species…More than 65% of all Forest Service sensitive species are directly or indirectly affected by inventoried roadless areas…" While this statement was directed at inventoried roadless areas (IRAs), the same can be said for all unroaded forest system lands.

The D-Bug project proposes treating 965 acres of IRAs in Alternatives 2 and 406 acres in Alternative 5 along the edges of the Mt. Bailey and Thirsty Creek Appendage IRAs. Neither alternatives propose road building in the Mt. Bailey IRA or the Thirsty Creek Appendage IRA. Alternative 2 would create 6.25 miles of new temporary road in the southeast corner of the planning area, adjacent to the Oregon Cascades Recreation Area and just north of Crater Lake National Park. The effect of this would be the fragmentation of 750 acres of habitat for sensitive, management indicator and landbird species, including the pine marten and cavity nesting birds, as well as increased access to this area to OHVs and snowmobiles. During logging operations these roads will be open to the public, and will allow increased access for vehicle traffic, increasing the likelihood of direct effects to wildlife through vehicle collisions and the indirect effect of disturbance. However, these new temporary roads would be removed and access would be blocked off after logging operations have been completed. The road beds would still be visible for up to 30 years after project implementation (Morrison, personal communication), but as they would not be traveled on by OHVs, impacts to wildlife would be reduced. The thinning prescriptions for this unroaded area will leave stand conditions open enough to allow for cross-country travel by snowmobiles for decades in this area due to the slow vegetation growth in these cold pumice soils. While road decommissioning proposed for all action alternatives will reduce road densities lower than the no action alternative after project implementation, the associated disturbances with increased snowmobile use and barren decommissioned road beds will last up to 20 years before stands and road beds have vegetation recovered sufficiently to prevent cross-country travel.

Table 3-28. Miles of roads and densities of roads by alternative during implementation and post implementation of the D-Bug Project.

	Alternative 1	Alternative 2	Alternative 5
Total Miles of Roads in Planning area During Implementation	166	207	190
Open Road Density/Mile During Project Implementation	2.52	3.15	2.89
Total Miles of Roads in Planning area After Implementation	166	164.2	164.2
Open Road Density/Mile After Project Implementation	2.52	2.50	2.50

MANAGEMENT INDICATOR SPECIES

The Umpqua National Forest Land Management Plan (USDA, 1990) designated seven species, and one group of species (cavity nesters) as Management Indicator Species (MIS, Table 3-29). They were selected to track and evaluate the effects of Forest management activities on all wildlife species that occur on the Forest. The Northern Spotted Owl, pine marten, and Pileated Woodpecker represent mature and old growth conifer habitats. Primary cavity excavators represent the dead and defective tree habitat. Big game winter range is represented by Roosevelt elk and the black-tailed deer. The Bald Eagle and Peregrine Falcon are sensitive species that require special management.

Umpqua National Forest Wildlife Standards and Guidelines pertaining to MIS:

> 13. Pileated Woodpecker Habitats - Provide one habitat area for every 12,000 to 13,000 acres of suitable habitat. Habitats will be distributed in such a way that any given habitat unit will be connected to two or more other suitable habitats.

This Standard and Guideline has been superseded by the Northwest Forest Plan Late Successional Reserve land allocation, which encompasses all previous Pileated Woodpecker Habitats.

> 14. Pine Marten Habitats - Provide one habitat area for every 4,000 to 5,000 acres of suitable habitat. Habitat will be distributed in such a way that any given habitat unit will be connected to two or more other suitable habitats.

Pine marten are an MIS for high-elevation lodgepole pine and mountain hemlock ecoclasses. The Northwest Forest Plan Late Successional Reserves and Congressionally reserved lands (Wilderness, Inventoried Roadless Areas, and the Oregon Cascades Recreation Area), and historical Northern Spotted Owl 100-acre owl cores encompassed most of the suitable pine marten habitat on the Umpqua National Forest. However, three additional 160-acre pine marten habitats were created on the Diamond Lake Ranger District to ensure that there was a minimum of three miles between protected lands with suitable pine marten habitat to meet LRMP standard and guidelines for pine marten habitats. These pine marten habitats all have a minimum of 50 percent canopy cover of ≥100 year old trees with a minimum of two dead or down trees per acre. These pine marten areas were created to allow for dispersal of pine marten between reserved land allocations and pine marten reserves to be able to maintain a viable pine marten population on the Umpqua National Forest.

> 17. When planning timber sales in important big game areas, a habitat effectiveness model ("A Model to Evaluate Elk Habitat in Western Oregon" or similar model) will be used to compare the impact of various alternatives on big game habitat

See MIS discussion for elk and black-tailed deer.

Figure 3-10. Alternative 2 compared to Umpqua National Forest's Land Management Plan pine marten habitats and reserved land allocations. Alternative 2 is displayed as it contains all harvest units proposed under all alternatives.

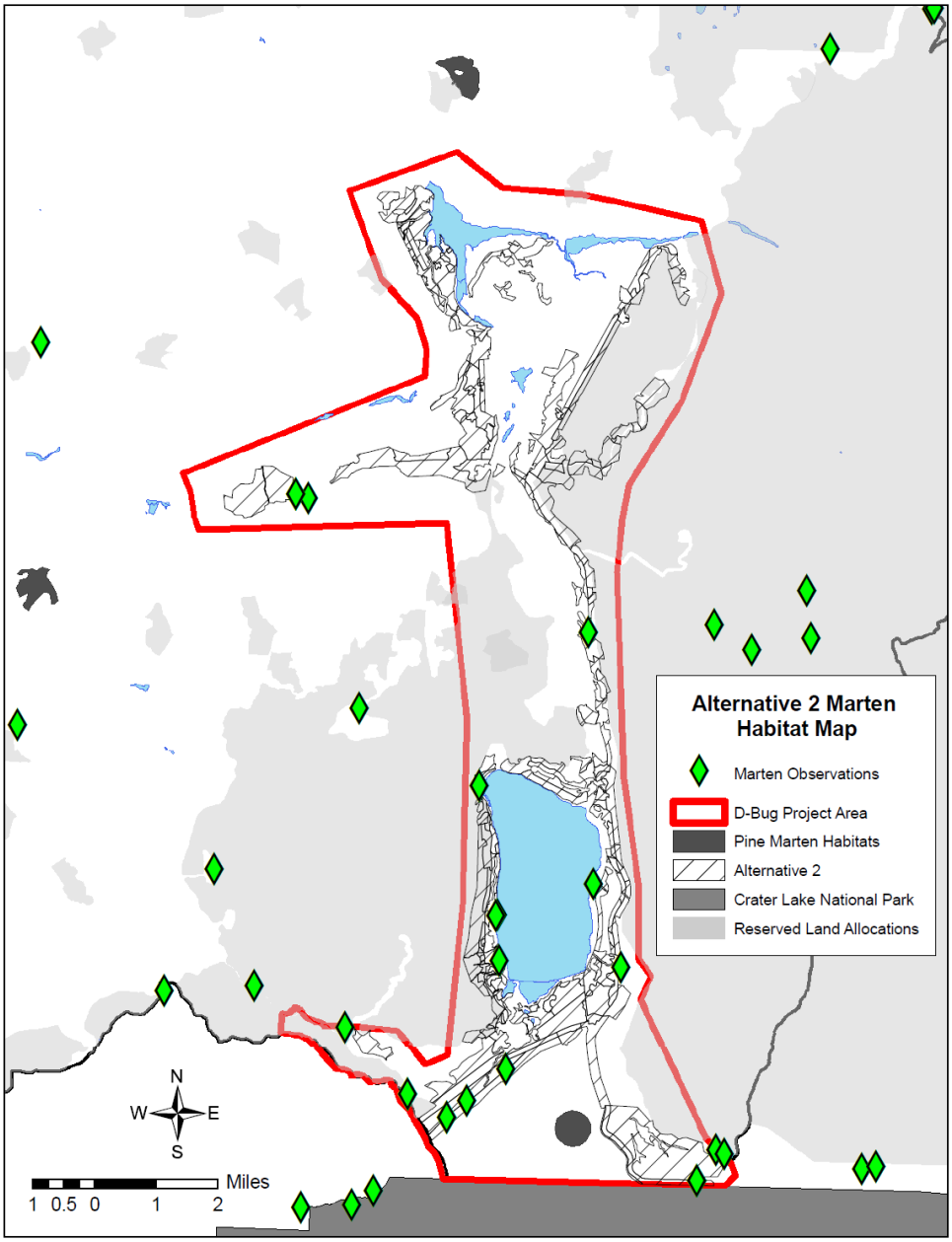


Table 3-29. List of the Umpqua National Forests Management Indicator Species and a description of their habitat.

Common Name	Scientific Name	Indicator Habitat Attribute	Species or Habitat Present?
Northern Spotted Owl	*Strix occidentalis caurina*	Mature or old growth forested habitats	Yes, discussed earlier in document
Pileated Woodpecker	*Dryocopus pileatus*	Mature forested habitats with large (>20”dbh) snags	Yes
Cavity Nesters		Snags and defective trees	Yes
Roosevelt Elk	*Cervus elaphus roosevelti*	Managed forest conditions and early successional vegetation	Yes
Blacktail Deer	*Odocoileus hemionus*	Managed forest conditions and early successional vegetation	Very limited due to elevation
Pine Marten	*Martes americana*	Mature or old growth high elevation lodgepole pine and mountain hemlock	Yes
Bald Eagle	*Haliaeetus leucocephalus*	Large trees next to large bodies of water, in particular ponderosa and Shasta red fir	Yes, discussed earlier in document
Peregrine Falcon	*Falco peregrinus*	Ledges and rock outcrops suitable for use as eyries	No

Primary Cavity Nesters including Pileated Woodpeckers (Dryocopus pileatus)

Primary cavity nesters are birds who excavate cavities in both live and dead trees for foraging and nesting purposes. These cavities may then be used by a wide variety of secondary cavity nesters. The Forest Plan has standard and guidelines that pertain to primary cavity nesters and snag habitat, which were addressed in the coarse woody debris section. In addition to snag and downed wood standards, the Forest contains a standard and guideline requiring the forest to provide for adequate snag habitat must be provided to meet 60 percent potential population capability (PPC) for cavity nesters (USDA, 1990). The potential population capacity (PPC) provides an indicator of the number of cavity-nesting species likely to be present on the Forest in comparison to the Forest’s total potential.

Primary cavity nesters require habitat with adequate levels of dead and dying trees of sufficient size and densities to support sufficient nesting and foraging opportunities to maintain self sustaining breeding populations. DecAID, which contains a summary of the best available information on snag and coarse wood requirements for a host of wildlife species (including primary cavity nesters) documents that much higher levels of snag retention are required to maintain individual species than what was originally required by the LRMP (USDA, 1990; Mellen, et al., 2007).

Populations of primary cavity nesters on the Umpqua National Foret likely spend portions of their life on adjacent forested lands, therefore population trends for these species will be discussed at the statewide level where sufficient long-term population monitoring data is available to determine population trends. The Breeding Bird Survey consists of 136 routes in Oregon, and one of them (69051, Clearwater) is about 4 ½

miles west of the planning area (Sauer, et al., 2006). Population trends for primary cavity nesters are shown in Table 3-30.

Table 3-30. List of the cavity nesters present on the Umpqua National Forest and their population trends for Oregon from 1966-2006. Data courtesy of Sauer, et al., 2008.

		Population Trends for Oregon (1966-2007)		
Species	**Local status**	**Trend**	**Trend Estimate**	***P* Value**
Red-breasted Sapsucker	Common	Stable	2.45	0.02
Hairy Woodpecker	Common	Stable*	-0.93	0.22
Northern Flicker	Common	Decreasing	-1.07	0.03
Pileated Woodpecker	Common	Increasing	1.53	0.13
Downy Woodpecker	Uncommon	Decreasing	-2.63	0.06
Black-backed Woodpecker	Uncommon	Decreasing*	-1.51	0.60
White-headed Woodpecker	Uncommon	Stable*	1.83	0.53
Lewis' Woodpecker	Uncommon	Decreasing*	-5.27	0.39

*Not statistically 'significant' (p>0.10)

Direct and Indirect Effects

Direct and indirect effects for primary cavity nesters are analyzed at the planning area scale. Alternative 1 would result in a net increase in snags over time, especially within lodgepole dominated stands and mixed conifer stands containing a lodgepole understory. This alternative would provide the most benefit to cavity nesters over the short term as it would provide for the most available snags. This is due in part to the anticipated spread of the mountain pine beetle, and the increasing risk of stand replacing fire in both lodgepole and mixed conifer stands which would create higher snag densities. Pileated woodpeckers, Black-backed Woodpeckers, White-headed Woodpeckers and Hairy Woodpeckers all benefit from insect and fire disturbance in the initial 3-5 years after fire or beetle outbreak as insect populations increase during this time in recently killed trees (Bull, 1987; Corace, et al., 2001; Dudley, 2005; and Covert-Bratland, 2006; PNW Science Findings, 2009). Pileated woodpeckers have also been documented to aid in the dispersion of wood decaying fungi, potentially increasing the number of ponderosa pine snags across the landscape (Farris, et al., 2004). Black-backed Woodpeckers (BBWO) in particular benefit from mountain pine beetle infestations as the beetles are a primary prey source. In a study on the neighboring Deschutes National Forest in lodgepole dominated woodlands during a mountain pine beetle outbreak, BBWO selected for mature unlogged stands of lodgepole to establish home ranges, and selectively foraged on older lodgepole with higher incidences of mountain pine beetles (Goggans, et al., 1989). BBWO in this study nested exclusively in lodgepole cavities, in both live and dead trees, and fed mainly on wood-boring beetles, especially larvae and pupae of mountain pine beetles (Goggans, et al., 1989).

Both action alternatives would reduce within stand snag levels as snags are routinely felled within harvest units to reduce hazards to timber fallers working within the stands. Snag densities, primarily of snags between 10-20" dbh would be reduced below DecAID's 30 percent tolerance level in all treated stands immediately post treatment in

both action alternatives (coarse woody debris section, Table 3-20). Alternative 2 contains the most acres of lodgepole harvest, thus reducing the most snags densities. Prescriptions 1-3 for lodgepole dominated stands common to both action alternatives would allow for the retention of all standing lodgepole snags, while prescription 4 calls for the removal of existing lodgepole snags. Alternatives 2 has 375 acres of snag removal (salvage of dead lodgepole in prescription 4) compared to 285 acres in Alternative 5. However, across the entire planning area and into adjacent reserved land allocations (Mt. Thielsen Wilderness, Inventoried Roadless Areas, and the Oregon Cascades Recreation Area), mountain pine beetles would spread without interference from timber harvests, providing thousands of acres of new lodgepole pine snags for use by primary cavity nesters, therefore magnitude of the direct effects is limited when compared to the overall landscape outside of the planning area.

Table 3-31. Acres of lodgepole harvest by alternative, and the overall percent of lodgepole proposed to be harvested within the planning area.

Alternatives	Acres of Lodgepole Harvest	% of Lodgepole Proposed for Harvest in Planning Area	Acres of Mixed Conifer Harvest	% of Mixed Conifer Proposed for Harvest in Planning Area
Alternative 2	4,744	27%	2,258	10%
Alternative 5	4,177	21%	1,500	7%

The combination of commercial thinning and proposed fuel reduction treatments will benefit both treated stands and an area directly adjacent to the treated stands indirectly by creating a “shadow effect” where fire behavior is reduced in adjacent areas of untreated stands or habitat. This “shadow effect” is estimated to be 1.5 times the size of the treatment unit, and will result in minimized fire behavior as a result of thinning in adjacent stands (*see* Fuels section in this chapter). Additionally, fire breaks proposed under the action alternatives will aid firefighters to better contain fires at smaller scales.

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. Cumulative effects for cavity nesters extend throughout the potential range of birds utilizing the Umpqua National Forest. Past timber harvesting removed snags on the Umpqua National Forest, as well as on adjacent national forests, Bureau of Land Management districts and private lands, and has had the greatest influence on habitat condition and availability for primary cavity excavators. However, the trend in clearcut harvesting on federal forest lands that caused the concerns for decreasing populations of primary cavity excavators has been dramatically decreased by the NWFP. Currently, insects and wildfire are the most dramatic influences on the availability of snags across Oregon. The alternatives proposed by the D-Bug project would only affect the snag densities and recruitment within treatment units during the ten years of project implementation, thus their cumulative impact to snag reduction would be minor in comparison with ongoing spread of mountain pine beetle disturbance and wildfires.

Determination of Effects

No alternative considered for the D-Bug project would affect the population trends or viability for primary cavity nesters on a scale that would affect population trends

throughout their range on the Umpqua National Forest as the impacts associated with both alternatives are insignificant when compared to the overall range of the species and the amount of habitat in adjacent reserved land allocations that would remain untreated.

Roosevelt Elk and Black-tailed Deer - Big Game Winter Range

The Umpqua National Forest LRMP designated 198,146 acres of big game winter range as Management Area 11 (USDA, 1990). These areas were designed to provide for big game winter range habitat and timber production consistent with other resource objectives. They emphasize winter range management achieved through forage and cover production on land suitable for occupancy by deer and elk. Timber harvest is encouraged to provide stable production of forage and cover. A 60:40 ratio of forage to cover habitat was once considered optimum for winter range, but more recent studies suggest smaller ratios may be suitable as long as the interspersion of forage and cover is good (Larkin, et al., 2004). Ultimately however, forage is the limiting factor in the planning area.

The D-Bug planning area encompasses portions of the Indigo, Dixon and Rogue Wildlife Management units (WMU), established and managed by the Oregon Department of Fish and Wildlife (Table 3-32). The Indigo WMU is 1.2 million acres and contains about 700,000 acres of National Forest Land and 135,000 acres of BLM-managed forest, and is located in the western Cascades east of I-5, and north of State Highway 138. The Dixon WMU is over 1 million acres and contains about 152,500 acres BLM-managed forest, 552,873 acres of National Forest Land, and borders the Indigo WMU to the south. The Rogue WMU is 955,000 acres, comprised of the approximately 350,000 acres of the Rogue NF and approximately 230,000 acres of BLM-managed forests. In the 3 WMUs, elk and deer numbers are declining, and the forage to cover ratios are trending toward increased cover.

Table 3-32. Wildlife Management Units in the D-Bug Planning area by acres.

Wildlife Management Unit (WMU) Name	Acres in Planning Area	Alt 2 Acres of Treatment	Alt 5 Acres of Treatment	% of WMU in Planning Area	Acres of WMU in Total
Indigo	21,465	3,431	3,890	2%	1,244,320
Dixon	16,880	4,902	3,160	2%	1,009,765
Rogue	3,746	686	710	0.4%	955,390

In the D-Bug Project, approximately 500 acres of winter range would be treated in both action alternatives (Table 3-33). Within the winter range treatments thinning would reduce TPA from 52 to approximately 30 percent, and overstory canopy cover would be reduced from an existing 51 to 41 percent after harvest. With this project, no openings would be created within winter range. Existing forage:cover ratio is 10:90 in the D-Bug planning area. The present trend is for decreasing forage due to regrowth of past clearcuts in the area that would soon no longer provide forage. Areas of beetle killed lodgepole pine are regenerating into a carpet of lodgepole seedlings with very little long term forage being produced.

Table 3-33. Acres of winter range and percent of total Umpqua National Forest winter range affected by alternative.

Alternative 2		Alternative 5	
Acres of Winter Range Affected	***% of Umpqua NF Winter Range***	***Acres of Winter Range Affected***	***% of Umpqua NF Winter Range***
500	0.2%	500	0.2%

Direct and Indirect Effects

The direct and indirect effects to big game winter range were analyzed at the planning area scale. Alternative 1 (no action) would maintain the current forage:cover ratio and declining trend in forage habitat resulting in poorer future forage habitat and winter range conditions. Alternative 2 would provide the best forage to cover ratio of all alternatives (Table 3-34). However, there is unlikely to be an increase in high quality forage for both elk and deer because Alternative 2 has an increase in harvest in lodgepole-dominated stands in unproductive areas and it is unlikely to increase in palatable forage in the heavily thinned lodgepole stands. Alternative 2 would result in more landings, which would be seeded to prevent establishment of invasive plant species, but these areas would not account for a substantial increase in available elk or deer forage. No alternatives would create openings in areas suitable to producing increased forage for deer.

Table 3-34. Forage to cover ratio by each action alternative for the D-Bug project.

	Alternative 1	Alternative 2	Alternative 5
Forage:Cover Ratio	10:90	21:79	18:82
HE_s* for Size and Space of Forage:Cover	0.658	0.655	0.641
HE_r^ for Road Density	0.250	0.234	0.245

*HE_s is a habitat effectiveness index derived from sizing and spacing of forage and cover areas.
^HE_r is a habitat effectiveness index derived from the density of roads open to vehicular traffic.

Additionally Alternative 2 contains the highest densities of temporary roads of any alternative (Table 3-34). HE_r is a habitat effectiveness index derived from the density of roads open to vehicular traffic. The closer the value is to 1 indicates that elk are better able to utilize more of the analysis area, while lower values as seen in Table 3-34 indicate that the area is fragmented and less of the planning area is free from the disturbance related to roads. The additional roads created in Alternative 2 not present in Alternative 5 are in lodgepole-dominated stands with unproductive soil conditions. Though they would be subsoiled and some will be planted with seed after they are used, they would not provide a substantial increase in forage, and they would serve to increase unauthorized OHV use in these areas, leading to increased disturbance to elk and deer. Road densities would decrease after the implementation of any action alternative as compared to the no action alternative, as a small amount of existing road is being proposed for decommissioning.

Roadside treatments in both alternatives would be arranged to ensure that there are some areas of clumped retention to provide for roadside hiding cover for deer and elk to

help reduce their visibility to hunters traveling along roads. Both alternatives treat along the same major roads, however Alternative 2 treats additional roadside acres along both sides of the Thirsty Creek Road and the south side of the Kelsay Point Road, increasing hunter visibility in these areas when compared to Alternative 5, which does not contain units on the Kelsay Point Road and only treats the northern side of the Thirsty Creek Road. Due to need for roadside treatments to act as fuel breaks, sight distance into stands adjacent to roads will increase as a result of the proposed thinning in all action alternatives. Mastication of small-diameter material, which provides much of the current roadside cover will only occur within 80 feet of roadsides in both action alternatives, limiting the amount of habitat where elk and deer could be more visible to hunters traveling along roads.

Cumulative Effects

The cumulative effects of this project are analyzed at the WMU scale. This is the spatial scale at which elk populations are monitored by Oregon Department of Fish and Wildlife. At this scale, about 23 percent of the Federal forest land is in a reserved land allocation and clearcut harvesting is not expected to occur in the foreseeable future. This suggests a continued decline in the amount of forage habitat within these WMUs over the next 1-2 decades. However, future wildfires would increase forage availability for both deer and elk. Most of the larger patches of forage habitat are likely to continue to occur on private forest land, which are located toward the western boundaries of these three WMUs.

Given the past, present and foreseeable actions, the direct and indirect effects of the action alternatives (when cumulatively added to foreseeable future actions) would not affect the declining trend in forage habitat and forage:cover ratios within the WMU. The population viability of Roosevelt elk or Black-tailed deer would not be reduced by the action alternatives because the acres of impact when compared to the size of the WMUs will have no effect to habitat trends for these species.

Determination of Effects

No alternative considered for the D-Bug project would affect the declining population trends and habitat trends for Roosevelt elk or Black-tailed deer throughout their range on the Umpqua National Forest, as the anticipated increase in forage from the action alternatives and continued loss of forage in the no action alternative are inconsequential when compared to the overall range of the species and the WMUs.

Given the past, present and foreseeable actions, the direct and indirect effects of the action alternatives (when cumulatively added to foreseeable future actions) would not affect the declining trend in forage habitat and forage:cover ratios within the WMU. The population viability of Roosevelt elk or Black-tailed deer would not be reduced by the action alternatives because the acres of impact when compared to the size of the WMUs will have no effect to habitat trends for these species.

Pine Marten (Martes americana)

Pine marten are small carnivores (<1-2 lbs) with brown fur, a long bushy tail, and a buffy throat patch. They are a MIS for high-elevation lodgepole pine and mountain hemlock ecoclasses.

They are found in higher elevations, in mesic, late successional stands of conifers, including lodgepole, hemlock and fir. They require high densities of snags and in particular downed logs for denning and resting, and to serve as subnivean winter habitat for their small rodent prey (Bull and Blumton, 1999; Powell, et al., 2003). Marten eat

small rodents, snowshoe hares, birds, and occasionally fruit and carrion (Buskirk and Zielinski, 1999). In winter, marten use structurally complex forests and avoid openings (Powell, et al., 1999). On a smaller scale, martens abandon, or fail to colonize home range size landscapes with less than about 60 percent mature forest cover (Powell, et al., 1999) (*see* Pine Marten map). Marten avoid regenerating clearcuts for several decades (Powell, et al., 1999). Martens prefer older forested habitats with closed canopies and high levels of structural complexity on the forest floor over clearcuts or forest openings. (Jones and Raphael, 1991; Chapin, et al., 1998; Powell, et al., 1999; Bull, et al., 2005).

Direct and Indirect Effects

Alternative 1 would have no direct effects to marten as no timber harvest or fuels reduction activities would take place. Indirectly, Alternative 1 has an increased hazard for stand-replacement fire, which may consume suitable pine marten habitat, rendering it unusable until burned habitats regenerate. Marten give birth in cavities in larger logs and trees often close to the ground, from early April through May, and juveniles stay with their mothers for up to three months (Powell, et al., 1999; Bull and Heater, 2001). At birth, young marten are helpless, with eyes and ears closed, and juvenile martens are unable to provide for themselves until 18 weeks to three months of age when they develop teeth and reach adult size (Clark, et al., 1987; Powell, et al., 1999).

Direct mortality may occur from logging operations as they would occur (June 1st) while juvenile marten are not mobile or able to flee from maternal dens. Alternative 2 contains the most amount of marten habitat (lodgepole pine) harvest; therefore it has the potential to directly affect the most marten.

Indirect effects to pine marten from timber harvest and fuels reduction activities include noise disturbance; loss of suitable denning, foraging, and resting habitat for themselves and their prey; increased habitat fragmentation; increased energetic costs due to increased home range sizes necessitated by increased fragmentation; and increased potential for trapping and predation. Of these effects, habitat fragmentation constitutes the largest impact, as the prescriptions for lodgepole-dominated units would result in canopy cover (Table 3-17) and downed wood reductions (figures 3-11 and 3-12) that would render the habitat unsuitable for anything other than dispersal. Marten have been documented to tolerate low levels of fragmentation, but no martens were found with home ranges that had more than 30 percent fragmentation (Buskirk and Zielinski, 1999).

Pine marten habitat suitability was modeled for the Cascade Mountains of Oregon and the pine marten habitat across the Umpqua National Forest was quantified as either suitable or optimum (Figure 3-21 and Table 3-35; Hirzel, et al., 2006; Davis and Chapman, 2008). Suitable habitat was defined as having a HSI (Habitat Suitability Index) value >35, and optimum habitat was defined as having an HSI value >75 (Hirzel, et al., 2006). All prescriptions in suitable pine marten habitat result in unsuitable habitat due to the decreased canopy covers resulting from proposed harvest. Each action alternative drops canopy cover and downed wood densities below suitable habitat levels for pine marten, therefore each action alternative removed both suitable and optimum pine marten habitat (Table 3-35). Alternative 2 would remove the most habitat, including 19 percent of the Forest's optimum habitat.

Table 3-35. Pine marten habitat availability on the Umpqua National Forest by alternative based upon a pine marten habitat suitability map by Davis and Chapman (2008) for the Cascades of Oregon.

			Alternative 2		Alternative 5	
Habitat Quality	**Total Forest Habitat (Acres)**	**% Habitat in Reserved Land Allocation**	**Total Forest Acres**	**% Loss**	**Total Forest Acres**	**% Loss**
Suitable	61,401	67%	59,294	-3%	59,710	-3%
Optimum	4,499	41%	3,651	-19%	3,953	-12%

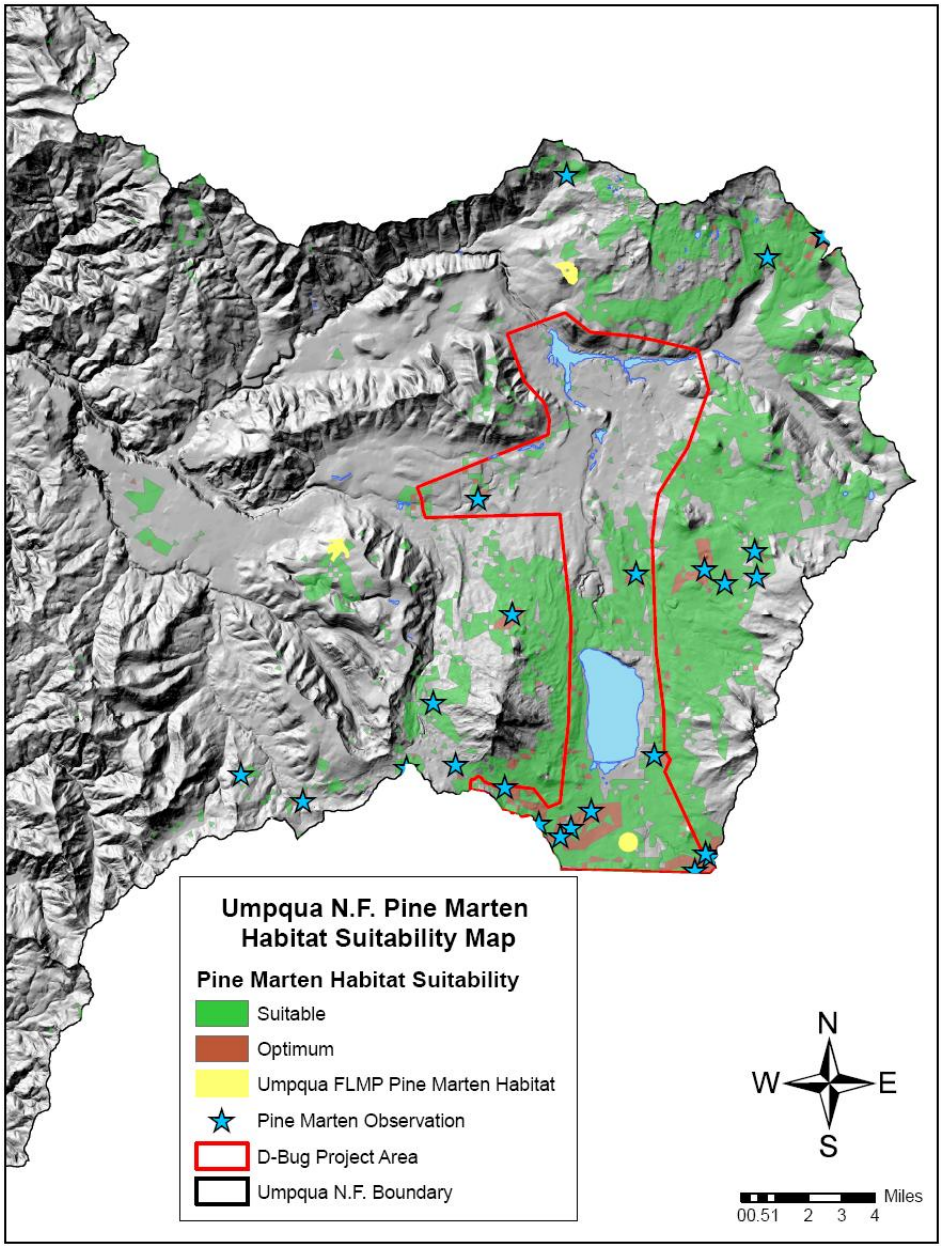
* Reserved land allocations are wilderness, inventoried roadless areas (IRAs), and the Oregon Cascades Recreation Area (OCRA). All action alternatives include harvest along the edges of the IRAs and the OCRA therefore habitat loss for pine marten includes small amounts of habitat in the reserved land allocations.

Action alternatives would remove optimum and suitable pine marten habitat, but they would also reduce the within-stand probability to crown fire. After thirty years the canopy cover and snag level within treated stands of lodgepole pine would recover to levels slightly below levels modeled for the no action alternative (Table 3-17). However, in the event of a wildfire within the homogenous stands of lodgepole in the planning area, more marten habitat would likely be removed, and recovery timeframes would likely be longer than the thirty years modeled for treated stands due to crown fire spread in Alternative 1 (*see* Fuels section of this chapter). Wildfires that completely consume the understory and/or reduce the canopy closure to less than 30 percent are detrimental to American marten populations in the short-term, until the burned forests can recover canopy closures and structural complexity (Snyder, 1991). The action alternatives would reduce the risk of within stand crown replacement fire, and may disrupt the flow of fire across the landscape, allowing for additional time to suppress wildfires in the planning area and potentially smaller wildfires than predicted in Alternative 1 (*see* Fuels section of this chapter).

Cumulative Effects

Refer to tables 3-1 through 3-3 for a complete list of past, present and reasonably foreseeable actions within the D-Bug planning area. The cumulative effects of this project are analyzed at the Forest scale. There are no reasonably foreseeable future harvests of lodgepole planned within the planning area. Therefore very little additional contiguous pine marten habitat that would be available to harvest if an action alternative is selected (67 percent of suitable and 41 percent of optimum habitat is in reserved land allocations), as the remaining contiguous suitable and optimum habitat falls within reserved land allocations which prevent large scale timber harvest (Table 3-35). Due to their preference for deep snow depths, warming winter temperatures may already be having an effect on marten foraging habitat (Carroll, 2007). Wildfire will continue to be a major threat to pine marten habitat across its suitable habitat on the Umpqua National Forest. However, because of the lack of overlapping direct or indirect effects from past or future projects, there would be no cumulative effects to marten.

Figure 3-21. Map of suitable and optimum pine marten habitat on the Umpqua National Forest.



Determination of Effects

No alternative considered for the D-Bug project would affect the population viability of the pine marten on the Umpqua National Forest because the majority of their habitat is within reserved land allocations. However, both action alternatives would result in a downward trend for pine marten habitat in the short term as they would reduce the amount of suitable and optimum habitat available for pine marten on the Forest in the short term, but may result in a less negative trend in the longer term future (~30 years) due to increases of within-stand fire resiliency. The no action alternative would maintain

the current habitat trend for the pine marten across the forest in the short term, but may result in higher levels of habitat loss in the future to stand-replacing wildfire.

LANDBIRDS

Population declines of some landbirds resulted in the creation of a Landbird Strategic Plan (USDA, 2000) that set management goals and actions for providing sustainable habitat for them. The Landbird Strategic Plan called for utilizing Bird Conservation Plans developed regionally by Partners in Flight working groups to incorporate landbird management into forest plans and at all levels of the Forest Service (USDA, 2000).

In addition, Executive Order (EO) 13186, signed January 10, 2001, lists several responsibilities of federal agencies to protect migratory birds, among them to support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions.

Additional direction comes from the Memorandum of Understanding (MOU) between USDA Forest Service and USDI Fish and Wildlife Service, signed January 17, 2001. The purpose of this MOU was to strengthen migratory bird conservation through enhanced collaboration between the Forest Service and Fish and Wildlife Service, in coordination with state, tribal and local governments. The MOU identified specific activities for bird conservation, pursuant to EO 13186 including: strive to protect, restore, enhance, and manage habitat of migratory birds, and prevent the further loss or degradation of remaining habitats on National Forest System lands. This includes: Identifying management practices that impact populations of high priority migratory bird species including nesting, migration, or over-wintering habitats on National Forest System lands; and developing management objectives or recommendations that avoid or minimize these impacts. Although this interim MOU expired on January 15, 2003, the conservation measures that it contained are still applicable for use in environmental planning today. The MOU continues to provide guidance for the two federal agencies until more detailed direction is developed pursuant to the executive order.

The Forest Plan has no specific standards and guidelines for landbirds, other than for cavity nesters, raptors (protected from human disturbance until nesting and fledging is complete), and TES species (e.g., northern spotted owl) (USDA, 1990).

Existing Conditions for Landbirds

The D-Bug planning area falls along the crest of the Cascades; therefore, two separate conservation plans will be considered: one strategy for landbirds in the coniferous forests of western Oregon and Washington (Altman, 1999) and one for the landbirds of the east slope of the Cascade Mountains in Oregon and Washington (Altman, 2000; Table 3-36). Focal species are identified within the plan to represent habitat attributes such that most important components in a functioning coniferous ecosystem are represented, and many other species will also be conserved (Altman, 1999). Units within the D-Bug planning area in the Western Cascades portion contain old growth, mature-multi-layered forest, and montane wet forests habitats (Table 3-36). The Eastern Cascades portions of the D-Bug planning area contain mixed conifer and old-growth lodgepole habitats (Table 3-36). There are no Important Bird Areas (areas identified by the Audubon Society to be protected and managed for preserving bird populations and other biodiversity) within the planning area.

Table 3-36. Landbirds identified by the Oregon/Washington Partners In Flight Conservation Plans for the Western Forests and East Slope of the Cascades (Altman 1999 & 2000) representing habitats found within the D-Bug planning area.

Western Cascades Focal Species			
Common Name	**Habitat Attribute**	**Abiotic and Landscape Factors[1,2]**	**Status in Planning area[1,2,3]**
Old Growth			
Vaux's Swift	Large Snags	Sea level to >5,000 ft Availability of large hollow snags major limiting factor	Common spring and fall migrant
Brown Creeper*	Large Trees	Sea level to >5,000ft Sensitive to habitat fragmentation Peak densities occur in closed canopy stands >100 years old	Year round resident, but in low to moderate densities
Red Crossbill	Conifer Cones	Sea level to >5,000ft, found higher locally Seed availability critical to breeding	Year round resident, but numbers fluctuate greatly between year (low of 8 detected in 1992 high of 230 detected in 2003[1])
Mature Forest: Multi Layered			
Pileated Woodpecker	Large Snags	Low to moderate elevations Require mature forest for nesting, will forage in younger stands	Very uncommon in the planning area, uncommon on the rest of the Diamond Lake RD (DLRD)
Varied Thrush	Mid-story Tree Layers	Sea level to >5,000ft, found higher locally Prefers a component of riparian vegetation and deciduous vegetation	Uncommon summer resident, more common during spring and fall migration
Hermit Warbler	Closed Canopy	Sea level to >5,000ft Forage high in canopy, avoids areas with shrubs	Common summer resident, however avoids lodgepole stands
Pacific-slope Flycatcher	Deciduous Canopy/subcanopy Trees	Sea level - 4,192 ft Prefer riparian drainages and north slopes	Uncommon in the planning area, common resident west of the planning area in lower elevations
Hammond's Flycatcher	Open Mid-story	Elevation 1,050-4,500 ft Will respond positively to thinning from below to open the mid-story	Uncommon in the planning area, absent from lodgepole stands, more common in the rest of the DLRD
Wilson's Warbler	Deciduous Understory	Sea level to 5,000 ft Prefers habitat heterogeneity and edge habitats	Spring migrant in planning area and the rest of the DLRD, rare resident
Winter Wren	Forest Floor Complexity	Sea level to 5,000 ft Sensitive to habitat fragmentation Ground nester	Very uncommon in the planning area, as there is very little low forest floor complexity in planning area.

Common Name	Habitat Attribute	Abiotic and Landscape Factors[1,2,3]	Status in Planning area[4,5]
Forest Inclusions/Unique Habitats			
Lincoln's sparrow	Montane Wet Meadows	Breeds above 3,000 ft in elevation Breeding season depends on snowpack	Summer resident around south shore of Diamond Lake, Toolbox Meadows, DL Sewage ponds
East Slope Cascades Focal Species			
Mixed Conifer			
Williamson's sapsucker^	Large Snags	Mid to high elevation breeder Primarily found in ponderosa pine in Oregon.	Very rare, documented in the planning area.
Flammulated Owl^	Interspersion Grassy Openings and Dense Thickets	3,000- 5,000 ft elevation Associated with ponderosa pine, found in general mixed conifer Prefers higher canopy cover	Very rare to the DLRD, not documented in the planning area.
Hermit Thrush	Multi-Layered/Dense Canopy/Vertical Cover	Found across majority of Oregon Ground nester and ground forager	Common on the DLRD and observed within the planning area.
Unique Habitats			
Black-backed Woodpecker	Old Growth Lodgepole Pine	Found across mountains of eastern Oregon Feeds on wood boring beetles, benefits from mountain pine beetle outbreaks and fires	Uncommon but present throughout the planning area. May become more common with increase in mountain pine beetle activity.

*Also East Slope focal species for large trees.
^Also Audubon Society Watchlist Species for 2007
[1]Altman 1999
[2]Altman 2000
[3]Marshall et al. 2003
[4]Fix 1990
[5]Umpqua Valley Audubon 2006`

Table 3-37. Breeding Bird Survey results for Oregon and the Cascades Region (OR, WA) from 1966-2006 (data from Sauer, et al., 2006) for landbirds identified by the Oregon and Washington Partners in Flight Conservation Plan for coniferous forests.

	Oregon 1966-2007			Cascades (OR & WA) 1966-2007		
Common Name	**Trend Estimate**	***P***	**Average Count**	**Trend Estimate**	***P***	**Average Count**
Vaux's Swift	1.83	0.24	0.61	0.23	0.86	1.92
Brown Creeper	1.28	0.50	1.21	-2.80	***0.07***	***1.07***
Red-Crossbill	-0.72	0.70	8.06	-0.06	0.98	6.74
Pileated Woodpecker	1.52	0.13	0.56	0.50	0.78	0.98
Varied Thrush	-0.86	0.47	3.49	-1.14	0.30	14.49

	Oregon 1966-2007			Cascades (OR & WA) 1966-2007		
Common Name	**Trend Estimate**	***P***	**Average Count**	**Trend Estimate**	***P***	**Average Count**
Hermit Warbler	0.07	0.94	10.43	0.41	0.67	10.12
Pacific-slope Flycatcher	-2.86	.04	3.95	-1.35	0.06	7.48
Hammond's Flycatcher	0.93	0.28	3.80	***2.74***	***0.05***	***7.86***
Wilson's Warbler	-1.07	0.20	3.78	***-2.26***	***0.07***	***2.32***
Winter Wren	0.76	0.30	4.73	0.71	0.23	11.69
Lincoln's Sparrow	5.11	0.13	0.35	-0.94	0.49	0.53
Williamson's Sapsucker	-1.64	*0.60*	1.22	-1.14	*.59*	0.31
Flammulated Owl	---	---	---	---	---	---
Hermit Thrush	***-1.61***	***0.001***	***6.47***	*-1.02*	*0.41*	*12.90*
Black-backed Woodpecker	-1.51	0.60	0.28	1.28	0.67	0.48

--- = no data, ***bold italics*** = 'significant' to p ≤0.10.

Direct and Indirect Effects

The direct and indirect effects to landbirds were analyzed at the planning area scale. Alternative 1 would have no direct impacts to landbirds because no thinning, fuels treatments, or other habitat modifying activities would occur. Alternatives 2 and 5 would cause changes to landbird habitats that would occur over the next 10-30 years.

Western Cascades Old Growth and Mature Forests:Multi-layered

These forest types occur in units along Highway 138, west of Lemolo Junction. All action alternatives contain the same units and prescriptions, therefore effects are the same among action alternatives. Direct effects include some potential for loss of nest structures and young that have not fledged by early June, including Brown Creepers, Varied Thrush, Hermit Warbler, and Pacific slope and Hammond's Flycatchers. Spring and fall migrants should have no direct effects.

The main indirect effects are the reduced canopy covers and potential loss of snags being fallen as hazard trees. Pileated Woodpeckers, Wilson's Warblers and Hammond's flycatchers can benefit from the increased habitat heterogeneity that would result from thinning. Other species like Brown Creepers and Winter Wrens would likely respond negatively due to increased habitat fragmentation and forest floor disturbance (Vanderwel, et al., 2007). Riparian buffers would limit impacts to Pacific-slope flycatchers and Varied Thrush. Lincoln's Sparrow would not be affected by the action alternatives as their habitat falls within riparian buffers and would not be treated. All species in these habitats would benefit from the treatments in the event of a future wildfire, as the probability of crown-replacing fire is reduced within treated and adjacent stands, and treated stands would serve as refugia habitat in the event of landscape scale wildfire.

East Slope Cascades Mixed Conifer and Old-growth Lodgepole

The D-Bug planning area contains very little ponderosa pine in harvest units, and the Flammulated Owl and Williamsons Sapsucker are rarely encountered in the planning area. The mixed conifer units around the northern half of Diamond Lake, and along the

Thirsty Creek road contain some ponderosa pine. Harvest would occur during the breeding season, and these two species may be breeding within treatment units, therefore there is some chance for direct mortality of nestlings or eggs through harvest of nest trees. Alternative 5 does not treat along Thirsty Creek Road; therefore, it would have less direct effects to Flammulated Owls and Williamson's Sapsuckers. Hermit Thrush are confirmed breeders in the planning area, and the ground based harvest of the mixed conifer units are likely to cause mortality for this species as harvest would occur during the breeding season.

Indirect effects to mixed conifer habitat include reduced canopy cover, the potential loss of snags within units, and ground disturbance. Additionally, underburning would occur in some units which would benefit Williamson's Sapsucker by potentially recruiting snags, but would adversely affect Hermit Thrush in the short term by consuming ground vegetation they use for cover. Long term, the thinning and fuels reduction work would beneficially affect these species in the event of a wildfire by decreasing the within-stand and stands adjacent to treatment risk of crown-replacing wildfire (*see* Fuels section of this chapter).

Black-backed Woodpeckers and the effects of the alternatives on their lodgepole pine habitat were discussed earlier in the MIS section; therefore they will not be discussed here.

Cumulative Effects

Neither of the action alternatives considered for the D-Bug project would alter the population trends observed for these species throughout Oregon, or the Cascades of Washington and Oregon as the small scale disturbance and/or habitat effects of the alternatives are limited to small portions of their overall ranges. Therefore, when combining this project with other past, present, or future projects over the next ten years, there would be no measureable cumulative effects to landbirds.

Determination of Effects

No alternative considered for the D-Bug project would alter the population trends observed for these species throughout Oregon, or the Cascades of Washington and Oregon as the effects of the alternatives are limited to small portions of the overall ranges of the species discussed. This is because of the small scale of disturbance related to their range associated with the action alternatives and the potential benefit in the reduction of extent and severity of future wildfire in the planning area.

UNIQUE HABITATS AND MEADOW MOSAIC HABITATS

Unique habitats are non-forested openings that vary in size from one to 75 acres and include meadows, hardwood stands, wetlands, ponds, caves, cliffs, and rock outcrops. Meadow mosaics are large areas (>75 acres) with high wildlife values (USDA, Forest Service, 1990). These areas are commonly intermixtures of meadow and conifer stands. They are important due to their scarcity in the forest environment and high wildlife and plant values (Ch. 2, FEMAT, 1994; USDA, Forest Service, 1990). Approximately 85 percent of the plant species diversity of the Western Cascades is found in non-forested habitats (Hickman, 1976) which make up about three percent of the Umpqua National Forest. Unique and mosaic habitats account for less than one percent of the area of the 42,000-acre D-Bug planning area. The majority of unique habitats in the planning area are wet meadows associated with Diamond and Lemolo lakes. Many of these wetlands include rare or unusual plant and animal species.

Existing and Desired Conditions

There are approximately 191.5 acres of unique and mosaic habitats mapped immediately adjacent to project units (Table 3-38). These openings range from 0.5 to 95.7 acres in size.

Table 3-38. Proposed Treatment Units Adjacent to Unique Habitats.

Unique Habitat Type	Location	Acres	Adjacent Unit(s)	Buffer Size (feet)
wetland	S Lemolo stringer	11.4	162	150
wetland	S Lemolo stringer	3.4	162	150
sedge wetland	Lemolo S inlet W	6.6	164	150
wetland	Lemolo, Lake Ck	2.6	185	150
sedge wetland	Lemolo, N. Umpqua inlet	3.7	189	150
pond	Teal Lk	2.1	32, 33, 35	150
pond	Horse Lk	2.0	35	150
sedge wetland	N Diamond Lk springs	1.0	95	150
wetland	N of Diamond Lk, W of Hwy 138	1.1	97	150
tufted hairgrass wetland	E of Silent Ck	1.4	25	150
tufted hairgrass wetland	E of Silent Ck	0.5	25	150
sedge wetland	E of Silent Ck, near Bailey Trailhead	5.9	27, 28	150
dry meadow	E of Silent Ck	1.3	18, 19	150
tufted hairgrass wetland	E of Silent Ck	26.1	18, 22, 25	300
wetland	W of Silent Ck, dissected	11.7	32, 34, 35	300
sedge wetland	S of Diamond Lk	95.7	32, 35	300
sedge wetland	W of Silent Ck, dissected	2.9	34	300
tufted hairgrass wetland	S of Horse Lk, dissected	0.8	35	150
sedge wetland	S of Horse Lk, dissected	2.0	34, 35	150
Spruce meadow mosaic	E hwy 138, N of DL	5.0	96, 95	150
meadow mosaic	Rabbit Ck	4.3	53, 54, 56, 215	50
TOTAL		191.5		

The desired condition is to maintain the habitat quality of the unique and mosaic habitats. This includes restricting introduction of invasive species and reducing the potential for uncharacteristic wildfire impacts. In addition, water table levels in wetlands should be maintained as described under Objective 7 of the Aquatic Conservation Strategy.

Direct and Indirect Effects

Alternative 1 would result in no direct effects to unique habitats because no activities would occur in or near them. These habitats would indirectly be at increased risk from uncharacteristic wildfire under this alternative due to dense stand conditions that would remain unmanaged. In the event of a wildfire, these mostly wet meadows would be impacted primarily along the ecotones where a stand replacement type fire would reduce moist conifer edges in some places. Otherwise, the dominant wetland species, including bog huckleberry, bog birch and sedges, would rapidly resprout following a fire. Road 6592-100 would continue to bisect two wetlands south of Diamond Lake.

The unique habitats would receive a 150-foot buffer under both action alternatives with a few exceptions. Units 53, 54, 56 and 215 surround a small meadow mosaic at the headwaters of Rabbit Creek between the Diamond Lake Campground and Highway 138. Unit 215 is only in Alternative 5. Because of the immediate proximity of abundant fuels in the form of dead lodgepole and spruce, only a 50-foot buffer is prescribed. This smaller buffer would still maintain practically all of the Englemann spruce ecotone around the meadows while allow for management of the surrounding fuels. Units 53 and 215 would only treat fuels; the former would be an underburn, the latter would involve mechanized fuels treatments. Unit 54 is a mixed conifer thinning that would leave 50-70 TPA while Unit 56 is a lodgepole pine thinning that would leave 90-200 TPA. Because these prescriptions all involve leaving much or most of the canopy, including the biggest trees, there should be limited indirect effect from alteration of the microclimatic in and immediately surrounding the meadow mosaic.

In both action alternatives, a 300-foot buffer would be placed around all meadows over ten acres south of Diamond Lake in order to maintain habitat for great gray owls (see the wildlife section). This includes the large wetland immediately south of Diamond Lake, the large tufted hairgrass meadow to the west of Silent Creek and the dissected wetland west of Silent Creek. Otherwise the 150-foot prescribed buffer around the rest of the unique habitats would eliminate any direct effect to these areas. Because of the nature of the pumice soils surrounding the wetlands, no indirect impact upon the hydrologic regime in anticipated from removal of timber canopy (see the aquatic habitat section). Therefore, the action alternatives would be consistent with Objective 7 of the Aquatic Conservation Strategy, which calls for the maintenance of water table elevation in meadows and wetlands.

A similar action associated with both of the action alternatives would obliterate and remove the crushed rock fill from 0.8 miles of Road 6592-100 that bisects two wetlands south of Diamond Lake (contingent upon available funding). Restoration of the hydrologic regime in these wetlands would be a direct beneficial effect. Thinning under alternatives 2 and 5 would indirectly improve resilience to stand replacement fire in adjacent stands and along ecotones.

Cumulative Effects

Numerous activities have occurred historically that have resulted in the current condition of the unique habitats around Diamond and Lemolo lakes, including lowering the lake level at Diamond Lake to facilitate past rotenone treatments. Lemolo Lake is a reservoir that flooded an area of extensive wetlands; these wetlands are also tied to lake level fluctuations that reflect hydroelectric power generation, recreation needs and ODFW water rights permit at Diamond Lake. The action alternatives would partially reverse the impact of past actions, specifically the potential fire risk of overstocked lodgepole pine resulting from past timber harvest and hydrologic impact of road building through

wetlands. Overall, there would be no cumulative effects to wetlands with implementation of any action alternative due to a lack of the effects of any of these actions overlapping with each other.

Aquatic Conservation Strategy

As disclosed above in this Unique Habitat section, no measurable impacts to the wetlands are expected from any of the proposed activities in any of the action alternatives including road work, thinning, burning, or yarding activities. As such, there would be no measurable effect upon water tables associated with the project's wet areas so wet areas would remain unaltered and wet, consistent with ACS Objective 7.

INVASIVE PLANTS/NOXIOUS WEEDS

Invasive plant species are alien plants whose introduction do, or are likely to, cause economic or environmental harm, or harm to human health (USDA, Forest Service, 2005a). Noxious weeds are plant species designated as such by the Secretary of Agriculture or by the responsible State official, and generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and being new to or not common to the United States. Noxious weeds infest over 420,000 acres of National Forests and Grasslands in the Pacific Northwest Region (USDA, Forest Service, 2005a).

Relevant Standards and Guidelines

Forest Service Region 6 issued a Record of Decision (ROD) in October 2005, for the Pacific Northwest Region Invasive Plant Program Final Environmental Impact Statement. The 2005 ROD added a set of standards to Forest Plans (USDA, Forest Service, 2005a). Several of the standards that are pertinent to this project are incorporated into the Botany Mitigation Measures in Chapter 2.

The Umpqua National Forest LRMP was also amended in 2003 with the following relevant standards and guidelines:

- Integrated weed management prevention and treatment strategies will be used to treat noxious weeds within the constraints of laws, policies and regulations and to meet Forest Management objectives. Methods may include manual (mowing, clipping, grubbing), biological, heated steam, competitive seeding, competitive planting, solarization, prescribed fire, grazing, chemical, or other applicable methods designed to control and/or eradicate the noxious weed. Biological controls tested and sanctioned by the US Department of Agriculture would be allowed to occur. Manual control methods within disturbed sites, such as along roads, trailheads, landings and within administrative sites would be allowed at any time.
- Require all ground disturbing machinery to be washed prior to entering and leaving the Forest, using the appropriate timber sale contract provisions and construction contract requirements.
- Require the use of certified-weed-free seed for all revegetation projects.
- Revegetate disturbed sites as soon as practical using native species unless there is no immediate resource concern and the site is anticipated to revegetate naturally to native species to desired cover standards.

Existing and Desired Conditions

The health of native plant communities throughout the Pacific Northwest is at risk by noxious weeds and other invasive plants. Introduced plant species thrive in new ecosystems for various reasons including a lack of natural predators, change in disturbance regime, adaptations for growing on nutrient-poor soils, and allelopathic (plants with natural pesticides) abilities. As a result, many weeds are capable of out-competing native plants, ultimately altering the structure and lowering the diversity of native plant communities. The frequency of fire can also be altered in ways that are detrimental to natural ecosystems (Brooks, et al., 2004; Harrod and Reichard, 2001; Keely, 2001). Further, different soil organisms predominate under different kinds of vegetation. Replacement of native plant communities with weed species can be expected to change soil microbial populations and nutrient cycling processes.

Roads are considered the first point of entry for weed species into a landscape, and roads serve as corridors along which plants move farther into the landscape. Logging, construction equipment and off-road vehicles have the potential to transport weed seed beyond roadsides to the disturbed soil that they concurrently generate. Invasive plant seed can also be moved by wind, water, animals, and humans. Most weeds take advantage of disturbed areas such as roadsides, trails, logged units, burns, rock quarries, mined sites and areas around human structures. Established populations serve as sources for further dispersal, especially along road, power line, and trail corridors.

The increase of noxious weed introductions on the Umpqua National Forest is directly related to expanding weed populations on nearby federal, state, and private lands. Populations of extremely aggressive species such as spotted knapweed, meadow knapweed, and rush skeletonweed have become roadside weeds on frequently traveled highways in Oregon and along arterial roads in the Umpqua and adjacent national forests. The greatest risk of human-caused noxious weed introduction into the proposed units is from seed-contaminated vehicles and equipment traveling through the planning area.

The Umpqua National Forest has classified its noxious weeds into four categories: high priority species (Forest Rating A), lower priority species (Forest Rating B), detection species (Forest Rating D), and other weeds of interest (Forest Rating O). The noxious weeds known[31] to occur on the Diamond Lake Ranger District of the Umpqua National Forest are presented, by category, in Table 3-39.

Table 3-39. Noxious Weed List for the Umpqua National Forest.

Common Name	Scientific Name	D-Bug Planning Area?
High-Priority Species (Forest Rating A)		
Spotted knapweed	Centaurea stoebe ssp. micranthos	Yes
Diffuse knapweed	Centaurea diffusa	Yes
Scotch broom	Cystisus scoparius	Yes
Lower-Priority Species (Forest Rating B)		
Meadow Knapweed	Centaurea nigrescens	Yes

[31] The following weeds occur on the Forest, but not within the planning area. These weeds will continue to be monitored for: False brome, Italian thistle, yellow starthistle, Malta thistle, rush skeletonweed, Portuguese broom, French broom, English ivy, yellow toadflax, Japanese knotweed, giant knotweed, sulfur cinquefoil, puncture vine, gorse, Canada thistle, Himalayan blackberry, Medusahead rye, common burdock, poison hemlock, chickory, common teasel, common tansy.

Common Name	Scientific Name	D-Bug Planning Area?
Bull Thistle	Cirsium vulgare	Yes
St. Johnswort	Hypericum perforatum	Yes
Tansy Ragwort	Senecio jacobaea	Yes
Other Weeds of Interest (Forest Rating O)		
Oxeye daisy	Chrysanthemum leucanthemum	Yes
Wild carrot	Daucus carrota	Yes
Reed canarygrass	Phalaris arundinacea	Yes
Curly pondweed	Potamogeton crispus	Yes

Noxious weed surveys for the D-Bug project were conducted during the summer of 2008. The D-Bug planning area is relatively free of invasive weeds although the major highways, 138 and 230, provide corridors for movement of weeds from eastern Oregon and the Rogue Valley, respectively, onto the Umpqua National Forest. There are numerous infestations of spotted knapweed along both highways 138 and 230 adjacent to stands proposed for thinning and fuels treatment. These infestations have been spot sprayed with herbicide and monitored since 2003 so major seed sources within the planning area are being actively managed. However, new plants continue to appear along the highway shoulder and along adjacent FS roads, presumably from residual seed and possibly continued movement from infestations east of the Cascades. The small infestation of diffuse knapweed on Highway 138 near the Crater Lake north entrance appears to have been eradicated. Small numbers of diffuse knapweed plants have continued to be found and sprayed with herbicide along the Lemolo Lake Road.

St. Johnswort is the most prevalent weed in the area but even it is largely confined to roadsides. There are also isolated spots of meadow knapweed, Scotch broom, tansy ragwort, and bull thistle. The former two species, in particular, are limited enough in the vicinity to be hand pulled when they are encountered, although meadow knapweed is very abundant in other parts of the Umpqua National Forest.

Diamond Lake has small infestations of an aquatic nuisance plant, curly pondweed, near the South Shore and Thielsen View Campground boat launches. Reed canarygrass is abundant around the lake's shoreline, where it was likely planted for shoreline stabilization. There are isolated patches of it downstream along Lake Creek.

The desired condition for the watershed and planning area is to be free of priority noxious weed infestations and maintain plant communities that are resilient to the introduction and spread of all invasive plants. Disturbed areas, such as rock quarries and waste disposal areas are maintained free of invasive weeds to the degree practicable.

Direct, Indirect, and Cumulative Effects

Alternative 1 would not result in any direct effects because ground disturbing activities with the potential to encourage new noxious weed invasions, would not occur. Continued noxious weed inventory, monitoring, and management would be subject to funding levels and district priorities. Because of potential wildfire hazard associated with dying lodgepole pine, failure to address fuels under the no action alternative could result indirectly in more severely burned acres that would be susceptible to weed invasion. In general, lodgepole pine stands appear to be somewhat less susceptible to non-native weed invasion. This would be most true of the stands bordering Crater Lake National

Park because of their exceptionally low soil nutrients, low summer soil moisture and exceptionally low native species richness and cover (Stohlgren, et al., 1999, 2002).

Because there are a few short segments of existing road that would be scheduled for obliteration under the action alternatives there would be slightly more road remaining under Alternative 1, resulting in slightly greater potential for long-term distribution of weeds along roadsides under this alternative. The absence of any roadwork under Alternative 1 would result in no road-related direct effects upon invasive plants. Because slightly more road would remain in the planning area under Alternative 1, there would be a minor indirect effect of greater potential weed spread over time on more road miles than the action alternatives.

Timber harvest and fuels reduction activities have the potential to directly affect weed spread under all action alternatives by vehicles and equipment carrying weeds to the areas where vegetation is being removed and soil disturbed. This potential would largely be mitigated through application of the prescribed prevention measures, particularly the vehicle washing requirement.

Weed spread and colonization would be indirectly facilitated by removing competing vegetation and disturbing the soil in the timber harvest units and fuelbreaks (Merriam, et al., 2006). This is particularly acute where vegetation is removed immediately adjacent to the primary dispersal corridors (i.e., roads). The priority weed infestations are currently largely confined to the roadsides, with heavily traveled roads tending to have more diverse and abundant roadside weeds. The overstocked stands of lodgepole and Douglas-fir lining the highways in particular help to contain weeds to the road shoulders. The effect of thinning this vegetation would be partially mitigated by: treating known sites prior to timber harvest and fuels management activities (and continuing to manage the known sites); subsoiling and seeding temporary roads, landings and skid trails adjacent to landings; and post-project monitoring to detect and treat invasive weeds before they can establish. The amount of mitigation that would occur would be dependent upon available funding. If weed mitigation is not funded, or funding is delayed, there is the potential for weed infestations to become established that would be much more expensive to manage over the long-term.

It is anticipated that, at least in part, fuels treatments involving mastication would result in a mulch layer dense enough to reduce weed colonization; therefore, these areas would not be seeded. The area south of the Hwy 230/Hwy 138 junction is naturally depauperate of vegetation because of the excessively well-drained pumice soils with low organic content and harsh climatic conditions. This area would not be seeded under any alternative because of the low potential for seeding success, although the area would continue to be monitored for weed colonization. Because of the high-elevation, low soil productivity, low soil moisture and low native species richness and cover, this particular area is thought to be less prone to exotic weed invasion (Stohlgren, et al., 1999, 2002).

Opening some stands could indirectly result in greater use of OHVs and other off-road vehicles away from roadways in places where travel is currently precluded. Off-road vehicles have the potential to carry weed seed into areas that are difficult to monitor (Rooney, 2005). This would most likely occur immediately adjacent to existing recreation areas including dispersed campsites. The same mitigation measures would be applied, but could be less effective because recreation use is less predictable. An off-highway vehicle (OHV) plan is currently being developed by the Forest that would restrict OHV use to predetermined areas, which would greatly reduce the risk of weed spread.

Roads indirectly affect weed spread by creating habitat for invasive weeds and providing corridors for movement of weeds. Alternative 2 and 5 propose to construct 15.4 and 8.1 miles of temporary road, respectively. Under both alternatives these temporary roads would be subsoiled and revegetated after the sale, contingent upon funding and vegetation potential at each site. Road obliteration and revegetation, along with application of required weed prevention measures during timber sale operations and post-harvest monitoring, should mitigate the potential for weed invasion of the temporary roads. There are currently a total of 186 miles of permanent roads in the planning area. Because there are a few short segments of existing road that would be scheduled for obliteration, Alternatives 2 would result in 11.1 less miles of road subsequent to activities while Alternative 5 would obliterate 7.4 miles of road. This would result in a minor indirect benefit over the long-term because there would be less miles of road in the planning area to facilitate weed movement under these alternatives. Therefore both action alternatives would provide a modest improvement over the existing condition with Alternative 2 resulting in slightly less road miles than Alternative 5.

Because temporary roads would be obliterated and revegetated, there would be no cumulative impact of additional roads in the planning area under any of the action alternatives. In fact, the miles of road in the planning area would slightly decrease under both action alternatives. Numerous projects have occurred within the planning area that have contributed to soil disturbance and vegetation clearing that provide suitable habitat for weeds (tables 3-1 through 3-3). However, most of these activities have been away from the major weed dispersal corridors. Only minor activities have occurred along Highway 138, which is the principle weed dispersal corridor. The other important weed corridors are roads 60 and 2610, both of which have had extensive, recent vegetation clearing for the purposes of fuels reduction and powerline maintenance. Activities along both roads have mostly involved thinning of small diameter trees (< 5” DBH) within 150 feet of either side of the road then hand-piling and burning the slash. Treatment units under Alternatives 2 and 5 actually overlap most of these acres so there would be little meaningful cumulative effect from the past actions. In fact, mitigation measures included in this project could partially alleviate some effects of the prior actions through revegetation, since very little revegetation was attempted as part of these past treatments. As a percentage of the landscape, total existing soil compaction within the planning area is very small at two percent, well below the LRMP standard of 20 percent. Therefore, the effects of both past soil disturbance and vegetation clearing along weed dispersal routes are relatively small and would not contribute to a meaningful cumulative effect when combined with this project.

THREATENED, ENDANGERED, AND SENSITIVE PLANT SPECIES

There are two species known or suspected to occur on the Forest that are listed under the Endangered Species Act. *Lupinus sulphureus* ssp*. kincaidii* is listed as threatened and has been documented on the Tiller Ranger District on the Umpqua National Forest. This species occurs in low-elevation upland prairies and is primarily known from Willamette Valley grasslands although there are isolated occurrences documented throughout the Umpqua basin as well. *Plagiobothrys hirtus* is listed as endangered and is confined to low-elevation wetlands in the vicinity of Sutherlin in northern Douglas County. It has not been documented on the Forest to date. The D-Bug planning area is far too high in elevation for there to be potential habitat for either of the federally listed species; therefore, there would be **no effect** to either species.

Several sensitive plants occur in these areas including: Lesser bladderwort (*Utricularia minor*), swaying bulrush (*Schoenoplectus subterminalis*), scheuchzeria (*Scheuchzeria palustris*), *Calypogeia sphagnicola*, *Tritomaria exsectiformis*, *Schistostega pennata,* and *Tomenthypnum nitens*. The latter four species are mosses and liverworts. There were no sensitive lichen species detected during surveys in the planning area. It is Forest Service policy to "ensure that Forest Service actions do not contribute to loss of viability of any native or desired plant or contribute… trends towards Federal listing of any species" (FSM 2672.41). There are currently 39 vascular plant species 20 fungi, 12 lichens, and 24 bryophytes listed as Sensitive, on the Umpqua National Forest; only those species with potential habitat in the area and that are present[32,33] in the planning area are listed in Table 3-40.

Table 3-40. A Project Effects Assessment for Threatened, Endangered & Sensitive Plants.

Taxa Group and Species	Potential Habitat	Species Present	Project Effects		
Threatened or Endangered Plants			**Alt 1**	**Alt 2**	**Alt 5**
Lupinus sulphureus ssp. kincaidii	No	No	NE	NE	NE
Plagiobothrys hirtus	No	No	NE	NE	NE
Bryophytes					
Calypogeia sphagnicola	Yes	No	NI	NI	NI
Schistostega pennata	Yes	Yes	NI	NI	NI
Tomenthypnum nitens	Yes	Yes	NI	NI	NI
Tritomaria exsectiformis	Yes	Yes	NI	NI	NI
Fungi					
Boletus pulcherrimus	Yes	N/A	NI	MIIH	MIIH
Chroogomphus loculatus	Yes	N/A	NI	MIIH	MIIH
Cortinarius barlowensis	Yes	N/A	NI	MIIH	MIIH
Cudonia monticola	Yes	N/A	NI	MIIH	MIIH
Gastroboletus imbellus	Yes	N/A	NI	MIIH	MIIH
Gastroboletus vividus	Yes	N/A	NI	MIIH	MIIH
Gomphus bonarii	Yes	N/A	NI	MIIH	MIIH

[32] The following species have potential habitat in the planning area but are not present; as such, no impacts are expected to occur. See the Botany BE (project record) for a complete list: Barbilophozia lycopodioides, Bryum calobryiodes, Chiloscyphus gemmiparus, Encalypta brevicolla var. crumiana, Encalypta brevipes, Entosthodon fascicularis, Funaria muhlenbergii, Helodium blandowii, Jamesoniella autumnalis var. heterostipa, Marsupella emarginata var. aquatica, Meesia uliginosa, Polytrichum sphaerothecium, Rhizomnium nudum, Splachnum ampullaceum, Tayloria serrata, Tetraphis geniculata, Tetraplodon mniodes, Trematodon boasii, Chaenotheca subroscida, Dermatocarpon meiophyllizum, Leptogium burnetiae, Leptogium cyanescens, Lobaria linita, Pannaria rubiginosa, Petigera neckeri, Pelitigera pacifica, Pseudocyphellaria mallota, Arnica viscosa, Botrychium minganense, Botrychium pumicola, Carex abrupta, Carex crawfordii, Carex diandra, Carex lasiocarpa var. americana, Carex serratodens, Carex vernacula, Cimicifuga elata, Collomia mazama, Cypripedium fasciculatum, Iliamna latibracteata, Ophioglossum pusillum, Polystichum californicum, Romanzoffia thompsonii.

[33] The following species have no potential habitat in the planning area and will not be discussed further; see the Botany BE (project record) for the complete list: Porella bolanderi, Pseudoleskeela serpentinensis, Codriophorus depressum, Scouleria marginata, Nephroma occultum, Pseudocyphellaria rainierensis, Ramalina pollinaria, Usnea longissima, Dermocybe humboldtensis, Destuntzia rubra, Ramaria amyloidea, Ramaria aurantiisiccescens, Ramaria largentii, Ramaria spinulosa var. diminutiva, Rhizopogon exiguous, Rhizopogon inquinatus, Adiantum jordanii, Arabis suffrutescens var. horizontalis, Asplenium septentrionale, Calamagrostis breweri, Calochortus umpquaensis, Carex nardina, Elatine brachysperma, Eucephalus vialis, Gentiana newberryi, Kalmiopsis fragrans, Lewisia columbiana var. columbiana, Lewisia leana, Pellaea andromedifolia, Perideridia erythrorhiza, Poa rhizomata, Rotala ramosior, Utricularia ochroleuca, Viola primulifolia spp. occidentalis, Wolffia borealis, Wolffia columbiana, Plastismatia lacunosa, Cypripedium montanum.

Taxa Group and Species	Potential Habitat	Species Present	Project Effects		
Gymnomyces fragrans	Yes	N/A	NI	MIIH	MIIH
Leucogaster citrinus	Yes	N/A	NI	MIIH	MIIH
Pseudorhizina californica	Yes	N/A	NI	MIIH	MIIH
Stagnicola perplexa	Yes	N/A	NI	MIIH	MIIH
Turbinellus kauffmanii	Yes	N/A	NI	MIIH	MIIH
Vascular Plants					
Scheuchzeria palustris var. americana	Yes	Yes	NI	NI	NI
Schoenoplectus subterminalis	Yes	Yes	NI	NI	NI
Utricularia minor	Yes	Yes	NI	NI	NI
Strategic Species					
Buxbaumia aphylla	Yes	Yes	NI	MIIH	MIIH

NE – No Effect; NI – No Impact; MIIH – May Impact Individuals or Habitat, But Will Not Likely Cause A Trend Towards Federal Listing or Loss of Viability.

Vascular Plants and Bryophytes

Lesser bladderwort, swaying bulrush and scheuchzeria

Lesser bladderwort (*Utricularia minor*) occurs in shallow areas of standing water in wetlands associated with both Lemolo and Diamond lakes. This unusual wetland plant produces both dissected submerged leaves along with leaves that are modified into tiny helmet-shaped bladders for trapping microscopic aquatic animals. This carnivorous modification is an adaptation to the anaerobic environment from which nutrients are not readily extracted.

Swaying bulrush (*Schoenoplectus subterminalis*) is a sedge-like species with flaccid leaves that float on the water's surface. It occurs in the large wetland at the south end of Diamond Lake within shallow ponds of pond lilies that grade, without defined banks, into the wet sedge meadow. Smaller populations occur along the shallow margins of Horse and Teal Lakes.

Scheuchzeria is an unusual sedge-like plant with inflated fruits that occurs only in well-developed fens. This species occurs in a wetland on the stream terrace between Diamond and Lemolo Lakes and the wetland below Unit 162 south of Lemolo Lake. These are the only recorded sites of this species on the Umpqua National Forest.

Tomenthypnum nitens and *Calypogeia sphagnicola*

Tomenthypnum nitens is a wetland moss that is associated with the edges of hummocks while *Calypogeia sphagnicola* is a tiny liverwort that occurs as threads within mats of sphagnum mosses. Both species occur in the same wetland as Scheuchzeria along Lake Creek while the former also occurs in the wetland where Lake Creek enters Lemolo Lake.

Tritomaria exsectiformis and *Schistostega pennata*

Tritomaria exsectiformis grows on well-decayed logs and organic streambanks that are in immediate proximity to water. There are a few small, isolated sites of this liverwort along Silent Creek and Lake Creek. *Schistostega pennata* occurs in the wet lodgepole pine habitats adjacent to Diamond Lake. It is largely confined to the shaded, moist soil of uprooted trees although it has also been found in one hole in the ground along Silent Creek. Because it occurs in shaded areas, the new growth of germinating spores (called

protonema) glows yellow-green[34] from reflected light. The wet pits where *S. pennata* can be found are always filled with a cloud of gnats and mosquitoes. This adaptation is important because the upturned trees which *S. pennata* depend upon only provide habitat for so many years before they decay into a mound of soil. Because the insects and moss share the same habitat preference, the insects appear to facilitate transport of spores. The lodgepole pine surrounding Diamond Lake is currently at a late-mature stage and is subject to blowdown and breakage. This has created a flush of suitable habitat for *S. pennata* that should last into the near future.

Direct, Indirect, and Cumulative Effects

Lesser bladderwort, swaying bulrush, scheuchzeria, *Tomenthypnum nitens* and *Calypogeia sphagnicola* all occur in wetlands. These wetlands would receive a 150-foot buffer under all action alternatives, except in the non-commercial units 25 and 35 at the south end of Diamond Lake. These two units are designed to non-commercially thin dense, young lodgepole pine plantations. Because of the flat topography, well-drained pumice soils, and low current biological diversity in these plantations no direct or indirect adverse impacts are anticipated upon the wetlands from non-commercial treatment of the adjacent plantations. There may be a slight benefit due to the acceleration of tree growth and reduction of uncharacteristic fire hazard under the action alternatives although there is little discernable wetland interface within these two plantations. For these reasons, there would be **no impact** to any of these species or their habitat.

Tritomaria exsectiformis occurs near units along the riparian zones of Silent Creek and Battery Springs. Other sites within the planning area are well away from proposed activities. There is also an isolated site of *Schistostega pennata* along Silent Creek. If streams were left unbufferred, these species could be affected by alteration of the hydrology of these creeks. Because they are dependent upon down wood and wind thrown trees, actions that would alter down wood recruitment within the riparian interface of these streams would also affect these species. However, Silent Creek and its tributaries would be buffered by at least a 60-to-80-foot no-entry buffer. The smaller prescribed buffer would be at upper reaches of the stream. The buffer would be carried to the slope break if it is greater than the prescribed 60- or 80-foot buffer. Because of the nature of this system, this would isolate the stream from any discernable direct or indirect effects. Specifically, the segment of Silent Creek adjacent to proposed units winds through a largely dissected landscape with a mostly narrow floodplain that rises sharply to broad pumice flats dominated by dry lodgepole stands where the proposed harvest units are located. No harvest or fuels treatments would occur along the stream or the adjacent slopes. Because the proposed harvest units are almost entirely elevated above the height of the riparian trees, there would be no change in the microclimate along the stream or wind events affecting wind thrown tree recruitment along the streams.

Battery Springs is similar to Silent Creek except that the creek is much smaller and, in the reach where *T. exsectiformis* occurs, winds through a fairly flat landscape lacking the sharp transition to dry lodgepole forest. For this reason, a larger no-entry buffer of 100 feett would separate the stream from the adjacent units 163 and 164 starting at the spring initiation point and extending to the Road 2614 crossing. Unit 163 is a mixed conifer stand that would only have whips felled and handpiled for burning so there would

[34] This luminescence is the product of lens-shaped cells that concentrate light on the chloroplasts. Because it glows from darkened crannies in the forest, it is sometimes known as goblin's gold. It also is unusual in having sticky spores that are transported to fresh substrates on insects and other animals.

be little indirect adverse effect anticipated from this treatment. Unit 164 is mix of lodgepole pine and other conifers and would be thinned to 20-70 TPA. Because this unit would be very open subsequent to harvest the larger 100-foot no-entry buffer would be necessary to reduce alteration of microclimatic conditions along the immediate riparian zone where *T. exsectiformis* occurs. A 100-foot buffer would be sufficient to eliminate any change in stream hydrology (see hydrology section). For these reasons, there would be **no impact** to *T. exsectiformis* or riparian habitat for *S. pennata* from treatments in any of the alternatives.

Schistostega pennata occurs mostly in the timbered wetland interface around Diamond Lake along with a couple of isolated sites in the Lemolo Lake and Spring River area. Proposed units 2 and 94 are uphill, above the paved bike trail, from the *S. pennata* habitat along the northwest edge of Diamond Lake. These units are both mixed conifer stands that would be thinned leaving a 50-foot buffer around the lake and wetland edges. Because the hydrology of the *S. pennata* habitat is connected to the lake and the wind throw necessary for providing substrate is also connected with wind coming off the lake, no direct or indirect impact is anticipated from thinning uphill. Most of the habitat and recorded sites for this species are connected with wetlands at the south end of Diamond Lake. The wetlands all would receive 150-foot buffer with the exception of the plantations discussed above. No suitable habitat or substrate occurs within or immediately adjacent to these plantations. There are no treatments proposed in or near the isolated sites near Lemolo Lake or Spring River. Therefore, there would be **no impact** to *S. pennata* or its wetland associated habitat from the action alternatives.

Fungi

Surveys for fungi are ongoing within the D-Bug stands with old-growth characteristics. Because of their unreliable and often cryptic fruiting characteristics, pre-project surveys are not typically considered to be a reliable conservation tool for sensitive fungi. Although many years of multi-visit survey would be necessary to confidently indicate that any given species is not present in a stand, limited survey can provide additional information on range and distribution of species. Such surveys can be considered to be “equivalent effort” surveys when conducted to provide information on fungi presence within stands with proposed management (USDA and USDI, 2001). Otherwise, conservation of fungi on Forest Service lands entails management of known sites, targeted surveys based on Regional priorities and consideration of habitat elements for fungi during project planning.

There is one location of a sensitive species of fungus within the D-Bug planning area. *Pseudorhizina californica* (formerly *Gyromitra californica*) is known from two sites on the Diamond Lake Ranger District. One site occurs along the moist stream terrace of Lake Creek but well away (approximately 700 feet, horizontal distance) from the nearest unit. No known sites of any sensitive fungi occur within any of the proposed units. Eleven additional species of sensitive fungi have been determined to have potential habitat within the planning area (Table 3-40). Occurrence of any of the other species would represent an expansion of their currently recognized habitat niche. None of the sensitive fungi appear to have particular fidelity to habitats within any of the proposed units but the published habitat requirements for rare fungi are only broadly described (Aurora, 1986; Castellano, et al., 1999, 2003; Exeter, et al., 2006) so it is difficult to confidently predict potential habitat. The following describes what is known about the habitat of the other species of fungi that appear to have potential habitat within the planning area based on available information:

There is a single known site on the Forest of *Boletus pulcherrimus* along the North Umpqua Trail. It is reported to occur on humus in association with the roots of conifers, including Douglas-fir and grand fir, and hardwoods, including big-leaf maple and tan oak. Most sites are in coastal forest.

Chroogomphus loculatus is known from only a single site in the Northwest Forest Plan area. This site is on the saddle at the head of a creek in a stand of mountain hemlock at 4,590 feet on the Willamette National Forest.

This is one site of *Cortinarius barlowensis* on the Cottage Grove Ranger District. It is reported to occur on wood and litter in coastal to montane conifer forests at 25-4,729 feet in elevation with silver fir, western hemlock and mountain hemlock.

Cudonia monticola is a litter saprobe that has been reported on the Diamond Lake Ranger District. It is reported a little north of Lemolo Lake from behind a receding snowbank at 4,560 feet in a late mature stand in the Shasta red fir/thin-leaf huckleberry/prince's pine plant association. It is also reported from 3,000 feet on the Cottage Grove Ranger District.

Gastroboletus imbellus is known only from the one site on the Willamette National Forest along the Ollalie ridge Trail at 5,000 feet in a stand of mountain hemlock and silver fir forest.

Gastroboletus vividus is reported from Shasta red fir and mountain hemlock above 5,400 feet. There are nearby sites on the Rogue River-Siskiyou National Forest at Jackson Gap and Crater Lake National Park but it has not ever been found on the Umpqua National Forest.

The nearest site of *Leucogaster citrinus* is south of Cavitt Falls on Roseburg BLM but it is reported to occur elsewhere at elevations up to 4893 feet in stands with white fir, subalpine fir, western white pine and lodgepole pine.

There is a site of *Stagnicola perplexa* known from the Rogue River National Forest in the vicinity of Crater Lake National Park, not far from the Diamond Lake Ranger District. It occurs on rotten wood and is reported in stands with Douglas-fir, western hemlock and alder at elevations of 1,149-4,526 feet.

There are five reported sites of *Turbinellus kauffmanii* (formerly *Gomphus kauffmanii*) on the Forest. One site is in the Steamboat drainage while the rest are on the Diamond Lake Ranger District. Reported elevations are 5,200 feet or higher where it is recorded with Shasta red fir, mountain hemlock, silver fir and white fir.

Direct, Indirect and Cumulative Effects

None of the Umpqua sensitive species appear to be specifically tied to lodgepole pine stands. Only the false-truffle species *Leucogaster citrinus* have been specifically reported to occur with lodgepole pine at all. In general, lodgepole pine stands appear to have relatively low fungal species richness (Cullings, et al., 2000). Early seral species of fungi tend to persist as stands mature while additional species occur in older stands (Bradbury, et al., 1998; Byrd, et al., 2000). Therefore, it is anticipated that the direct effect of timber harvest in the lodgepole dominated stands would be a short-term reduction of fungal species richness in general due to habitat alteration, but that the potential for occurrence of any sensitive species of fungi is very low. Although Alternative 2 would harvest the most acres of lodgepole forest, there would be little difference among the action alternatives because the habitat is considered to be so poor for rare fungi.

Mixed conifer stands appear to represent the best potential habitat for rare species in the D-Bug planning area. Several species evidently prefer high-elevation silver fir-mountain hemlock stands. There are no silver fir-dominated stands within any of the units. Mountain hemlock is not a desired commercial timber species so proposed units avoided mountain hemlock dominated stands. However, it is a common species within many units, either as an incidental species or in patches within lodgepole pine stands where it would mostly remain unlogged. Mountain hemlock dominated stands are abundant in adjacent areas, particularly in areas without roads, recreation and wilderness areas. A few species of fungi are reported to have been collected in stands with red fir/Shasta red fir. There are Shasta red fir dominated or co-dominated stands at the north end of Diamond Lake including units 56, 95 and 194 along with unit 176 west of Lemolo Lake. White/grand fir and Douglas-fir are noted as associated conifers from known sites of several other rare fungi. These conifers dominate all or parts of stands between Clearwater Falls and Thielsen Creek including units 107, 115, 116 and 117. Mixed conifer units, including Douglas-fir, white fir and other conifers, also occur in stands along the Thirsty Creek and Kelsay Point roads. These stands are the most likely to support the sensitive species of fungi discussed above.

Based on apparent suitable habitat, along with number and distribution of known sites, *Pseudorhizina californica* and *Turbinellus kauffmanii* are the most likely species to occur in mixed conifer stands in the D-Bug planning area. The related genera, *Gomphus* (primarily *G. flocosus*[35]) and *Gyromitra* (primarily *G. esculenta*[5]) were observed to be abundant in places within the planning area. These common species were observed to be mostly, but not entirely, along stream terraces and lower slopes, which are largely excluded from harvest units. Although the potential for any individual species of sensitive fungi to occur in any given unit is slim, the large amount of acres that would managed under the action alternatives increase the possibility that a rare fungus could be present and be directly damaged by operations from host tree removal and habitat alteration. Alternative 5 proposes the least mixed conifer thinning (1,500 acres); Alternatives 2 would harvest approximately 48 percent more mixed conifer acres (2,225 acres). Therefore there would be approximately a 48 percent greater chance of direct or indirect adverse impact to sensitive fungi and their habitat under this alternative. Potential impacts are substantially reduced in the mixed conifer units by retention of large green trees, retention of down wood, implementation of soil mitigation measures including topsoil retention and subsoiling, and riparian no-cut buffers.

All mixed conifer prescriptions involve thinning that would leave 50 to 90 TPA greater than 7” DBH. Total cover after harvest would be approximately 50 percent from trees greater than 7” DBH. This prescription should limit impacts to fungi by leaving host trees for mycorrhizal fungi and providing enough canopy cover to moderate microclimatic alteration of the stand. In a study conducted, in part, on the Diamond Lake Ranger District, Luoma (2004) detected no treatment effect on fall mushroom or truffle standing crop when 40 percent of the basal area (BA) was left in a dispersed pattern similar to the mixed conifer prescription for D-Bug. Spring truffle biomass was down relative to the control but there was no ‘statistically significant’ difference to spring mushrooms in the 40 percent dispersed retention treatments. Retention trees in harvest units have been demonstrated to serve as important refugia for ectomycorrhizal fungi (Luoma, et al., 2006).

[35] Common species are not expert verified.

Downed wood in the form of logs can greatly influence the diversity, distribution and abundance of fungi. This is particularly true of wood saprobes such as *Stagnicola perplexa* that subsist directly on decaying wood. Logs also serve to retain moisture under them as the ground elsewhere dries out. Decayed wood represents an important source of inoculum for recolonization of surrounding area following a disturbance (Jones, et al., 2003). Several studies have associated down wood with fungal abundance and diversity (Amaranthus, et al., 1996; Clarkson and Mills, 1994; Gomez, et al., 2003; Mellen, et al., 2006). Surveys conducted in the D-Bug planning area indicate that there is currently about two percent log cover in both lodgepole and mixed conifer stands. Even in the mixed conifer stands, downed wood was comprised of 66 percent lodgepole pine logs. Modeling of coarse woody debris cover relative to proposed harvest and fuel reduction activities indicates that ground cover would drop slightly with activities and then progressively increases over the succeeding decades (see the coarse woody debris section).

Because of the advanced age of the lodgepole pine and beetle mortality, Alternative 1 would have the highest cover of downed wood, at least in the absence of uncharacteristic wildfire. There are no data available for providing an optimal or recommended amount of downed wood necessary for fungi (Mellen, et al., 2006). Presumably more would be better, but this would have to be considered against the uncharacteristic wildfire hazard in stands with excessive coarse woody debris. The prescription for down wood within each unit does not differ between action alternatives although the total acreage of units affecting down wood does. Since Alternative 2 harvests more acres of mixed conifer stands than Alternative 5, there would be greater indirect benefit of downed wood cover to fungi in Alternative 5 in the absence of uncharacteristic fire.

Jones (2003) concluded that indirect changes in the biology and chemistry of soils following logging have as much or more effect on ectomycorrhizal fungal communities than impacts to the direct fungal inoculum. However, characterizing specifically how changes to the soil would alter fungal communities is difficult. Trappe (2008) found shifts in fungal communities with changes in the carbon to nitrogen ratios in nearby Crater Lake National Park. Otherwise, he found it difficult to separate the effect of soil properties from biological characteristics of the sites. Mechanized timber harvest and fuels treatment result in soil compaction. Soil compaction reduces pore space for root penetration, which should affect ectomycorrhizal formation (Amaranthus, et al., 1996). Subsoiling of temporary roads, landings and skid trails near landings would partially reverse the effect of compaction on mycorrhizal fungi. Other soil mitigation measures involving stockpiling of topsoil to be returned to subsoiled sites, and maintenance of effective ground cover would ameliorate much, but not all, of the alteration of soil organic composition on fungal diversity and abundance. More acreage of soils affected would occur under Alternative 2 than under Alternative 5 (see soils section).

Numerous timber sales and fuels reduction treatments have occurred throughout the planning area (tables 3-1 through 3-3). The activities proposed under each of the action alternatives cumulatively add to the residual effects of similar past actions. Specifically, there are substantial acres of thinned stands associated with past timber and fuels management that, as previously discussed, remove host trees for mycorrhizal species and reduce input of at least small-diameter down wood. There is also soil disturbance and compaction associated with these past activities plus the recreation areas that, as previously discussed, reduces pore small for mycorrhizal formation, although existing soil compaction represents only two percent of the planning area. Most of the stand

management has been in lodgepole pine dominated stands that, as discussed previously, appear to be poor habitat for sensitive fungi. Conversely, there are vast acres of similar habitats in the adjacent IRAs, areas without roads, wilderness and parklands that receive little, or no, thinning or fuels reduction management. Therefore, because the potential for all but two species of fungi being present is very low; the potential impacts to host trees and habitat would be of moderate intensity and primarily of short duration; the best apparent habitat (e.g., older stands, riparian stands) would be mostly retained; the planning area is bordered by vast acreage of reserved land allocations; and the proposed activities are intended to reduce the risk of uncharacteristic wildfire that would potentially have greater impact on fungal diversity, it is determined that the action alternatives **may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability** for any sensitive species of fungi.

EFFECTS TO OTHER RARE, UNCOMMON, OR STRATEGIC SPECIES

A number of additional species are considered to be regionally Rare and Uncommon species but do not qualify for the Regional Forester's Sensitive Species list. Strategic species are species whose conservation status on National Forest lands is uncertain for any of various reasons.

Rare, Uncommon and Strategic Fungi

There are an additional 218 fungi species considered to be rare and uncommon regionally and two additional species on the strategic list. The range and habitat information for most of these species is vague but approximately half of these species appear to have a reasonable potential to occur on the Umpqua National Forest. The majority of these may have potential to occur in the D-Bug planning area although the likelihood for all but a few individual species is extremely low.

Direct, Indirect and Cumulative Effects

Some of these species are considered to be uncommon but not rare and loss of some sites is not anticipated to change the level of rarity so management of sites is not required (USDA and USDI, 2001). As previously mentioned, *Gyromitra esculenta* was observed to be common throughout most of the mixed conifer stands, particularly in the vicinity of the Clearwater River. The riparian reserve buffers appear to represent the best habitat for this species and capture many, but far from all, of the observed occurrences. In unit 118, where this species was observed to be the most abundant, the larger riparian buffer in Alternative 5 would protect more occurrences and habitat for *G. esculenta* than the narrower Alternative 2 buffer. *Gyromitra montana* was observed in units 98 and 107 and in the unique habitat buffer adjacent to unit 162. Unit 162 also has an observed site of *Plectania melastoma* along the cut-bank of an old skid road. These species are all Category F species with no management requirement (USDA and USDI, 2001) and none is recommended in these instances since, as described above under the sensitive species section, impacts to most species of fungi is anticipated to of only limited duration and extent in the mixed conifer thinning stands. These species do not appear to be rare enough, either locally or regionally, to anticipate an adverse impact to the viability of the species.

Supplemental surveys are ongoing and confirmed sites of those species for which management of the site would be required (categories A-E) would be buffered from all activities. The buffer would need to be of sufficient width to protect the host trees (for the mycorrhizal species), preserve down wood, organic material and soil integrity, and

minimize alteration of the microclimate at the site. Luoma (2004) demonstrated that a combination of dispersed green-tree retention (i.e., thinning rather than clearcutting) and aggregated retention (i.e. leave islands) can be successful at maintaining mushroom production in timber harvest units. Therefore, a 150-foot radius, no-entry buffer would be established around any confirmed occurrences of rare or uncommon species that require management (Table 3-41). This would result in leave islands of approximately 1.6 acres around occurrences which, in combination with the 50-90 trees per acre remaining in the mixed conifer stands, should effectively ameliorate adverse potential impacts to sites of rare and uncommon fungi. Category B species that have been tentatively identified within stands include: *Gyromitra melaleucoides*, *Mycena overholtzii, Nivatogastrium nubiginum, Pithya vulgaris* and *Sarcosphaera coronaria*. The former species is by far the most abundant of this group within the planning area and perhaps the least dependent upon closed canopy conditions. Several of the sites are associated with canopy gaps, a couple of which are quite open. Therefore, for *G. melaleucoides*, 100-foot radius, no-entry buffer would be expected to retain the species at all known locations.

Cumulative effects to other rare and uncommon species of fungi would be identical to those discussed for sensitive species.

Because any occurrences that are located during the course of survey would be managed for preservation of the species at the site and the proposed activities are intended to reduce the risk of uncharacteristic wildfire that would potentially have greater impact on fungal diversity, it is determined that the action alternatives **may impact individuals or habitat but are not likely to contribute to a trend toward federal listing or loss of viability** for any rare, uncommon or strategic species of fungi.

Rare, Uncommon and Strategic Bryophytes, Lichens and Vascular Plants

Only two mosses, *Buxbaumia aphylla* and *Grimmia anomala* were determined to occur within the planning area. Both are strategic species within limited occurrence data within the state.

Buxbaumia aphylla

Buxbaumia aphylla is a tiny moss that occurs on soil at high elevations and is considered to be a strategic species. Strategic species are seemingly rare species that little is known about. This curious moss has only microscopic, ephemeral leaves so it is only the small fruiting body that is observable by the naked eye. It is known from a Douglas-fir stand on the east side of the Kelsay Point road between units 146 and 196. It also occurs at the break between lodgepole-dominated unit 130 and the mixed-conifer unit 131. These units are included only in Alternative 2.

Direct, Indirect and Cumulative Effects

None of the action alternatives would have a direct impact to known sites of *Buxbaumia aphylla* because the location that occurs within a unit would be provided a 75-foot radius, no-entry buffer. This distance roughly corresponds to the height of the dominant tree species at the site. This buffer is anticipated to ameliorate any indirect impacts to the microclimate of the site, which has a relatively open canopy already. This species appears to prefer small patches of bare soil, which is currently rare in the existing stands that currently have the forest floor covered with a thin, highly snow-compacted duff. Timber harvest would create additional substrate of bare soil, however there are likely other factors that would limit effective colonization of soil immediately subsequent to

stand treatments including: unfavorable microclimatic conditions, inadequate spore dispersal vectors, and absence of other facilitating organisms such as the lichen *Cladonia* that locally appears to co-occur with *B. aphylla*. Units with what appears to be the best potential habitat (i.e., the units along the Thirsty Creek and Kelsay Point roads) for *B. aphylla* occur only in Alternative 2.

There is the potential for direct adverse impacts to undiscovered locations under Alternatives 2 and 5. This species is very tiny while the planning area is very large. The capsules are known to be consumed by mice and possibly other organisms and there is no information on how predictably the fruiting bodies are produced. Therefore there is the potential that individual plants may be damaged or destroyed under all action alternatives. However, because the potential habitat was surveyed to minimize the potential for unknown sites, known sites are being buffered, and the proposed activities under all alternatives are designed to maintain relatively healthy forests over the long-term relative to the no-action alternative, each of the action alternatives are anticipated to have no worse than a neutral and possibly a beneficial effect to habitat over the long-term.

There would be no direct adverse impacts to *B. aphylla* or its habitat under Alternatives 1 and 5 because no activities occur within likely habitat. Alternative 1 and 5 do not manage the existing fire hazard conditions along Thirsty Creek or Kelsay Point roads, therefore the stands and immediately adjacent areas have greater potential for stand replacement fire. The extreme environmental conditions that would accompany a stand replacement fire in this area aren't likely to encourage survival or colonization of *B. aphylla*. Therefore, there would be a potential indirect adverse effect upon the species and its habitat due to the increased risk of uncharacteristic wildfire.

Only the Charlene Timber Sale appears to have occurred recently in likely habitat for *B. aphylla*. The single site that was discovered was buffered from timber sale activities although potential habitat within the harvest unit would have been lost or diminished. Most of the potential suitable habitat for this species appears to lie within the Oregon Cascades Recreation Area and the Mt. Thielsen Wilderness Area where only recreation activities with minimal impact to suitable habitat occur; therefore there would be minimal adverse cumulative impacts to the species or its habitat under Alternative 2.

Grimmia anomala

Grimmia anomala grows on acidic rock outcrops and boulders at high elevations. Oregon sites are usually in the immediate vicinity of streams or wetlands. It was previously reported in Oregon from Josephine, Klamath and Lane Counties. It is otherwise known from boreal regions of North America and high elevations in the western United States.

Direct, Indirect and Cumulative Effects

This species was located along the edge of unit 997, which is only in Alternative 5. This is a non-commercial fuels reduction unit between a large work shed and Lake Creek. The stand is very rocky and dominated by large Douglas-fir and mature lodgepole pine with an understory of white fir, western white pine and mountain hemlock. Moss cover is generally high throughout the stand, particularly on rock. The understory is otherwise sparse, consisting primarily of prince's pine (*Chimaphila umbellata*) and twinflower (*Linnaea borealis*). The stand currently has a relatively open overstory in the immediate vicinity of the shed and becomes denser with larger trees closer to the creek. The prescription would call for thinning of the small understory trees and hand piling.

Thinning would result in increased direct sunlight and lower humidity in the understory during portions of the year, which could indirectly affect the composition and abundance of mosses and liverworts in this stand, including *G. anomala*. Because of proximity to Lake Creek, a 75-foot buffer around the rock outcrop with G. anomala should be sufficient to ameliorate alteration of the microclimatic at the site and provide for persistence of this species. There would be no management of fuels under Alternatives 1 and 2; therefore there would be no direct impact to the species under these alternatives. The likelihood of fire this close to a creek at this elevation is relatively low although, in the absence of fuels management, the impact of fire upon the stand and the understory species could be more severe. Because Alternative 2 treats some adjacent stands, the risk of an uncontrolled fire entering this stand would be greatest under the no action alternative. This species was not previously known to occur within the planning area and potential habitat is largely confined to riparian reserves and land allocations with little or no allowable timber harvest therefore there would be no cumulative effect from other activities.

Table 3-41. Rare, Uncommon and Strategic Species.

Other Rare or Uncommon Species[1]	Category[2]	Umpqua[3]
Fungi		
Acanthophysium farlowii (Aleurodiscus farlowii)	B	
Albatrellus avellaneus	B	S
Albatrellus caeruleoporus	B	S
Albatrellus ellisii	B	S
Albatrellus flettii	B	K
Alpova alexsmithii	B	
Alpova olivaceotinctus	B	
Arcangeliella camphorata	B	
Arcangeliella crassa	B	
Arcangeliella lactarioides	B	
Asterophora lycoperdoides	B	S
Asterophora parasitica	B	
Baeospora myriadophylla	B	
Balsamia nigrens (Balsamia nigra)	B	S
Boletus haematinus	B	
Bondarzewia mesenterica (Bondarzewia montana)	B	K
Bridgeoporus nobilissimus (Oxyporus nobilissimus)	A	
Cantharellus subalbidus	D	K
Catathelasma ventricosa	B	S
Chalciporus piperatus (Boletus piperatus)	D	S
Chamonixia caespitosa	B	

Choiromyces alveolatus	B	K
Choiromyces venosus	B	S
Chromosera cyanophylla (Mycena lilacifolia)	B	S
Chrysomphalina grossula	B	S
Clavariadelphus ligula	B	K
Clavariadelphus occidentalis (Clavariadelphus pistillaris)	B	K
Clavariadelphus sachalinensis	B	S
Clavariadelphus subfastigiatus	B	K
*Clavariadelphus truncatus (*syn*. Clavariadelphus borealis)*	B	K
Clavulina castanopes var*. lignicola (Clavulina ornatipes)*	B	
Clitocybe senilis	B	
Clitocybe subditopoda	B	
Collybia bakerensis	B	S
Collybia racemosa	B	S
Cordyceps capitata	B	S
Cordyceps ophioglossoides	B	
Cortinarius boulderensis	B	K
Cortinarius cyanites	B	
Cortinarius depauperatus (Cortinarius spilomeus)	B	
Cortinarius magnivelatus	B	
Cortinarius olympianus	B	K
Cortinarius speciosissimus (Cortinarius rainierensis)	B	
Cortinarius tabularis	B	
Cortinarius umidicola (Cortinarius canabarba)	B	
Cortinarius valgus	B	K
Cortinarius variipes	B	
Cortinarius verrucisporus	B	
Cortinarius wiebeae	B	
*Craterellus tubaeformis (*syn*. Cantharellus tubaeformis)*	D	K
Cyphellostereum laeve	B	
Destuntzia fusca	B	K
Dichostereum boreale (Dichostereum granulosum)	B	
Elaphomyces anthracinus	B	
Elaphomyces subviscidus	B	K
Endogone acrogena	B	

Endogone oregonensis	B	S
Entoloma nitidum (Rhodocybe nitida)	B	
Fayodia bisphaerigera (Fayodia gracilipes)	B	
Fevansia aurantiaca (Alpova aurantiaca)	B	
Galerina atkinsoniana	B	K
Galerina cerina	B	
Galerina heterocystis	E	K
Galerina sphagnicola	E	
Galerina vittaeformis	B	K
Gastroboletus ruber	B	S
Gastroboletus subalpinus	B	K
Gastroboletus turbinatus	B	S
Gastrosuillus amaranthii	E	
Gastrosuillus umbrinus	B	
Gautieria magnicellaris	B	
Gautieria otthii	B	
Gelatinodiscus flavidus	B	S
Glomus radiatus	B	
Gomphus clavatus	B	K
Gymnomyces abietis	B	
Gymnomyces nondistincta	B	
Gymnopilus punctifolius	B	S
Gyromitra esculenta	F	K
Gyromitra infula	B	K
Gyromitra melaleucoides	B	S
Gyromitra montana (Gyromitra gigas)	F	K
Hebeloma olympianum (Hebeloma olympiana)	B	
Helvella crassitunicata	B	S
Helvella elastica	B	K
Helvella maculata	B	K
Hydnotrya inordinata	B	
Hydnotrya subnix	B	
Hydnum umbilicatum	B	K
Hydropus marginellus (Mycena marginella)	B	
Hygrophorus caeruleus	B	

Hygrophorus karstenii	B	
Hygrophorus vernalis	B	
Hypomyces luteovirens	B	
Leucogaster microsporus	B	K
Macowanites chlorinosmus	B	
Macowanites lymanensis	B	
Macowanites mollis	B	
Marasmius applanatipes	B	
Martellia fragrans	B	S
Martellia idahoensis	B	S
Mycena hudsoniana	B	S
Mycena monticola	B	K
Mycena overholtsii	B	K
Mycena quinaultensis	B	S
Mycena tenax	B	S
Mythicomyces corneipes	B	S
Neolentinus adhaerens	B	
Neolentinus kauffmanii	B	
Neournula pouchetii	B	K
Nivatogastrium nubigenum	B	K
Octavianina cyanescens	B	S
Octavianina macrospora	B	
Octavianina papyracea	B	
Otidea leporina	B	K
Otidea onotica	F	K
Otidea smithii	B	S
Phaeocollybia attenuata	D	S
Phaeocollybia californica	B	S
Phaeocollybia dissiliens	B	
Phaeocollybia fallax	D	K
Phaeocollybia gregaria	B	
Phaeocollybia kauffmanii	D	S
Phaeocollybia olivacea	B	S
*Phaeocollybia oregonensis (*syn*. Phaeocollybia carmanahensis)*	B	
Phaeocollybia piceae	B	

Phaeocollybia pseudofestiva	B	S
Phaeocollybia scatesiae	B	
Phaeocollybia sipei	B	
Phaeocollybia spadicea	B	
Phellodon atratus (Phellodon atratum)	B	
Pholiota albivelata	B	
Pithya vulgaris	D	K
Plectania melastoma	F	K
Plectania milleri	B	K
Podostroma alutaceum	B	
Polyozellus multiplex	B	K
Pseudaleuria quinaultiana	B	
Ramaria abietina	B	S
Ramaria araiospora	B	K
Ramaria botryis var. *aurantiiramosa*	B	
Ramaria celerivirescens	B	K
Ramaria claviramulata	B	
Ramaria concolor f. marrii	B	
Ramaria concolor f. tsugina	B	
Ramaria conjunctipes var. *sparsiramosa (Ramaria fasciculata* var. *sparsiramosa)*	B	K
Ramaria coulterae	B	K
Ramaria cyaneigranosa	B	K
Ramaria gelatiniaurantia	B	
Ramaria gracilis	B	
Ramaria hilaris var. olympiana	B	
Ramaria lorithamnus	B	
Ramaria maculatipes	B	S
Ramaria rainierensis	B	
Ramaria rubella var. *blanda*	B	
Ramaria rubribrunnescens	B	K
Ramaria rubrievanescens	B	K
Ramaria rubripermanens	B	K
Ramaria stuntzii	B	K
Ramaria suecica	B	S
Ramaria thiersii	B	

Ramaria verlotensis	B	
Rhizopogon abietis	B	S
Rhizopogon atroviolaceus	B	K
Rhizopogon brunneiniger	B	K
Rhizopogon chamaleontinus	B	S
Rhizopogon ellipsosporus	B	S
Rhizopogon evadens var. subalpinus	B	K
Rhizopogon flavofibrillosus	B	K
Rhizopogon truncatus	D	K
Rhodocybe speciosa	B	
Rickenella swartzii (Rickenella setipes)	B	
Russula mustelina	B	
Sarcodon fuscoindicus	B	K
Sarcodon imbricatus	B	K
Sarcosoma latahense (Plectania latahensis)	B	K
Sarcosphaera coronaria (Sarcosphaera eximia)	B	K
Sedecula pulvinata	B	
Sowerbyella rhenana (Aleuria rhenana)	B	
Sparassis crispa	D	K
Spathularia flavida	B	K
Thaxterogaster pavelekii	B	
*Tremiscus helvelloides (*syn*. Phlogiotis helvelloides)*	B	K
Tricholoma venenatum	B	
Tricholomopsis fulvescens	B	S
Tuber asa	B	
Tuber pacificum	B	
Tylopilus porphyrosporus (Tylopilus pseudoscaber)	D	
Lichens		
Bryoria pseudocapillaris	B	
Bryoria spiralifera	B	
*Bryoria subcana (*syn*. Alectoria subcana)*	B	
Bryoria tortuosa, OR Western Cascades Province	A	S
Bryoria tortuosa, OR Klamath Province	D	S
Buellia oidalea	E	
Calicium abietinum	B	S

Calicium adspersum	E	S
Calicium glaucellum	F	K
Calicium viride	F	K
Cetrelia cetrarioides	E	
Chaenotheca chrysocephala	B	K
Chaenotheca ferruginea	B	K
Chaenotheca furfuracea	F	K
Cladonia norvegica	B	
Collema nigrescens, in WA and OR, except in OR Klamath Physiographic Province	F	K
Dendriscocaulon intricatulum	B	S
Heterodermia sitchensis	E	
*Hypogymnia duplicata (*syn*. Hypogymnia elongata)*	A	S
Hypogymnia oceanica	F	K
Hypogymnia vittata (Hygomnia vittiata)	E	
*Hypotrachyna revoluta (*syn*. Parmelia revoluta)*	E	
Leptogium rivale	B	K
Leptogium teretiusculum	E	S
Microcalicium arenarium	B	S
Nephroma bellum	F	K
Nephroma isidiosum	E	
*Niebla cephalota (*syn*. Desmazieria cephaolta, Ramalina cephalota)*	A	
Pannaria saubinetii	F	
Platismatia lacunosa	C	S
Pseudocyphellaria sp. 1 *(Pseudocyphellaria mougeotiana)*	B	
*Pyrrhospora quernea (*syn*. Lecidea quernea, Protoblastenia quernea)*	E	
Ramalina pollinaria	E	S
Ramalina thrausta	A	K
Stenocybe clavata	E	
Teloschistes flavicans	A	
Tholurna dissimilis, south of Columbia River	B	
Usnea hesperina	B	
Bryophytes		
Brotherella roellii	E	
Buxbaumia viridis	D	K
Diplophyllum albicans	D	K

Diplophyllum plicatum	B	S
Herbertus aduncus	B	
Iwatsukiella leucotricha	B	
Kurzia makinoana	B	
Orthodontium gracile	B	
Codriophorus ryzardii (*Racomitrium aquaticum*)	B	S
Tritomaria quinquedentata	B	
Vascular Plants		
Cypripedium montanum	C	K
Strategic Species[4]		
Bryophytes		
Buxbaumia aphylla		K
Scouleria marginata		K
Anastrophyllum minutum		S
Anomobryum julaceum		S
Cephaloziella spinigera		S
Grimmia anomala		K
Harpanthus flotovianus		S
Pohlia sphagnicola		S
Pohlia tundrae		S
Polytrichum sexangulare		S
Polytrichum strictum		S
Scapania obscura		S
Schofieldia monticola		S
Thamnobyrum neckeroides		K
Lichens		
Lecanora pringlei		S
Lecidea dolodes		S
Fungi		
Leucogaster odoratus		S
Rhizopogon flavofibrillosus		S

SOIL PRODUCTIVITY AND SUSTAINABILITY

The maintenance of soil productivity during forest management activities is critical to maintaining healthy forests and is addressed in and tiers to the Umpqua National Forest Land and Resource Management Plan (1990) with several standards and guidelines. The primary focus of this analysis centers on past and predicted soil disturbances, the maintenance of ground cover, and changes to forest cover.

Relevant Standards and Guidelines

The standard and guidelines from the 1990 LRMP related to soil productivity include:

- Soil Productivity S&G 1, p IV-67: Requires that the combined total amount of unacceptable soil conditions (compaction, displacement of surface soil and severe burning) in proposed activity areas would not exceed 20 percent, including areas in roads and landings.
- Soil Productivity S&G 2, p IV-68: Requires maintenance of ≥25% effective ground cover on areas with low erosion hazards and ≥45% in areas with moderate erosion hazards to prevent loss of topsoil through erosion.
- Soil Productivity S&G 3, p IV-68: Requires maintenance of ≥65% ground cover for surface organic material (defined as litter, duff and wood) on mineral soils with cold climatic conditions, low nutrient levels, and/or low water holding capacities.
- Soil Productivity S&G 4, p IV-68: Requires 250 linear feet of large down woody material per acre. Up to sixty percent of this wood can be in the form of standing cull or snags.
- Soil productivity S&Gs 5, 10, 11, and 12 and other NWFP requirements are also addressed here as project design, mitigation measures, or as monitoring requirements in the soils section at the end of Chapter 2.
- Watershed Cumulative Effects and Water Quality S&G 5, IV-65: Requires permanent roads and landings on inventoried aquifer lands will be occupied by less than 5 percent of land area or a road density of 5.3 miles/square miles and will not disrupt natural drainage or intercept and transfer subsurface water to surface channels.

Soil Productivity Standards and Guidelines and Best Management Practices were developed to limit management related impacts to soil tilth, soil carbon, surface organic matter, and large woody material to a level that provides protection of the soil hydrology, soil biology and flora and fungi, soil stability and erosion, and soil fertility.

Guidance for considering greenhouse gas emissions and climate change where provided by Climate Change Considerations in Project Level NEPA Analysis (Washington Office Memo, January 13, 2009). Stand carbon distribution was used as a measure of the 40-year wildfire hazard over the planning area. Fire hazard was analyzed by modeling a summer wildfire across the planning area using FFE-FVS[36]. Each stand type received four modeled fire disturbances, one at each decade over a forty-year period. Stand development was modeled from year-one to a single decade fire event using FVS, and then its recovery modeled from the year of a modeled fire event to year-forty. The results of each of the four disturbance periods, per decade, for each stand,

[36] Fire and Fuels Extension to the Forest Vegetation Simulator (Reinhardt and Crookston, 2003).

were then averaged with all other stands to provide an average fire hazard per decade over the planning area (Figure 3-22).

Existing and Desired Conditions

The 42,000-acre D-Bug planning (analysis) area is bordered on the south by Crater Lake National Park, Lemolo Lake Recreation Area to the north, Mt. Thielsen Wilderness and Oregon Cascades Recreation Area to the east, and the Mt. Bailey Inventoried Roadless Area to the west. The planning area watershed consists of eight sub watersheds that encompass about 114,493 areas.

Past disturbance and the current condition in each of the proposed units was investigated in the field by the project Soil Scientist. Most of the units have not been previously harvested. Approximately 115 acres of existing skid trails and landings were identified along with 37 miles of unclassified roads and 15 miles of unclassified OHV trails. Past timber harvest primarily utilized ground-skidding using cables or tractors without suspending logs. Harvest and fuel treatments that occurred in the past are now considered extreme disturbance by current standards. Regeneration of clear cuts was often difficult in some of the more harsh sites such as in the colder flats, dryer coarse pumice areas, or areas with severe soil disturbance. Road densities in the planning area for both classified and unclassified roads are 2.92 miles per square mile and road densities in aquifer related soil types[37] are even less.

The dominant landscape features of the area are the broad pumice flats covered in ash from the volcanic eruption of Mt. Mazama that formed Crater Lake over 7,000 years ago. The D-Bug planning area lies within frigid (the lodgepole/mixed conifer stands) and cryic (pure stands of lodgepole pine pumice flats) temperature regimes common to the high and eastern Cascades. Stands in this climate regime have a history of bark beetle outbreaks that are later suppressed by the cold climatic conditions. However, scientists have stated that global warming at these elevations are dampening temperatures allowing beetle attacks for longer periods over larger areas (Goheen, 2008).

Soils in the planning area are developed from Mazama ash, volcanic rock, and glacial debris. The flats around the Diamond and Lemolo Lake region contain relatively young, poorly developed coarse textured Volcanic soil (Andisols). Soil interpretations[38] for the planning area were made using the Umpqua Soil Resource Inventory (USDA, 1976) and field review. This inventory provides landscape-scale soils information on broadly mapped areas (average size = 250 acres) that have distinctly unique geology, landform and soils. This information is summarized for each landform:

> Cold-dry deep Pumice Flats – This landform is represented by Soil Mapping Landtypes 90 and 92. This feature represents 48 percent of the planning area between Lemolo and Diamond Lake. The combination of low fertility, cold air settling into these areas and the low moisture holding capacity of the coarse textured pumice creates a harsh environment in which lodgepole pine is best adapted and becomes the dominant species. In these areas of cold soil temperatures, fine roots, soil carbon, and soil biology are primarily concentrated just under the duff and close to the warmer soil surface making these areas susceptible to soil disturbance (compaction, displacement, severe soil heating). These deep (>12 feet) sandy soils are

[37] Since the 1990 Land and Resource Management Plan, Soil Landtypes have been found to be less of a predictor to the High Cascade aquifer than the jointed and fracture underlying geology (Jefferson et. al 2006).
[38] Detailed soil properties of each landform are found in the Project File – Soils section.

excessively drained. There is little risk of overland flow so surface erosion (0 to 0.15 ton per acre per year) or mass soil movement and the potential for sediment delivery is low. Water can concentrate and flow over disturbances such as compacted skid trails, roads, and landings but quickly disperses and infiltrates once it flows from these disturbances. These landtypes where identified as important to the North Umpqua River aquifer in the 1990 Forest Plan. The minimum effective groundcover for this area is prescribed at 65 percent, in order to meet standards and guidelines for site productivity. The surface of these soils dries quickly giving them a low resiliency to disturbance. (Refer to silviculture stand maps). These areas are generally only suitable for ground based harvest due to their lack of topographic relief.

Cold-moist Deep Pumice Flats – This landform is represented by Soil Mapping Landtypes 90, 92, and 96. This feature represents 25 percent of the planning area between Lemolo and Diamond Lake. Cold air settling into these areas creates a harsh environment in which lodgepole pine is best adapted and becomes the first species to move into these sites following disturbance. In these areas of cold soil temperatures fine roots, soil carbon, and soil biolology are primarily concentrated just under the duff and close to the warmer soil surface making these areas susceptible to soil disturbance (compaction, displacement, severe soil heating). These deep (>12 feet) sandy soils are excessively drained and are identified as important to the North Umpqua River aquifer in the 1990 LRMP. However, where soil surface texture is loamy over coarse-textured pumice, soil moisture during the growing season tends to favor fir trees under the lodgepole where they are protected from frost. There is little risk of overland flow so surface erosion (0 to 0.15 ton per acre per year) or mass soil movement and the potential for sediment delivery is low. Water can concentrate and flow over disturbances such as compacted skid trails, roads, and landings but quickly disperses and infiltrates once it flows from these disturbances. These soils have a low to moderate resiliency to soil disturbances. These areas are generally only suitable for ground based harvest due to their lack of topographic relief.

Gentle to Moderately Steep Glacial Deposits – This landform is represented by Soil Mapping Landtypes 92 and 96. These features represent 27 percent of the planning area between Lemolo and Diamond Lake. Soils in these areas range from less than three feet to eight feet in depth on slopes ranging from 20 to 50 percent. These slopes help to circulate the cold air, making it less of an issue than in the flats. These landforms favor high elevation mixed conifer forests. There is little risk of overland flow so surface erosion (0 to 0.15 ton per acre per year) or mass soil movement and the potential for sediment delivery is low. Water can concentrate and flow over disturbances such as compacted skid trails, roads, and landings but quickly disperses and infiltrates once it flows from these disturbances. This landform has been identified as important to the North Umpqua River aquifer in the 1990 LRMP. These soils are moderately sensitive to soil disturbance. The minimum effective groundcover for this area is prescribed at 65 percent, in order to meet standards and guidelines for site productivity. These areas are suitable for one end to full log suspension cable system yarding where there is are slopes and ground based harvest on flats and slopes of less than thirty percent.

Maintaining soil structure and soil organic matter, large woody material, and the forest litter is a critical element to long-term soil productivity. Unacceptable soil disturbance (severe compaction, displacement, or burned soil), effective ground cover, and maintenance of carbon and nitrogen balance are used as measures of the potential to

have direct, indirect, or cumulative effects to long-term soil productivity and sustainability.

The desired condition for soils in the planning area is to keep cumulative soil disturbance to less than 20 percent of the treatment areas, and maintain at least 65 percent effective ground cover of surface organic material for soil productivity (LRMP, p. IV-68, S&G 2). Forest soils are the primary stores of carbon and can store/sequester large amounts of greenhouse gases. A desired objective would be a carbon neutral project that sequesters or offsets more greenhouse gases than the project emits (IPCC, 2007). Nitrogen is a common nutrient that is used to measure effects to site productivity and sustainability.

For both lodgepole and mixed conifer snag densities current Umpqua National Forest LRMP and Northwest Forest Plan standards and guidelines for snag retention are being met, and would be met after the implementation of any alternative. Large down woody material is covered in more detail under Wildlife.

Direct and Indirect Effects

Direct and indirect effects are discussed at the scale of the treatment units. Direct effects would occur immediately as a result of thinning, fuel treatment, and road work while indirect effects would occur in the future as a result of potential wildfires. Predictions about future stand and fuel conditions were made using Forest Vegetation Simulator (FVS) (Dixon, 2003) and Fire and Fuels Extension to the FVS (Reinhardt and Crookston, 2003)[39]. Predictions of direct effects of burning where made using First Order Fire Effects Modeling (FOFEM).

Excessive displacement, compaction, and severe heating of the soil (from fire) are all considered unacceptable soil disturbance under S&G 1. Soil compaction and displacement can exceed this standard whenever legacy disturbance (from past management) combines with any new disturbance to affect more than 20 percent of a given treatment area. Thinning and associated activities in the action alternatives can result in soil disturbance during yarding, burning and temporary road building. Use of cut-to-length harvesters and biomass collection techniques would reduce soil compaction and displacement compared with other ground-based systems because the processing equipment is limited to a single pass over the soil (ghost roads). Three passes over dry soil is generally considered the level of disturbance that would commonly result in unacceptable soil compaction (>15 percent increase in bulk density). Ideally cut-to-length harvesters and biomass collectors would work on top of a three-inch or greater slash mat which further reduces that level of disturbance. However, for the purpose of this analysis a higher degree of disturbance was predicted for ghost roads in the pure lodgepole pine stands where the slash mat may be less than three inches.

Under Alternative 1, legacy soil displacement and compaction would remain at around 0.5 percent of the area analyzed and includes the land used for administrative sites at Lemolo and Diamond Lakes (parking lots, campsites, etc). Included in this 0.5 percent estimate are 64 miles of existing unclassified roads and OHV trails, and 115 acres of legacy landings and skid trails.

Under the action alternatives, approximately 800 to 1,200 acres of new soil disturbance is expected in the form of new temporary roads, log landings, and skid trails (Table 3-

[39] Summary of FVS-FFE runs and assumptions for Fire and Fuels – located in the D-Bug project files.

42). Subsoiling 598 to 635 acres of temporary roads, landings, and skid trails within 100 feet from each landing is included in D-Bug's project design. Following subsoiling, Alternatives 2 and 5 would continue to meet soil standards and guidelines for soil disturbance averaging from seven to ten percent of treatment acres. Unacceptable soil disturbance would not exceed 20 percent in any single treatment area (Table 3-42) and overall compaction levels over the planning area of the North Umpqua River aquifer would not exceed five percent (FEIS, p. IV-65), thus meeting Forest Plan Standards and Guidelines for compaction.

Table 3-42. Soil disturbance estimates from compacted and severely burned soil for the D-Bug activity areas.

Type of Soil Disturbance	Alt 1	Alt 2	Alt 5
Legacy Compaction*	226 ac	226 ac	226 ac
New Compaction (perm roads)	0	0 ac	0
New Compaction (harvest, landings, temporary roads)	0	1,025 ac	798 ac
Subsoiling (mitigation)	0	-635 ac	-598 ac
Severely Burned Soil** (fuel treatments)	0	72 ac	60 ac
Net Soil Disturbance (% of treatment areas)	0.5%	1.6%	1.2%
Severely burned soil (modeled wildfire***)	12,700 ac	10,500 ac	10,000 ac
% avg Soil Disturbance from Wildfire	30%	25%	24%

* Legacy Compaction includes compaction that already exists, prior to the implementation of D-Bug action, and includes unclassified roads, OHV trails, skid trails, and landings.

** Severely burned soil is a condition where soil has been heated to a point that alters soil structure resulting in increased soil erosion potential, and decreased soil organisms and nutrient holding capacity. Severely burned soil often occurs in the burning of large machine piles.

*** First Order Fire Effects Modeling (FOFEM). Results for Alternative 1 predict that severe soil disturbance during wildfire could be as high as 73% in some areas.

Alternative 5 would result in the least amount of compacted and severely burned soil following harvest and fuel treatments. Alternative 2 would result in 25 percent more soil disturbance than Alternative 5. This is primarily because Alternative 2 would ground skid more lodgepole pine stands where higher levels of soil compaction are expected. Alternative 2 would also construct seven more miles of temporary roads than Alternative 5; however, where subsoiling occurs on temporary roads, skid trails, and landings, these areas would be in a recovering condition.

Compaction from skid trails and landings within the harvest units would cause localized surface water to route and concentrate. However, this process would only carry water a relatively short distance before less compacted soil is reached where surface runoff would quickly infiltrate. With the typical low stream density and high infiltration of the High Cascade geology, Standards & Guidelines and Best Management Practices for soil protection, maintaining effective groundcover, and no cut buffers on perennial streams, it is very unlikely that surface water from soil compaction would have an effect on the North Umpqua River aquifer or that subsurface water runoff would reach stream channels (see Aquatics section for more information on the aquifer).

A minimum of 65 percent effective ground cover has been prescribed to mitigate both the risk of soil erosion and the need to maintain soil organic matter for long-term site productivity to meet Soil S&G 2. The forest floor typically accounts for seven percent of the nitrogen found in a lodgepole ecosystem and as much as 20 percent in true fir. Loss of nitrogen in these ecosystems would be directly proportional to forest floor consumption (Tiedemann, et al., 2000). The soil processes of aggregate formation/degradation, soil organic matter condensation/complexation and soil organic matter quality determine soil organic matter pool dynamics (Six, et al., 2002).

The combined effect of skid trails, landings, and fuel treatments would potentially expose soil across ten to 14 percent of the entire activity area under the action alternatives (Table 3-43). While limited effects on soil carbon[40] and ground cover would occur, disruption of natural processes such as surface erosion and nutrient cycling would be very limited under the action alternatives. Mastication would increase effective ground cover distribution after logging.

Table 3-43. Summary of Effective Ground Cover Predictions.

Exposed Soil	Alt 1	Alt 2	Alt 5
Harvest and Landings	0 ac	975 ac	731 ac
Fuel treatments	0 ac	250 ac	162 ac
% Exposed Soil from Management	0%	14%	10%
% Effective Groundcover	100%	86%	90%
Exposed soil from a Wildfire	32,000 ac	24,500 ac	24,900 ac
% Exposed Soil from Wildfire	76%	58%	59%

First Order Fire Effects Modeling (FOFEM) and Forest Vegetation Simulator (FVS-FFE) was used to predict the direct effects of fuel loads on the soil resource and smoke emissions from prescribed burns and wildfire. Under Alternative 1, wildfire would expose the soil surface over the burn area by an average of 56 percent (45 to 72 percent) in mixed conifer and 71 percent (60 to 80 percent) in the lodgepole pine stands (Table 3-43). An indirect effect of the surface ash and soil exposed by wildfire would be to warm the soil surface earlier in the spring and release nutrients to the soil. Exposed soil near streams would increase the risk of sediment and nutrient delivery. Sediment delivery would not increase on the flats where water infiltration into the soil remains high. Hydrophobic soil conditions and reduced infiltration would occur locally beneath large

[40] Forest management activities where biomass comes in contact with the soil, such as with mastication and with the use of soil amendments such as charcoal or biosolid application (Lal, 2005), can even increase soil carbon levels. Class A Biosolids refers to a compost by-product of municipal sewage. In Class A biosolids, 99 percent of the pathogens have been killed and it is not considered hazardous. Quality control and application rates are regulated under the direction of Oregon Department of Environmental Quality. A potential opportunity for mitigating ground cover loss on skid trails, temporary roads, and landings to help to capture carbon and improve soil productivity would be the application of Class A biosolids in conjunction with subsoiling. For D-Bug, biosolids are an option, but with limited funding, are unlikely to be used. If funding were available, biosolids would be applied as compost to the soil surface at a rate equivalent to 300 to 400 lb N per acre prior to subsoiling, benefiting soil productivity by slowly releasing nutrients, promoting soil restoration, rapid revegetation, enhanced CO2 sequestration, soil structure, wildlife forage quality (Orton, 2007), and increases to soil carbon (Lal, 2005). The Diamond Lake sewage treatment plant is considering developing a site for drying and composting, potentially making a local source of Class A biosolids available for soil restoration in D-Bug.

wood which can smolder for long periods. Relative to Alternative 1, wildfire effects to ground cover and the soil within treatment areas would potentially decrease by about 22 to 24 percent under the action alternatives.

Ecosystem nitrogen is a key nutrient managed for long-term site productivity. The distribution of nitrogen in the ecosystem varies by stand age, climatic conditions, and the nutrient/moisture holding capacity of the soil. The direct and indirect effects of timber harvest and fuel reduction on long-term site productivity was considered by modeling[41] the potential for nitrogen losses associated with the size and type of the treatments and biomass removal. Alternative 1, retains the most biomass, but carries the highest risk of wildfire effects from severe soil heating and litter consumption. The largest pools of nitrogen are located in the soil (81 to 87 percent) and the forest floor (seven percent lodgepole, 13 percent true fir). Alternatives 2 and 5 would remove biomass, which can reduce the effects of severe soil heating, but also removes nutrients and carbon. A theoretical removal of all other above ground woody material would represent about 6 percent of the total nitrogen pool. The direct effect of nutrient loss would be mitigated by retaining effective ground cover under the action alternatives (Table 3-43). Slash collected for biomass would be retained on site for a winter to allow for needle fall and nutrient leaching before removal. The potential effect for nutrient loss from harvest and fuel treatments would depend on the distribution of the woody material in the forest. The largest portion of nutrients found in the harvested timber would be contained in the new growth found in needles, fine roots, and twigs (Kimmins, 1977).

Over the next forty years, while alternatives 2 and 5 would carry lower crown fire risk within the treated stands, all alternatives retain some level risk of ground fire effects from severely burned soils from wildfire (Table 3-42). This risk is generally highest where there are concentrations of large down woody material that once on fire can carry heat close to the soil for long periods.

Cumulative Effects

The D-Bug planning area has a moderate to high risk of severely burned soils from ground fires on soils that are relatively sensitive to disturbance. All action alternatives are within standards of acceptable disturbance and therefore would not add to past soil impacts that result in adverse cumulative effects to soil.

Cumulatively, considering recent and foreseeable activities (tables 3-1 through 3-3) in the D-Bug planning area, there would be no cumulative effect (positive or negative) to long-term soil productivity. The “worst case” scenario would be an initial increased soil compaction from skid trails, landings, and new temporary road disturbance over nine to 12 percent of the project area (Table 3-43). Subsoiling the temporary roads, skid trails, and landings would mitigate these affects on approximately 600 acres helping to restore soil tilth and hydrologic function (Table 3-43). While the time required for full restoration to pre-disturbance soil conditions would be greater than 5 years, after subsoiling skid trails within 100 feet of landings, landings, and temporary roads, detrimental compaction would only increase by about 1.4 to 2.2 percent from the Alternative 1 over the project’s analysis area and 0.00006 to 0.00012 percent of the planning area.

[41] Biomass distribution was modeled using FS Veg. Nitrogen values were assigned to each component using values from Edmonds, 1989.

CARBON

Carbon is an essential element when considering the potential effects of forest management on long-term soil productivity and contributions to global warming. Forests and forest products play a critical role in the carbon cycle. Down woody material, litter, duff, and soil organic matter are two of the primary factors influencing soil biology, site productivity, and soil development. Impacts to the carbon cycle were analyzed quantitatively to provide a relative comparison between alternatives and actions. The carbon stored in live biomass, dead plant materials, and soil represents the balance between carbon dioxide absorbed from the atmosphere and its release through respiration, decomposition, and burning. Charcoal is a natural bi-product of forest fires and has a long residence time in soils. Over longer time periods (as long as forests exist) they will continue to absorb carbon.

Carbon capture[42] (sequestration) can be defined as the net removal of greenhouse gases (reported here in negative metric kilotons carbon dioxide equivalents[43]) from the atmosphere into long-lived carbon pools. These carbon pools are composed of live and dead aboveground and below ground biomass or wood products. Most soil carbon and available nutrients for plants are retained in the upper 10 inches of forest soils where carbon is in its most stable form. Down woody material and soil organic matter are critical elements to site productivity and soil development. Without substantial disturbance, soil carbon can remain relatively constant or even increase through time (Smith, et al., 2006). Fine roots and mychorrizal fungi activity occur in the top two inches of surface soil where carbon accumulation is highest. Fine root development plays an important role in sequestering soil carbon (Lal, 2005) to improve long-term soil fertility and productivity (Marcot, 2003). Mycorrhizal fungi in turn take up much of the nutrients needed for plant growth. Fungi play a key role in soil ecosystems by integrating the soil carbon and nitrogen cycles. Forest soils that are low in organic matter are also less productive. Mazama ash soils, especially those that are finer textured, can retain some of the highest levels of organic carbon and nitrogen found in western-montane forest soils (Meurisse, et al., 1989). However, in cold climates, plants are very shallow rooting and the soil's carbon is also located close to the surface.

Direct and Indirect Effects

Due to fire exclusion, the lodgepole pine and mixed conifer stands in the D-Bug planning area now carry a higher balance of carbon and nutrients in the vegetation and down wood where they are more exposed to the effects of a prescribed or natural fire than when stored as soil organic matter (Figure 3-23, Table 3-44). The key factor in how any ecosystem will respond after any fire is where the carbon in that system is distributed (Page-Dumroese and Jurgensen, 2006). If the majority of carbon is above ground including the forest floor then more carbon will be lost from the ecosystem after fire. But,

[42] Although most of the capture and release of carbon happens at the molecular scale, management decisions regarding carbon sequestration occur at the stand and landscape levels.

[43] Global warming potential (GWP) is used to convert emissions of non-CO_2 gases into their CO_2 warming equivalents (CO_2eq). The CO_2eq of a non-CO_2 gas is calculated by multiplying the mass of the emissions of the non-CO_2 gas by its GWP, allowing for comparison of the total cumulative warming effects of different greenhouse gases over a specified time period. The warming effect of CO_2 is assigned a value of 1, and the warming effects of other gases are calculated as multiples of this value. GWPs used are for a 100-year time horizon from the IPCC Second Assessment Report (SAR) as updated by the Third Assessment Report (TAR). All GWPs used in this analysis are from the SAR. Emissions calculations relevant to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol are also based on SAR GWPs.

if most of the carbon pool is below ground (as is typical in mixed conifer stands), then less carbon will be lost.

A meta-analysis[44] of 432 temperate forest harvest studies found soil carbon losses on inceptisols' of temperate forests was not permanent as it recovered in 6-20 years following harvest (Naïve, et al., 2009). Because of the colder soil conditions found at D-Bug the recovery of soil organic carbon would be greater than 6-20 years. This study along with more recent work (Page-Dumroese, et al., 2010) show that forest harvest activities that leave the forest floor intact do not reduce soil carbon stocks significant degree (Hover, 2003; Page-Dumroese, et al., 2010).

An indirect effect of Alternative 1 is a higher future level of risk to ecosystem productivity from wildfire (Hatten, et al., 2005) over the next forty years. Under Alternative 1, direct effects to the soil productivity from wildfire would be 5 percent to 6 percent greater than under the action alternatives (Table 3-42). An indirect effect of Alternative 1 would be a 12 percent average increase in potential carbon emissions from wildfire smoke (Figure 3-23) as dead and down timber accumulate due to the beetle kill (Table 3-44).

Table 3-44. Forty-year average Ecosystem carbon distribution from vegetation within the D-Bug planning area. Alternative 1 (Alternative 1) maintains a higher carbon distribution as standing dead snags and down woody material. Alternatives 2 and 5 would maintain a higher distribution of carbon in the live trees, roots, and duff.

ECOSYSTEM CARBON DISTRIBUTION **40-year annual Averages (kilotons CO_2-eq year^{-1})**	**Alternative 1**	**Alternative 2**	**Alternative 5**
Trees	42%	**45%**	**44%**
Snags	**15%**	10%	11%
Shrubs	1%	1%	1%
Down Wood	**18%**	13%	14%
Litter	9%	**13%**	**12%**
Roots	14%	**18%**	**18%**
40-year annual average (kilotonnes CO_2eq)	234	153	172

Under Alternative 1, a wildfire would have a direct effect to long-term soil productivity by potentially consuming greater than 70 percent of the litter and duff layer over a quarter of the burn area, potentially exposing about three-fourths[45] of the soil surface. Under a moderate severity ground fire scenario, depth-of-mortality[46] (60° C) would average approximately 2.5 inches in mixed conifer stands with 70 percent of the litter and duff potentially being consumed over half of the soil surface while depth-of-mortality would average 3 inches in lodgepole pine stands with all of the ground cover consumed over

[44] A meta-analysis combines the results of several studies that address a set of related research hypotheses.
[45] FOFEM results using 6 percent soil moisture and 20 percent duff on SAF-Douglas-fir – western hemlock.
[46] Depth of mortality is the maximum soil depth where temperatures would be expected to reach 60°C causing damage to plant roots.

91 percent of the stand under the same fire scenario. Deeper soil heating and longer burn durations would occur in areas of high fuel concentrations resulting in detrimental effects on soil organic matter due to increased soil loss through erosion in riparian areas (Hatten, et al., 2005) (see Aquatics section). A literature review on the effects of wildfires on soil carbon showed the loss of carbon and organic matter from the surface soil can be substantial and slow to recover (Hover, 2003). Forest practices and fire suppression that maintains intermediate tree survival Prescribed fire prescriptions, on the other hand, are designed to protect surface soil and minimize loss of the forest duff layer. Fuel treatments that reduce the number of small-diameter trees, which act as ladder fuels, reduce emissions and the mortality of large trees (Hurteau and North, 2009). While, increasing the time interval between disturbances would increase intermediate tree survival, when a wildfire disturbance does occur emissions also increase substantially (Hurteau and North, 2009).

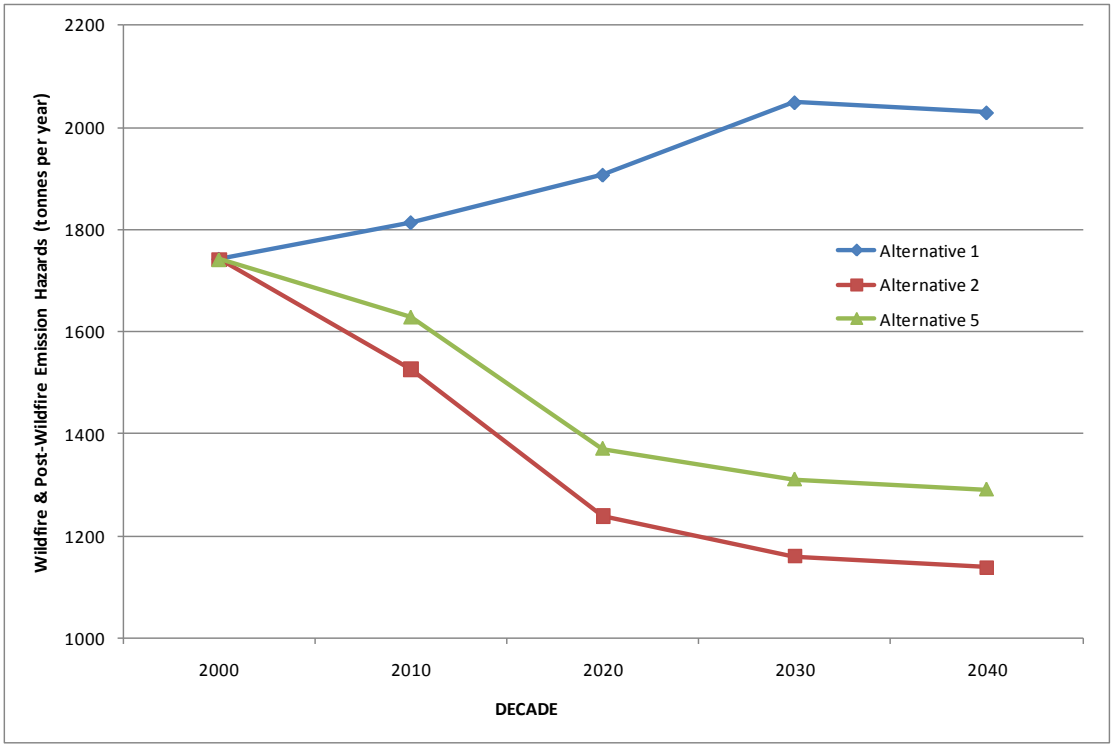


Figure 3-22. Emissions summary of wildfire and post-wildfire47 hazard for each decade over a forty-year period following harvest and fuel treatments. Displayed in metric tons of carbon dioxide equivalents. As wildfire hazard increases, the potential emissions from a fire also increase.

Under Alternative 1, there would be a pulse of beetle-killed lodgepole during which carbon in the forest floor would have a mean residence time of around three years with about 30 percent decomposition occurring during the first year. Most of the large wood would have a residence time of over 80 years with 30 percent decomposition occurring during the first forty years (Edmonds, 1991; Hart and Firestone, 1991). Under Alternative 1, during the first decade, the decay of coarse woody debris could account for as much as a 15 percent increase in CO_2 emission during the first decade. By the fourth decade there could potentially be a three percent increase in total carbon primarily due to

[47] High-intensity, post-wildfire carbon release has been reported to be approximately three times the direct release of CO_2 during the fire event (Hurteau and North, 2009; Auclair and Carter, 1993).

increased lodgepole regeneration and root development (Hart and Firestone, 1991). However, the effect of beetle outbreaks on carbon balance may be underestimated. Studies of large scale beetle outbreaks in Canada recorded CO_2 emissions for a single year equivalent to about 75 percent of the average annual direct forest fire emissions from all of Canada during 1959-1999 (Kurz, et al., 2008). This impact converted the forest from a small net carbon sink to a large net carbon source both during and immediately after the outbreak.

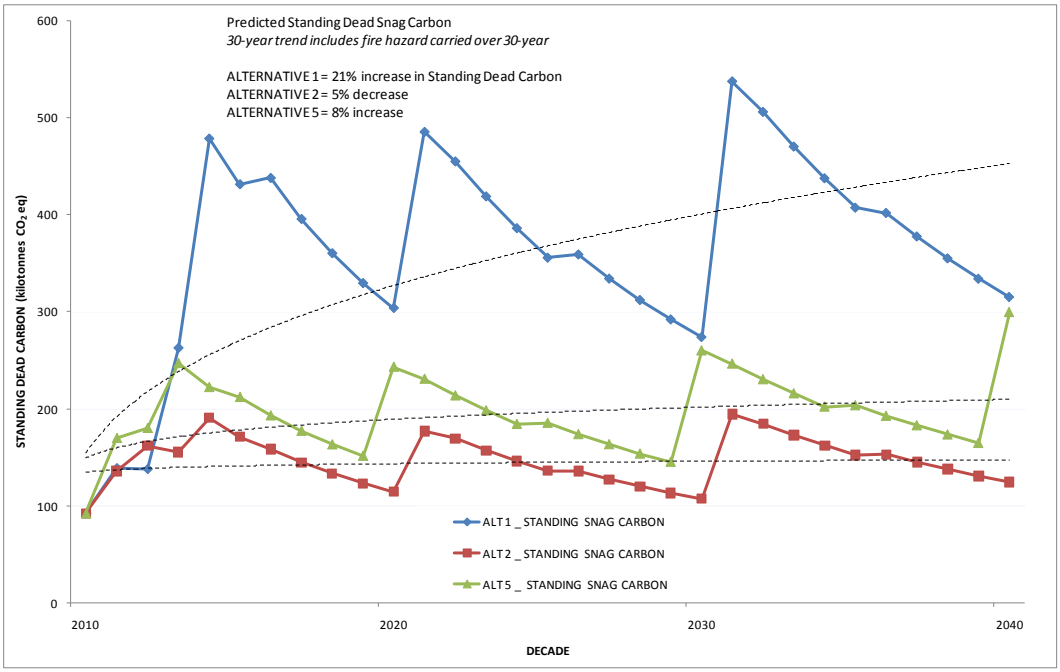


Figure 3-23. Standing dead snag predictions using FFE-FVS for the D-Bug planning area. Considering beetle damage and the average 40-year fire risk, the carbon balance in standing dead snags may potentially increase 21% from the existing condition under Alternative 1 and potentially decrease 5% to 8% under the action alternatives.

The action alternatives include harvest and fuels treatments to reduce future wildfire severity, increase control options for fire managers, and protect human safety and developments. Underburning would be more effective at reducing severity than other treatments such as thinning, crushing or mastication, and handpile burning. While these other treatments reduce burn intensity and rate-of-spread, they would not reduce burn duration and depth of soil heating during a ground or surface fire. Alternative 5 prescribes fire on fewer acres than Alternative 2 and would lose 20 percent less CO_2 through smoke emissions.

Under the action alternatives, carbon loss from exhaust emissions would be an indirect effect of equipment use during logging, fuels reduction road work, log haul, soil restoration, and product milling of biomass/bio fuels (Table 3-45). Alternative 2 would emit 6 percent more carbon dioxide (CO_2eq) from equipment exhaust emissions per thousand board feet than Alternative 5. Carbon emissions during subsoiling operations would be equivalent to 0.47 metric kilotons (0.0118 kiloton per year averaged over 40 years) of carbon dioxide under Alternative 5 and 0.49 kilotons (0.0123 kiloton per year averaged over 40 years) under Alternative 2 (Table 3-45).

Table 3-45. Harvest, Management, and Manufacturing summary of potential carbon emissions from D-Bug treatments. Displayed in metric kilotons of carbon dioxide equivalents per year averaged over 40-years (CO2eq year-1).

Annual Emissions average over forty-years	Alt 1 kilotons CO2	Alt 2 kilotons CO2	Alt 5 kilotons CO2
SMOKE & EXHAUST EMISSIONS			
Road work	0	0.0029	0.0001
Temporary road const. & mitigation	0	0.0028	0.0019
Skid trail & Landing mitigation	0	0.0123	0.0118
Harvest, yard & haul systems	0	0.1324	0.1000
Biomass hazard reduction – exhaust	0	0.0656	0.0559
Biomass hazard reduction – smoke	0	1.2132	1.1938
Post-Biomass hazard - decomposition	0	3.6396	3.5814
Biomass removal & haul – exhaust	0	0.0107	0.0134
Lumber Mill Production	0	0.0004	0.0003
Net 1-year value averaged over 40-years	+0	+5.08	+4.96

Carbon Leakage and Forest Product Substitution

The recommendations from the Intergovernmental Panel on Climate Change (IPCC) to reduce greenhouse gas emissions[48] from forest management includes the replacement of fossil energy sources with sustainably managed sources of biomass, substitution of high energy consuming products with wood, improving technology with regards to the use of fuel wood, and encouraging the recycling of forest products to provide even longer storage for carbon pools.

For the purpose of this document and in response to public comment, substitution considers substituting like materials and like processing with materials outside our local markets. Such an analysis is intended to address “carbon leakage” rather than substitution of high energy consuming products for unavailable an unavailable wood supply. Carbon leakage occurs when there is an increase in carbon dioxide emissions in one country as a result of an emissions reduction by a second country with a strict climate policy.

Carbon leakage may occur for a number of reasons:

1. if the emissions policy of a country raises local costs, then another country with a more relaxed policy may have a trading advantage. If demand for these goods remains the same, production may move offshore to the cheaper country with lower standards, and global emissions would not be reduced.
2. if environmental policies in one country add a premium to certain fuels or commodities, then the demand may decline and their price may fall. Countries that do not place a premium on those items may then take up the demand and use the same supply, negating any benefit.

On most occasions, leakage is understood as having negative effects in terms of emissions increasing outside of domestic emission reduction policies. Long-haul calculations were used as a conservative estimate for potential leakage to offset timber

[48] Greenhouse gas emissions and sequestration from direct, indirect, and connected actions are reported in carbon dioxide equivalents.

not harvested under Alternatives 1 and 5. Under this scenario leakage accounted for 81 metric kilotons of additional emissions under Alternative 1 and 35 kilotons under Alternative 5. The forty year average for this carbon leakage represented an average annual 2 to 1 metric kilotons (Table 3-46).

All action alternatives would result in a negative[49] net carbon balance and would offset through sequestration or energy substitution more greenhouse gases than they emit. Carbon storage in the D-Bug planning area is equivalent to the average annual emissions of 39,000 cars in Oregon (Table 3-46).

Table 3-46. Greenhouse Gas balance summary of direct and indirect effects associated with alternatives and wildfire hazards averaged over a 40-year following harvest and fuel treatments. Displayed in metric kilotons of carbon dioxide equivalents (CO2-eq decade-1). No Action would maintain 10,184 metric kilotons CO2 per decade. Carbon emissions are displayed as positive (+), with carbon storage or capture displayed as negative (-).

Net Annual Emissions (+) and Sequestration (-) averaged over forty-years	Alt 1 kilotons CO_2	Alt 2 kilotons CO_2	Alt 5 kilotons CO_2
EMISSIONS (+)			
Harvest, Mgt., & Manufacturing[50]	+0	+5.08	+4.96
Forest Products Leakage[51]	+0.04	+0	+0.01
Wildfire Hazard[52]	+195	+127	+140
NET Annual Average Emissions	**+195**	**+132**	**+145**
SEQUISTRATION (-) OFFSET			
Forest Carbon Pool (trees to soil)	-234	-153	-172
Forest Products	-0	-0.030	-0.029
RENEWABLE ENERGY (-) OFFSET			
Biomass utilization[53]	-0	-0.020	-0.021
Hog Fuel to Fossil Fuel balance	-0	-0.012	-0.012
NET Avg. Sequestration & Energy	**-234**	**-153**	**-172**
AVERAGE ANNUAL 40-YR GREENHOUSE GAS BALANCE (NET Emissions - NET Offset)	**-39**	**-21**	**-27**
Greenhouse Gas Equiv. (cars/yr)	**-8,286**	**-4,544**	**-5,673**

49 A negative carbon balance is used to represent carbon storage. A positive carbon balance is used to represent carbon emissions.
50 Refer to Table 3-45.
51 Substitution (CO_2 leakage) of like products from a non-local source was estimated by adding in 2,000 miles of long-haul at a rate of 0.2 miles per gal diesel for 2,000 miles or 1.344 tonnes CO_2/mbf.

53 The relative carbon offset of biomass utilization was estimated using the heating value of oil (19.9 metric tons carbon/TJ). Woody feedstock has a heating value 71 percent that of oil. Oil was used as the substitution for bio-fuel.

Net Annual Emissions (+) and Sequestration (-) averaged over forty-years	Alt 1 kilotons CO_2	Alt 2 kilotons CO_2	Alt 5 kilotons CO_2
Change in Greenhouse Gases (cars/year)[54] (% change)		**+3,742 +45%**	**+2,614 +31%**

Utilizing biomass (including logging slash) would greatly reduce smoke emissions of carbon from prescribed fires (13 to 15 metric kilotons) while providing a renewable source of energy. However, a balance needs to be made between the amount of down woody material removed as biomass with the amount remaining on-site. Excessive removal, especially in the pure lodgepole pine habitat, would decrease soil carbon creating a carbon debt that would require time to replace (Mitchell, et al., 2009; Ingerson, 2009). Lengthening the period between harvests would help mitigate the affect of carbon loss to the soil. At the same time, the potential to increase carbon storage in forests needs to be weighed against the projected increases in disturbance promoted by a changing climate that would lower carbon storage. This is especially true in the pure lodgepole pine where, because of cold climatic conditions, the largest apportionments of total carbon are above or close to the soil surface available to a wildfire (Table 3-44). Where bio-fuel projects are implemented, bio-char the by-product of bio-fuel production, would be applied to areas where the feedstocks for the bio-fuel project originated to replace the above ground carbon being removed (Draft Wildland Forest Soil Carbon Management, April 2010, Washington Office memo).

New and developing technologies that have potential for reducing carbon emissions, sequestering carbon, and providing renewable energy are being developed and would become more cost effective over time. One such opportunity may be sustainable forest bioenergy production using in-woods fast-pyrolysis conversion including bio-oil production and bio-char incorporation[55]. Should the technology become cost-effective, such wood fiber utilization may occur utilizing the 9 biomass collection landings identified under the action alternatives. This could potentially generate as much as 1,000 gallons of bio-oil[56], 40,000 cubic feet of bio-gas (used to run the plant), and 102 metric tons of charcoal per acre of slash treatment in the non-merchantable lodgepole pine stands which have an average value of nine dry U.S. tons per acre of available biomass. The charcoal (bio-char) from this process could be added to the soil to sequester carbon (1.8 metric tons CO_2 per acre slash treated) where it would become biologically active. As the word looks to reduce the use of hydrocarbons for transportation and develop off-set strategies to reduce carbon footprints, adding biochar to forest soils would be a long-term means to sequestering carbon. Bio-char reacts similarly as charcoal produced during wildfire by enhancing water holding capacity and nutrient retention. Bio-char

[54] Greenhouse Gas Savings was calculated in gallons of gasoline consumed for a 2008 Ford Taurus with a rating of 28 mpg highway and average CO_2 emissions of 0.8506 lbs CO_2/mi or 0.4286 lbs CO_2/gallon of gasoline consumed. [http://www.terrapass.com/carbon-footprint-calculator]. 15,000 miles per car was used as the average annual miles per car in Oregon.

[55] A proposal was submitted May 2008 in cooperation with the University of Idaho, University of Montana, the Umpqua Nat'l For., and Renewable Oil International, LLC for funding to investigate the economic feasibility of in-woods biomass pyrolysis compared to a fixed centralized processing unit.

[56] The heating potential of bio-oil (75,500 BTU/gal) is 90 percent that of Ethanol (84,000 BTU/gal).

would not add nutrients to the soil, but it can improve the nutrient retention and exchange. Under Alternatives 2 and 5, the amount of carbon that could be sequestered to the soil through bio-char would potentially be equivalent to offsetting the annual emissions generated from 2,300 to 2,800 cars on Oregon's highways. The potential bio-oil output from this project could provide renewable fuel equivalent to powering two cars over forty years. Fast-pyrolysis would have limited direct, indirect, or cumulative effects, since the material being used would already exist at landings, and the operation would use the existing biomass to generate its own power. Moreover, no sediment delivery is possible from the processing of bio-fuels because the landings would all be located on flat ground well away from streams. There would be little, if any, carbon or particulate emissions from the bio-oil and bio-fuel production.

Table 3-47. Potential Greenhouse Gas saving from future technologies. Alternative methods of reducing currently non-merchantable slash to reduce fire hazard such as Fast-pyrolysis, biomass utilization, or supplying teepee poles have the potential for increasing the green-house gas savings of this project.

Emissions average over 40-years	**Alt 1 kilotons CO2**	**Alt 2 kilotons CO2**	**Alt 5 kilotons CO2**
Potential CO2 substitution and sequestration			
Biomass utilization	-0	-31	-28
Fast-pyrolysis	-0	-0.014	-0.012
Bio-oil	-0	-13	-11
Fast-pyrolysis Bio-char			
NET Decade Average	-0	-0.8 to -13	-0.83 to --11

Cumulative Effects

Alternative 1 maintains the largest annual carbon balance of the three alternatives. The amount of carbon stored under Alternative 1 averaged annually over forty-years would be equivalent to the annual carbon emitted by about 8,300 cars in Oregon (Table 3-46). Alternatives 2 and 5, would maintain carbon storage equivalent to the annual emissions of about 4,500-5,700 cars. Alternative 1 would potentially retain 32 to 45 percent more carbon over the next forty years than either action. However, alternative methods of treating and utilizing the currently non-merchantable slash such as fast-pyrolysis, biomass utilization, and even supplying teepee poles may potentially reduce this disparity to 25 to 38 percent of Alternative 1. While Alternative 1 would potentially retain a higher carbon balance over forty years it also would retain a greater hazard to public safety from wildfire, would not provide a renewable forest product source, nor provide biomass for renewable energy. Even with these tradeoffs, all alternatives would meet standards and guidelines for long-term soil productivity by maintaining carbon in the form of ground cover and large wood.

CLIMATE CHANGE

Ongoing climate change research has been summarized in reports by the United Nations Intergovernmental Panel on Climate Change (IPCC), U.S. Climate Change Science Program's of Science Synthesis and Assessment Products and the US Global Change Research Program. These reports concluded that climate is already changing; that the change would accelerate; and that human related greenhouse gas emissions are the main source of accelerated climate change.

Carbon dioxide remains in the atmosphere for more than 100 years. Analysis of carbon dioxide in Antarctic ice suggests that at no point in the past 650,000 years did levels approach today's carbon dioxide concentrations (Ryan, et al., 2010). Human-caused warming over the last three decades has likely had a discernible influence at the global scale on observed changes in many physical and biological systems[57].

Effects of Climate Change on the Project Area

Projected effects of future climate change to the D-Bug Planning area include (BASC 2010; Ryan, et al., 2010):

- Increased forest growth in colder environments;
- Decreased forest growth in warmer climates;
- Water availability would decrease where rivers are fed by glaciers or snowpack;
- Earlier aquifer recharge with earlier baseflow discharge to streams
- Increased insect outbreaks
- Increased danger of wildfire

These predicted warmer average temperatures combined with an increased and longer duration insect outbreak would continue to add environmental stresses to the watershed. (USDA Forest Service, May 2010). Due to a history of fire exclusion, the lodgepole pine and mixed conifer stands in the area now carry a higher balance of carbon and nutrients in the vegetation and down wood where they are more exposed to the effects of wildfire than when stored as soil organic matter. Infested stands would likely suffer as much as 90 percent mortality of the overstory lodgepole pines and may also lose portions of any ponderosa, western white, or white bark pines that they contain (Goheen and Bridewater, 2007). This mortality would contribute additional surface fuel to the watershed.

As forest carbon storage increases, there is a potential for greater loss of carbon stores from forest fires, insect outbreaks, and ice storms. Climate change threatens to amplify these risks by increasing the frequency of these disturbances. As climate change increases the frequency of disturbance, many forests could release substantial amounts of carbon to the atmosphere over the next 50-100 years. Climate change could also increase soil decomposition, leading to carbon losses from a part of the ecosystem that we consider to be relatively stable. At the landscape level over the long term, disturbance would not cause a net loss of forest carbon as long as the forest regenerates. But if the frequency and/or severity of fire disturbance increase substantially, long-term carbon storage at the landscape scale would be reduced because the fraction of the landscape with large older trees (that have high carbon stores) would decline (Ryan, et al., 2010). Although the concept of restoring forests in the west to some pre-settle target may not be feasible as the climate changes, reducing fire severity and increasing and stabilizing tree-based carbon storage may be achieved with fuel managements that promote low-density, large pine dominated structures (Hurteau and North, 2009).

Groundwater-dominated watersheds such as the D-Bug planning area are somewhat buffered from <2-year fluctuations in precipitation, but are susceptible to prolonged droughts or wet periods. Snowpack is also more sensitive than discharge to climate changes in these ground-water dominated watersheds. Regional warming of the past

[57] United Nations Intergovernmental Panel on Climate Change (IPCC). 2007, Climate change 2007: Synthesis report, summary for policymakers.

several decades has affected the shape of the annual hydrograph, with the temporal center (mid-point of total annual streamflow) of the hydrograph occurring earlier in the season and reduction of minimum flows (Jefferson, et al., 2006; Tague, et al., 2008). Continued warming is predicted to lead to loss of snowpack and continued decline in minimum flows.

The action alternatives would allow more snow to accumulate in some small openings due to the reduction in canopy; however snowpacks are projected to be greater under the no-action alternative due to continued loss of canopy due to the beetle spread and potential wildfire. Young stands use more water which could offset any increases in minimum streamflows due to canopy loss.

Most recent studies on the interaction between climate change and invasive plants conclude that climate change is likely to favor invasive plant species to the detriment of native plant species for individual ecosystems (Chornesky, et al., 2005; Climate Change Science Program, 2008; Dukes and Mooney, 1999; Hellmann, et al., 2008; Pyke, et al., 2008). In some studies, invasive plant species have demonstrated increased growth rates, size, seed production, and carbon content in the presence of elevated CO_2 levels (Rogers, et al., 2008; Rogers, et al., 2005; Smith, et al., 2000; Ziska, 2003). Warming climates may remove elevational barriers to invasive plant distribution that currently exist (Tausch, 2008).

Many invasive plants are species that can thrive in the presence of disturbance and other environmental stressors, have broad climatic tolerances, large geographic ranges, and possess other characteristics that facilitate rapid range shifts. The predicted changes in climate are thought to contribute additional stressors on ecosystems, including those on National Forests, making them more susceptible to invasion and establishment of invasive plant species (Joyce, et al., 2008).

Predicted conditions may also make management of invasive species more difficult. Some current treatments used on invasive plants may be less effective under conditions of climate change scenarios and/or elevated CO_2 (Hellmann, et al., 2008; Pike, et al., 2008; Ziska, Faulkner, and Lydon, 2004).

Predicting how climate change would affect invasive plants, and invasive plant management, at the local or even regional scale is more difficult to deduce than are these general indications. Anticipated changes in the climate for the Pacific Northwest (e.g., more rain, less snow, warmer temperatures) or elevated CO_2 may not be realized at a local area, particularly within the time frame of this analysis (Mote 2004; Mote, et al., 1999; National Assessment Synthesis Team, 2000). Growth of invasive plants under elevated CO_2 conditions would also be influenced by environmental conditions such as soil moisture, nutrient availability, and the plant community in which the invasive species occurs (Cipollini, Drake and Whigham, 1993; Curtis, Drake, and Whigham, 1989; Dukes and Mooney, 1999; Johnson, et al., 1993; Taylor and Potvin, 1997). The complex interaction of multiple and uncertain variables make site-specific predictions speculative.

Effects of the Project Area on Climate Change

Currently, there are no Federal statutes, regulatory standards, or policy direction on the significance of such effects on which to weigh the alternatives (Stein, 2010). As greenhouse gas emissions are integrated across the global atmosphere, it is not possible to determine the cumulative impact on global climate from emissions associated with the D-Bug alternatives (Climate Change Considerations in Project Level NEPA Analysis, January 13, 2009, WO memo).

Strategies that combine increased use of forest products to offset fossil fuel use (such as use of biomass energy and substitution), in conjunction with increasing carbon storage on the forest landscape (such as bio-char retention in place of slash burning), are likely to produce the most sustainable forest carbon benefits (Ryan, et al., 2010).

Aquatic Environment

The proposed action and its relationship to the aquatic environment were assessed during the scoping process. Concerns were raised over impacts of new temporary road construction and the reconstruction and use of existing snow trails as timber haul routes. This road issue was addressed in the development of Alternative 5, and the effects related to this issue are disclosed in this section and under the Terrestrial and Social Environments.

This aquatic analysis focuses on how the D-Bug alternatives affect riparian and aquatic physical and biological processes at various scales. This includes site specific disclosure at the scale of individual streams or thinning units and at various larger scales including the Diamond Lake, Lemolo Lake, and Clearwater watersheds58 (Figure 3-24).

The compatibility with the objectives of the Aquatic Conservation Strategy in the Northwest Forest Plan (ACS) is discussed in this section of Chapter 3 and under the headings of Forest Vegetation and Unique Habitats in the Terrestrial Environment section of this Chapter. The results of watershed analysis are presented, a description of the existing condition of the important physical and biological components of the ACS are discussed, and conclusions are presented regarding how the alternatives move conditions toward desired conditions in terms of all nine ACS objectives which include:

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.
2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.
3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.
4. Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.
5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.

[58] A “watershed” is a subdivision of land that is based on hydrologic drainage and defined by a national hierarchical system, which delineates hydrologic drainage in nested multi-level subdivisions (FGDC, 2004). The watershed level subdivides the “sub-basin” level (4th level). The 5th level watershed is subdivided by smaller subwatersheds (6th level).

6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.
7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.
8. Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.
9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.

BENEFICIAL USES OF WATER

To meet the Clean Water Act and standards and guidelines in the Umpqua National Forest Land and Resource Management Plan (LRMP), the beneficial uses of waters must be identified and management activities planned so they would not interfere with or be injurious to the beneficial uses of adjacent and downstream waters. The relevant beneficial uses of the North Umpqua River and planning area tributaries, including Lemolo and Diamond lakes as determined by Oregon Department of Environmental Quality (ODEQ) are: 1) public and private domestic water supply; 2) industrial water supply; 3) irrigation; 4) livestock watering; 5) resident fish and aquatic life; 6) wildlife and hunting; 7) fishing; 8) water contact recreation; and 9) aesthetic quality (ODEQ, 2003).

Relevant Standards and Guidelines

The relevant standard and guidelines from the Umpqua LRMP related to water quality include:

Water quality/riparian area S&G 1: All effective shading vegetation would be maintained on perennial streams unless a site-specific assessment shows that shade removal will not result in water temperature increase or degrade aquatic habitat.

Water quality/riparian area S&G 5: Streams would be designated for protection on timber sale maps (e.g.; Timber Sale Contract provision B6.5).

Water quality/riparian area S&G 12: The application of best management practices (BMPs) for the protection of water quality and beneficial uses (e.g.; fish habitat or potable water) would be monitored where ground disturbing activities occur.

Watershed cumulative effects and water quality, S&G 1: The beneficial uses of water must be identified and management activities planned so they would not interfere with or be injurious to the beneficial uses of adjacent and downstream waters.

Watershed cumulative effects and water quality S&G 2: Beneficial uses of water and aquatic habitats would not be degraded by turbidity, sediment, or scoured stream channels caused by timber harvest, road construction, and related activities.

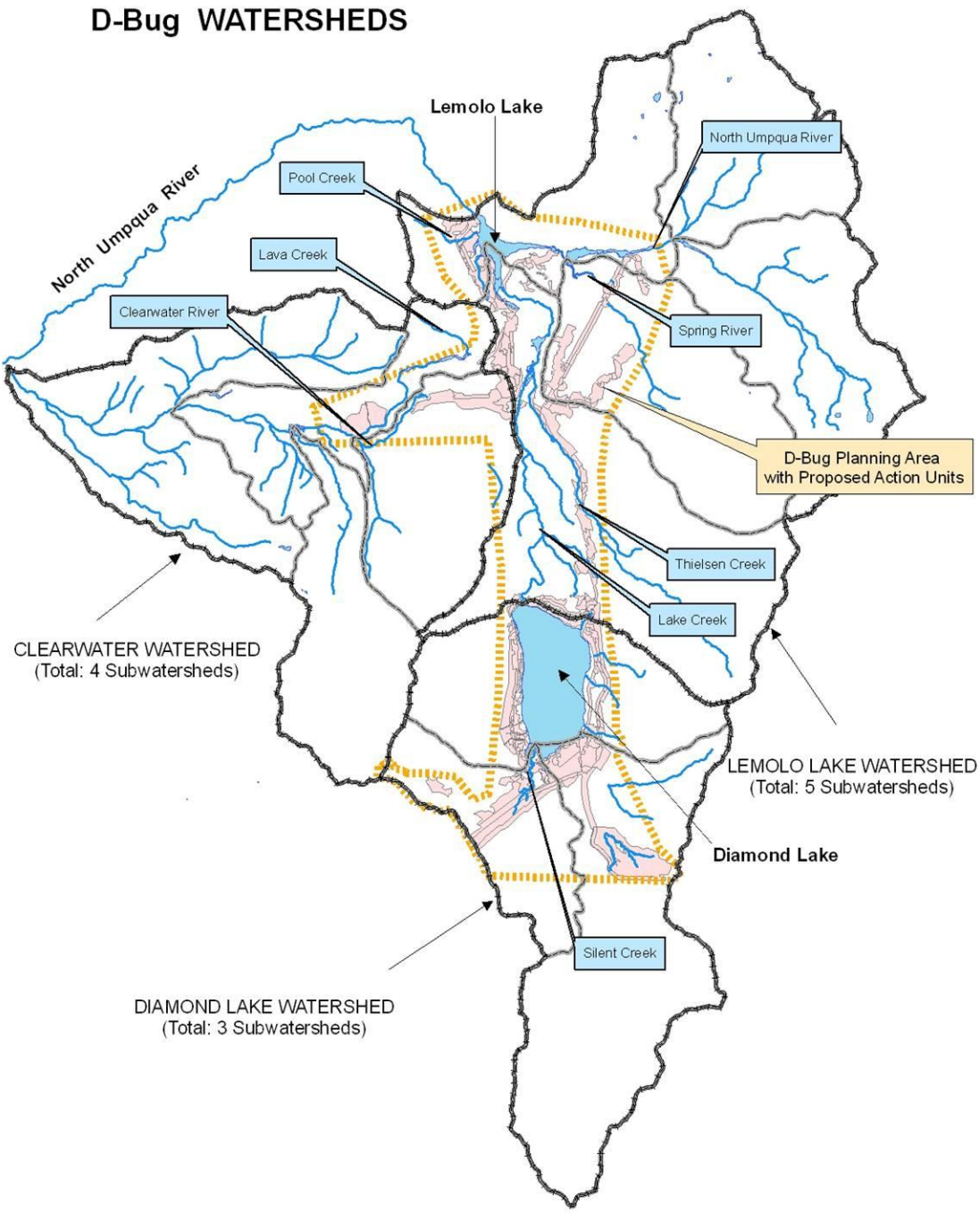


Figure 3-24. The three watersheds and eight subwatersheds that subdivide the D-Bug Planning Area with the Proposed Action Units.

The D-Bug planning area is located in three watersheds that include eight subwatersheds, which together encompasses about 114,493 acres. Table 3-48 displays the total acreages of these watersheds and subwatersheds that include D-Bug activities. The North Umpqua River is the primary stream that drains into and from the planning area.

Table 3-48. Summary of 5th Level Watersheds and 6th Level Subwatersheds that include the D-Bug Planning Area.

Watershed Name 5th Level	Subwatershed Name 6th Level	Area (acres)	Stream Density (miles/square mile)	Fish Bearing Stream Miles (miles-Class II)
Clearwater		49,680*		
	Clearwater River Headwaters	11,324	0.6	7
	Stump Lake	9,404	1.9	14
Lemolo Lake		76,706*		
	Lake Creek	23,543	1.1	17
	Thirsty Creek	15,320	1.0	0
	Lemolo Reservoir	11,926	1.8	8
Diamond Lake		42,976*		
	Diamond Lake South	21,621	0.7	0
	Silent Creek	7,994	0.5	1
	Diamond Lake	13,361	0.5	0
Subwatershed Totals:		114,493	---	47

* Acreage for total watershed, which includes other subwatersheds not in the D-Bug planning area.

Note: D-Bug planning area is dispersed across the above eight subwatersheds located in Clearwater, Lemolo Lake, and Diamond Lake watersheds.

Watershed Analysis Recommendations

The 1996 Upper Clearwater River and 1998 Diamond Lake/Lemolo Lake watershed analyses recommendations relevant to the D-Bug planning area include the following:

•Apply silvicultural programs to restore large conifers in Riparian Reserves if the need and treatment are consistent with the Aquatic Conservation Strategy.

•Prescribed fire for ecosystem maintenance and restoration should be allowed to burn within riparian reserves as fire did historically.

WATER QUALITY

Existing Conditions

The Diamond Lake/Lemolo Lake and Upper Clearwater watershed analyses (USDA, Umpqua National Forest, 1996 and 1998) both characterize the overall perennial stream temperature as cool because of groundwater influence. The exception is Lake Creek. Since Lake Creek originates from the warmer surface water of Diamond Lake, summer stream temperatures are warmer than the typical High Cascade streams that are influenced by groundwater through seeps and springs. Lake Creek maximum summer water temperatures near the Diamond Lake outlet closely parallel summer daytime air temperatures. However, over the length of Lake Creek, from Diamond Lake to Lemolo Reservoir, additions of cool groundwater, as well as tributary inflow, help to reduce stream temperature. The maximum summer temperature for the mouth of Lake Creek at Lemolo Reservoir is about 10°F cooler than at the outlet by Diamond Lake (USDA, 1998). Riparian and topographic shade also contributes to the downstream cooling in Lake Creek.

Vegetation disturbance from timber harvest, road construction, and recreational management activities has been limited along Lake Creek over the past 60 years (USDA, 1998). Because of this atypical stream heating and little disturbance of the stream shade, the current water temperature profile in Lake Creek is likely similar to pre-management activity. If any change has occurred, temperatures are likely to have improved since the 1940s, when sheep grazing ended.

Water rights for drinking water within the planning area are protected through the federal Safe Drinking Water Act (SDWA). The 1996 Amendments to the federal Safe Drinking Water Act provided new resources for drinking water protection. The lead state agencies implementing SDWA are Oregon's Department of Environmental Quality (DEQ) and Department of Human Services (DHS). As a result, DEQ and DHS have delineated the groundwater and surface water source areas which supply public water systems across Oregon, inventoried each of those areas to determine potential sources of contamination, and determined the most susceptible areas at risk for contamination.

The Diamond Lake Lodge/Resort uses springs for drinking water within the D-Bug planning area. Both the springs and the spring source area or the groundwater recharge zone are located within the planning area. DHS and DEQ completed a source water assessment report for this drinking water use in April, 2004 (DHS and DEQ, 2004). The report identified that under a "worst-case" scenario the two potential contaminant sources within the groundwater source area are managed forest lands and Highway 138. To reduce the potential of future drinking water contamination, the report recommended that DHS setback standards be applied. A setback of 100 feet from the spring would be relevant to this site. The report also states that "environmental contamination is not likely when contaminants are used and managed properly" along with Best Management Practices that are associated with the potential contaminant sources.

Nutrients (phosphorus and nitrogen) in planning area streams and bodies of water are naturally influenced by the High Cascade geology. The volcanic soils and bedrock in the upper North Umpqua sub-basin are relatively high in phosphorus and consequently most streams, bodies of water, and groundwater have high phosphorus concentrations. These nutrients can be utilized by algae, which in turn, can influence the water pH and

dissolved oxygen (DO). When this occurs, the pH and dissolved oxygen levels can have extreme daily swings in response to algal metabolic processes.

The water quality history of Diamond Lake has been influence by the introduction of fish. The lake was naturally a fishless lake. In the early 20th century, the Oregon Department of Fish and Game began stocking the lake with trout and managing it as a recreational trout fishery. Tui chub were inadvertently introduced to the lake in the mid-1940s. The tui chub overpopulated the lake and degraded the fishery and water quality. The Oregon Department of Fish and Game treated the lake with rotenone in 1954 and later restocked with trout. Following the treatment, a thriving fishery was maintained for several decades. However, the tui chub was found again in the lake in the early 1990s. In 2001, the lake experienced large blue-green algae (cyanobacteria) blooms. The chub again overpopulated the lake and dramatically impacted the recreational fishery and water quality, changing the lake's nutrient cycling. The lake was drawn down and treated again with rotenone in the fall of 2006.

The Oregon Department of Environmental Quality (ODEQ) has identified water quality impaired streams and bodies of water throughout the State of Oregon as required by the Clean Water Act, Section 303(d). The water quality listings for the D-Bug planning area are summarized in Table 3-49.

Lake Creek was first identified as water quality impaired in 1998 for elevated water temperatures. It was later updated to recognize a year around temperature impairment and elevated pH. Both temperature and pH are influenced by the water quality of the outflow from Diamond Lake.

Diamond Lake was identified as water quality impaired and listed for pH and aquatic weeds/algae in 1998, and dissolved oxygen was added in 2004. For dissolved oxygen, pH, and aquatic weeds, resident fish and aquatic life are the most sensitive beneficial uses that occur in Diamond Lake and downstream in Lake Creek (ODEQ, 2006). Lemolo Reservoir was also listed in 1998 for elevated summer pH.

The water quality modeling for the Diamond Lake Total Maximum Daily Load[59] (ODEQ, 2006) in 2002 showed that inputs of nitrogen (N) and phosphorus (P) are largely natural. This is in agreement with a previous study of Diamond Lake from 1972-1977 by the US EPA (1978). The TMDL modeling results helped to determine that both nitrogen and phosphorus are, however, "pollutants" of concern within Diamond Lake. The introduction of tui chub and subsequent population explosion changed the lake biology, which had dramatic consequences on nutrient cycling within the lake, which ultimately led to algae blooms, high pH values, and reduced dissolved oxygen levels (DO). The modeling also indicated that it was necessary to remove the tui chub in order to meet quality standards. Since the rotenone treatment of 2006, the water quality parameters of pH, dissolved oxygen, and aquatic weeds/algae have improved.

An Umpqua Basin TMDL was approved in 2007. For stream temperature, no increase was allocated. For nutrients, allocations for nitrogen and phosphorus are focused on internal lake loads in order to limit the blue-green algae production, since the loads from management activities in the watershed do not approach the loads that can be generated from internal lake processes. As such, external watershed inputs from projects such as D-Bug are allocated to approximate natural background levels (ODEQ,

[59] A Total Maximum Daily Load (TMDL) is the calculated amount of pollutant a water body can receive and still meet Oregon water quality standards.

2006). The pH and dissolved oxygen allocations are also linked to the same internal lake process.

The Lemolo Reservoir was listed for pH in 1998. However, the reservoir was delisted as part of the 2004 303(d) assessment under an exemption from numeric criteria, which is defined in Oregon Administrative Rules. ODEQ evaluated the reservoir pH condition in the 401 water quality certification process[60] for the North Umpqua Hydroelectric Project and found that the reservoir geometry and the general inherent nature of the impoundment create conditions conducive to increased pH. In summary, ODEQ's findings state that the reservoir "qualifies for the exemption to the hydrogen ion concentration (pH) water quality standard" with reasonable assurance that the standard will be met through "Protection, Mitigation, and Enhancement measures" in the operation of the reservoir. These measures "include each practicable pH control technique known" at the time of hydropower evaluation (DEQ, 2002). Consequently, thinning projects similar to D-Bug would not influence the physical reservoir condition, influence the elevated pH levels, or likely contribute nutrients (see effects discussion).

Table 3-49. Water Quality Listings in the D-Bug Planning Area.

Waterbody Name	River Mile	Parameter	Season	List Date	Status
Lake Creek	0 to 11.5	Temperature	Year Around (Non-spawning)	2004-06 (update)	Addressed by Umpqua Basin TMDL
Lake Creek	0 to 11.5	pH	Summer	2004-06 (update)	Addressed by Umpqua Basin TMDL
Diamond Lake	0 to 3.7	Dissolved Oxygen	Summer	2004-06 (update)	Addressed by Umpqua Basin TMDL
Diamond Lake	0 to 3.7	pH	Year Around	2004-06 (update)	Addressed by Umpqua Basin TMDL
Diamond Lake	0 to 3.7	Aquatic Weeds or Algae	Undefined	2004-06 (update)	Addressed by Umpqua Basin TMDL

Direct and Indirect Effects

Direct effects in the context of water quality are those that would occur in planning area streams or bodies of water within a unit. Direct effects are triggered immediately as a result of the D-Bug alternatives. Indirect effects are those that could either occur later in time or downstream of a unit at the drainage or larger scale.

Alternative 1 would result in no direct or indirect effects to water quality, since no riparian trees would be cut along perennial streams that could affect stream shade and influence stream temperature, pH, or dissolved oxygen. No ground disturbing activities would occur that would accelerate sediment delivery and attached nutrients, reduce water

[60] 401 water quality certification is identified in the Federal Clean Water Act and is the mechanism by which the State of Oregon evaluates whether an activity may proceed and meet water quality standards.

clarity, or impact groundwater quality or quantity. However, over the long-term, water quality could potentially decrease as a result of Alternative 1 if the expanding mountain pine beetle infestation area experienced a stand replacement wildfire in large portions of the planning area. In this case, canopy closure would be lost allowing increased solar radiation to affect stream temperatures and large-scale release of abnormal levels of nutrients, which could stimulate algae growth, elevate pH, and reduce dissolved oxygen. There is more of a likelihood of such a crown-type wildfire moving through the Wildland Urban Interface in the planning area under Alternative 1 than under the action alternatives due to higher fuel levels and limited fuelbreaks compared to the action alternatives (see Fuels section).

Alternatives 2 and 5 would not have a direct or indirect effect on stream temperature. The action alternatives would thin within riparian reserves, while retaining the effective shade in the primary stream shade zone along perennial streams as described in the "Northwest Forest Plan Temperature TMDL Implementation Strategies" (USDA/USDI, 2009). Best Management Practices including primary shade protection, stream course identification, limited operation near streams, and directional falling where applicable, would ensure protection of perennial stream shade. The riparian reserve thinning would improve overall health and vigor of the riparian trees, further protecting water quality consistent with recommendations in the Watershed Analysis. Therefore, the action alternatives would meet the water quality/riparian area Standard and Guideline 1. Streams within and adjacent to thinning units would be identified with applicable protection, which meets water quality Standard and Guideline 5.

Studies of potential nutrient release from harvest and fuel treatments have been focused on clear-cut harvest and fuels treatment such as broadcast burning. While clear-cut harvesting can release nitrogen that potentially would leach to adjacent surface waters during runoff periods (Brown, 1972 and 1973; Sollins, et al., 1980; Sollins and McCorison, 1981; Harr and Fredriksen, 1988; MacDonald, et al., 1991; Beschta, et al., 1995), thinning treatments typically do not result in nitrogen delivery to streams. Nitrogen leaching to surface water is directly proportional to harvest extent (clear-cut versus thinning) (Prescott, 2002; Lindo and Visser, 2003). Thinning, compared to the creation of openings, reduces the likelihood of nitrogen losses to the soil and losses to the local streams. The process of organic nitrogen (e.g., limbs, bark, needles) converting to available and mobile nitrogen in the soil profile is limited by the cool climate of the D-Bug planning area. The heaviest harvest prescription under the action alternatives (Alternative 2 at 59 acres) would likely elevate mobile nitrogen at the site scale in the surface soil, but would not move off the site or leach into streams. This is because of the limited amount of released nitrogen that would be utilized on-site by microbial activity in the soil or taken up and used by the smaller residual trees (MacDonald, et al., 1991).

The low stream density (Table 3-48) further reduces the likelihood of mobile nitrogen reaching surface water. Nutrient input to the planning area streams, Diamond Lake, Lemolo Reservoir, and further downstream would remain at background levels as before treatment for all the action alternatives resulting in no direct or indirect effects and therefore consistent with the 2007 Umpqua Basin TMDL.

Dissolved oxygen (DO) and pH would not be affected by the action alternatives. According to the Umpqua Basin TMDL (ODEQ, 2006), Diamond Lake's high pH and low DO levels were a result of changes in the internal lake loading of nitrogen and phosphorus, not external nutrient loading from the watershed. The internal lake nutrient output is also the source of the pH problem in Lake Creek. The Diamond Lake water

quality recovery that has been observed since 2006 would likely continue and the action alternatives would not hinder the progress. Therefore, the action alternatives would not result in higher nutrient input to Diamond Lake, Lemolo Reservoir, or planning area streams that would affect DO or pH.

The small amount of underburning activity fuels within riparian reserves of both streams and lakes would not impact the overall effective shade along perennial streams, but would allow natural ecosystem maintenance and restoration that fire did historically (Watershed Analysis Recommendation 2). Under both alternatives 2 and 5 approximately four acres within the riparian reserves would be underburned.

Although the underburning would potentially release nitrogen to the soil, the mobile nitrogen would remain local in the upper soil layer (Monleon, et al., 1997) and would return to unburned levels within one season. Site-released nitrogen would be utilized by microbial activity and/or understory vegetation. Since prescribed fire would not consume large amounts of organic matter (carbon), the surface carbon would help to “hold” fire-released nitrogen at the site (Brady, 1990). Organic matter has been found to regulate nitrogen mobility in the soil by encouraging microorganism uptake of nitrogen (Stark and Hart, 1999; Prescott, et al., 2003; Prescott, 2002). Therefore, any release of nitrogen associated with underburning would not be expected to impact water quality at the site or downstream.

The construction of temporary roads under Alternative 2 would address ongoing turbidity sources and associated nutrient input at the stream crossings on two temporary roads. Alternative 5 would only require one new temporary stream crossing. Reconstruction of a road crossing on the 4795-300 road would also occur under both action alternatives. All of the crossings are on intermittent snowmelt runoff channels and located in gentle landscapes. The reconstruction of the crossings on intermittent channels are the only floodplain ‘occupancy’ that would occur through the action alternatives. The environmental effects of road reconstruction within a floodplain are consistent with the Standards and Guidelines for the LRMP and have been evaluated and declared in the Final EIS for the LRMP (1990). Since the activities in this project follow those Standards and Guidelines, this activity will not be declared separately for this project.

Under both action alternatives a temporary crossing would be required at an existing ford near the summer homes. This site would deliver concentrated runoff and sediment from the road into Diamond Lake. Under Alternative 2 a second crossing would be required over a wider and more incised channel on a temporary road in Unit 73. This channel goes subsurface downstream and does not connect to another stream or to Diamond Lake.

The reconstruction of road 4795-300 crossing under both the action alternatives involves the replacement of a wooden culvert, which would not support log haul without reconstruction. Downstream of this crossing, the stream flows into a wetland along Silent Creek.

The use of Best Management Practices and project design features (see Chapter 2) for the reconstruction and removal of temporary crossings, including timing of in-stream work and erosion control measures, would minimize water quality effects at the immediate work site and downstream through the following winter seasons (water quality/riparian area S&G 12). All the action alternatives would contribute to turbid water with potential sediment-bearing nutrient release. However, the predicted sediment delivery is relatively small (Table 3-51). This water quality impact would occur after the in-stream work because of the dry channel condition at the time of work. The indirect

effects (turbid water and nutrient release) in response to snowmelt runoff and rain would be short-term (one to three seasons) during the wet season and difficult to discern from background runoff. These water quality effects would lessen over time as mitigation measures (erosion control) become effective with time (by the second season).

Although Alternative 1 would not have the in-stream work effects, the potential long-term direct and indirect erosion and nutrient release effects at these crossings from chronic road drainage problems would not be corrected. Over the long-term (by the third season), the action alternatives would correct minor chronic road drainage problems, providing a small benefiting water quality trend while Alternative 1 would not (Table 3-51).

All of the action alternative would operate on about four percent of the 979 acre groundwater source area for the Diamond Lake Lodge/Resort. A setback or buffer around the spring area of at least 100 feet would be applied under all action alternatives. Public water system Best Management Practices for protection from sanitary hazards that are identified in the Oregon Administrative Rules (Chapter 333, Division 061) and relevant to this setting would also be applied. These Best Management Practices (see Chapter 2), along with compaction BMPs, were discussed with DHS (personal communication, DHS, 2008) to ensure the protection of this drinking water system. Therefore, no direct or indirect effects to the Diamond Lake Lodge/Resort drinking water are expected from the action alternatives.

Cumulative Effects

Alternative 1 would result in no direct or indirect effects to water temperature, nutrients, pH, DO, or turbidity to incrementally add to possible downstream heating, algae responses, or stream turbidity due to past, present or reasonable foreseeable future disturbance. Therefore, Alternative 1 would not have cumulative temperature, nutrients, pH, DO, or turbidity effects.

Alternative 1 would not remove the wetland road fill of Road 6592-100 so it would maintain the loss of wetland function, which would add incrementally to past, present, or reasonably foreseeable loss of wetlands at multiple scales.

Alternatives 2 and 5 would protect the effective shade along perennial streams. No direct or indirect effects to water temperature or groundwater quality and quantity would occur. Beneficial uses of water and aquatic habitats would not be degraded. Therefore, no accumulative stream temperature effect would occur.

The action alternatives would cause short-term indirect turbidity and sediment-bearing nutrient release effects from in-stream work (stream crossing repair or temporary replacement). Since the spatial extent of the effect would be for the immediate stream, only similar activities on the same stream would influence a cumulative effect. However, no other activities would incrementally add to past, present, or reasonably foreseeable similar effects in these streams. Beneficial uses of water and aquatic habitats would not be degraded by pH, DO, turbidity, or scoured stream channels caused by timber harvest, road construction or reconstruction, or related activities identified in the watershed cumulative effects and water quality standard and guideline 2. Therefore, no cumulative nutrients, pH, DO or turbidity effect would result from these action alternatives.

Aquatic Conservation Strategy

As disclosed previously, no prolonged or adverse impacts to water quality or the associated beneficial uses of water are expected from any of the proposed activities in

any of the action alternatives, including those actions occurring in the riparian reserve land allocation. As such, the long-term trend of improving water quality in the watersheds will not be set back; water quality in planning area streams will continue to support healthy riparian, aquatic and wetland ecosystems consistent with ACS objective 4. Since the action alternatives apply all relevant standards and guidelines, and they were developed to restore riparian ecosystem health at the stream reach and landscape scale, they are also in keeping with the overarching intent of the Aquatic Conservation Strategy (USDA/USDI, 1994).

CHEMICAL CONTAMINATION

All action alternatives present some risk of water contamination due to the use of fuel products and dust abatement chemicals that have the potential to enter streams if spilled or misapplied. The production of biofuels from woody biomass in the planning area also carries some risk of water contamination during the trucking of these products to the marketplace. The most commonly used dust abatement compound by the Forest Service is magnesium chloride. This compound is typically used on a limited basis and at low application rates, as compared to study areas where the most noticeable effects have been seen.

Dust abatement with magnesium chloride would be applied to approximately four miles of Windigo Pass Road (Road 60) in the Lemolo Lake Watershed (Thirsty Creek Subwatershed) under all the action alternatives. This product would be applied to gravel road surfaces used for log haul at a frequency of one treatment for every 1-5 million board feet of timber hauled (depending on site specific road conditions). Excessive rates of application could potentially increase either the surface runoff or the migration of the material through the soil to stream channels. The primary risk of water contamination would occur with a spill near a waterway. Concentrations in excess of 10,000 parts per million (ppm) could be expected if a transport truck spilled into a perennial stream.

Magnesium chloride is highly soluble and moves through the soil with water. Movement is largely dependent on the rate of application, the rate and frequency of rainfall, the drainage characteristics of the area of application and the chemical and physical nature of the soil. During periods of long-duration or high-intensity rainfall, in areas of high surface runoff, or in areas of high soil permeability, magnesium can move considerable distances, either as surface runoff or as soil leachate (materials dissolved in water that is within the soil). Surface runoff typically drains into streams, lakes, or ponds whereas leachate feeds groundwater. Under these conditions it is the constituent ions of magnesium and chloride (Mg2+, and Cl-) that migrate through the environment.

Magnesium ions are readily held by soil particles while chlorides tend to remain in solution and potentially infiltrate ground water or runoff into surface waters. Magnesium is a very common element in soil and water and because it readily bonds with soil particles and it typically does not migrate far from the point of application, which is the case of dust abatement chemical application (USDA, 1997). Because chlorides do not bond well with soil particles and tend to migrate, their effects are more widespread. Although chloride is present in all natural waters, it usually occurs in concentrations of less than 50 ppm. Trout begin to experience adverse effects from chlorides when concentrations reach 400 ppm. Concentrations in excess of 10,000 ppm place all fresh water biota in immediate jeopardy. At typical application rates these concentrations would not be expected to occur (Bolander, et al., 1999).

Direct Effects

A dust abatement spill or petroleum spill could potentially result in direct effects to aquatic resources and the beneficial uses of water. The haul routes within the planning area are often narrow where increased truck traffic elevates the potential for an accident. For Alternatives 2 and 5, the treated route would be the Windigo Pass Road (Road 60). This road has drainage relief culverts, which disperse water to the immediate environment, and treatment ends before the North Umpqua River crossing, the only actively flowing stream. Since the drainage relief culverts do not carry surface water beyond the road prism, any spill near these culverts would not carry beyond the application. If an accident were to occur near a stream during the haul to the application road, fuel or dust abatement chemicals could enter live waterways. This could result in immediate physical harm from a truck entering a waterway, water pollution that could kill or otherwise harm aquatic organisms, and the additional disturbance associated with cleanup. Alternatives 2 and 5 have equal risk of water contamination from a vehicle accident spill.

The risk of water contamination due to the application of dust abatement is minimized under all action alternatives with the absence of active stream channels within the treated road segment. Moreover, the application of dust abatement materials would occur in a window of time when no rain is forecast for at least three days. The buffering of applications away from perennial stream crossings, such as the North Umpqua River crossing, has been found to effectively mitigate pollution of adjacent waters (USDA, 1999). The rate of application of dust abatement compounds in the D-Bug planning area would be limited to road 60 and therefore is not expected to contribute to adverse riparian or aquatic affects.

Based on the literature review and typical application rates for dust abatement purposes that would be used in the D-Bug planning area, effects from these compounds to plants and animals in the riparian and aquatic environments would be negligible.

Under all action alternatives, timber sale purchasers would be required to have spill prevention and recovery equipment on site, and to develop spill prevention plans if the timber sale contract required substantial amounts of fuel, biofuel or other pollutants to be located on Forest Service lands. These requirements, detailed in Chapter 2 and in the Best Management Checklist (Analysis File) function to diminish the chances of any direct effects to aquatic resources and the beneficial uses of water from project-related pollutants.

Indirect Effects

Pollution of off-site or downstream waters is possible if trucks transporting fuel, biofuel, or dust abatement compounds were to spill into the North Umpqua River or tributary stream enroute to or away from the project area. The likelihood of an accidental spill is considered low, however no mitigation measures would be applied to the transport of potential pollutants outside the timber sale areas.

Cumulative Effects

Most past and ongoing land management operations throughout the Umpqua River basin such as silvicultural activities, timber sales, and all forms of road work use a variety of potentially polluting products (such as petroleum, concrete, adhesives, cleansers, herbicides) that pose a risk of entering waterways if spilled or mishandled. The level of timber harvest and associated road work on Federal land located in the Diamond and Lemolo Lake watersheds has diminished over the last two decades

relative to the previous three decades. Therefore, the level of additive effects that can contaminate water from such actions has also diminished.

Potential contamination of waters within the North Umpqua River Sub-basin associated with private industrial forestry operations, intensive agricultural operations (using pesticides, fertilizers, other petroleum products, and herbicides), and city and town development and use by people (sewage, plus all the above mentioned potential pollutants and others not mentioned) has not diminished. Water contaminations from these sources can be expected to increase as demand for food and natural resources increases with the human populations. Therefore, the lower areas of the Umpqua River Basin are where the cumulative effects of all the additive forms and sources of water contamination would be most likely realized.

The chances of any of the D-Bug action alternatives resulting in any cumulative effects to water contamination hinges on whether a substantial spill of petroleum, biofuel, or dust abatement products occurs. Should a spill occur and clean-up measures fail, a cumulative effect could be realized. This is particularly true the further downstream an accidental spill occurs.

Aquatic Conservation Strategy

No impacts to water quality or the associated beneficial uses of water are expected from any of the proposed activities in any of the action alternatives, including those actions occurring in the riparian reserve land allocations. Objective 4 of the Aquatic Conservation Strategy requires that water quality remain within the range that maintains the biological, physical, and chemical integrity of the aquatic and riparian communities. The action alternatives were designed to reduce the chances of uncharacteristic wildfire effects due to a lack of natural fire in both riparian and upland communities. The action alternatives proactively accomplish this in keeping with the broad landscape intent of the ACS while also meeting the specific requirements of ACS objective 4. Alternative 1 would not proactively implement ACS.

STREAM FLOWS

The streamflow regime for the area is uniquely influenced by High Cascade geology and spring snowmelt (USDA, Umpqua National Forest, 1998). The underlying geology is the controlling factor in the development of the High Cascade aquifer (USDA, Umpqua National Forest, 1996; USDA, Umpqua National Forest, 1998; Ingebritsen, 1994). Streamflow is dominated by groundwater. The geologic characteristics influence a high volume and high storage capacity of groundwater that slowly releases to channels. The pumice soil of the area allows rapid water infiltration. The common occurrence of joints and fracture patterns in the bedrock provides the opportunity for rapid infiltration and migration of water vertically as well as horizontally over a wide area. Low stream density is common in this geology with the higher infiltration rates and less tendency for surface water to concentrate.

The 1990 Umpqua Land Resource Management Plan (LRMP) addressed the concept of the North Umpqua River aquifer and its importance for high quality and quantity of water. The LRMP identified the High Cascade aquifer in the context of surficial pumice deposits. However, after further evaluation that was disclosed in the Diamond Lake/Lemolo Lake and Upper Clearwater watershed analyses, the role of the surficial pumice soil is less certain. The research suggests that the underlying volcanic rocks are the controlling factor in the characteristics of the aquifer (Sherrod, 1991). Since the

aquifer is largely a function of the underground bedrock, the role of the surface soil in the overall function of the aquifer is minor.

The resulting streamflow regime is not only slow responding, but also persistent with small annual flow fluctuations between summer and winter flow. This flow condition provides cool and consistent summer flow while producing less winter responsive runoff. Annual river flow in the North Umpqua River below the Lemolo Reservoir, which includes the D-Bug planning area, is approximately half of the annual precipitation for the watershed, which is typical of High Cascade streams. In contrast, streams in the Western Cascade sub-province, which do not exhibit the bedrock aquifer characteristics, tend to runoff over 70 percent of the precipitation because of much less storage ability in the older bedrock geology.

Relevant Standards and Guidelines

The relevant standard and guidelines from the Umpqua LRMP related to streamflow include:

Watershed cumulative effects and water quality, S&G 2: Beneficial uses of water and aquatic habitats would not be degraded by turbidity, sediment, or scoured stream channels caused by timber harvest, road construction, and related activities.

Watershed cumulative effects and water quality, S&G 4: Beneficial uses of water and aquatic habitat (water quality) would not be degraded by increased peak flows caused by canopy removal from timber harvest, road construction, and related activities.

Watershed Analysis Recommendations

The 1996 Upper Clearwater River and 1998 Diamond Lake/Lemolo Lake watershed analyses recommendations relevant to the D-Bug planning area include the following:

- Obliterate roads in Riparian Reserves where appropriate, considering short and long term transportation needs.
- Minimize disruptions of hydrologic flow paths.

Existing Conditions

The planning area is both within and above the transient snow zone (between 2,000 to 5,000 feet in elevation). The transient snow zone is the elevation zone where winter snow frequently occurs, but also melts a few days or weeks later. In this elevation zone, warm rain and possible wind can follow a snow storm causing rapid snowmelt during rain-on-snow events. The resulting winter peak flows are an important fluvial process in the transient snow zone. In the Upper Willamette sub-basin, 88 percent of floods with a return period of greater than six years were associated with rain-on-snow events (Harr, 1979; Christner, 1981). Sizeable canopy openings can result in greater snow accumulation and more rapid snowmelt in the transient snow zone compared to locations lacking large canopy openings.

The forest canopy has a major influence on snow accumulation, distribution, and melting rates. Standard and guideline 4 requires an analysis of forest canopy conditions. This hydrologic recovery procedure (HRP) was used to estimate the hydrologic recovery of the forest canopy at the subwatershed, and watershed scales. An area is considered fully recovered when the canopy closure is 70 percent and the average tree diameter is eight inches (USDA, Forest Service, 1990). The hydrologic recovery level represents an area compilation of forest canopy re-development following disturbance. It also

represents the potential influence on the streamflow and stream channel effects from floods. A hydrologic recovery of 75 percent or greater would maintain current peak flows and avoid adverse change to physical channel condition and associated factors such as water quality and fish habitat. Statistically discernible increases in peak flows have occurred when greater than 25 percent of smaller drainages have been clear-cut harvested with road building; that is, the hydrologic recovery was less than 75% (Jones and Grant, 1996; Thomas and Megahan, 1998). Conditions below the 75% hydrologic recovery (i.e.; lower levels of hydrologic recovery) need further evaluation for potential peak flow cumulative effects from rapid snowmelt during rain-on-snow storms (following S&G 4).

The hydrologic recovery levels for the D-Bug planning area include two of the three watersheds and five of the eight subwatersheds. The Diamond Lake Watershed and the three subwatersheds that subdivide it are completely above the transient snow zone, which is outside of the analysis criteria and not included. The other five subwatersheds in the Lemolo Lake and Clearwater watersheds include portions in the transient snow zone.

The hydrologic recovery levels for all the transient snow zone subwatersheds are currently greater than the 75 percent level of concern. Stump Lake subwatershed has the lowest level at 87 percent while the remaining subwatersheds and the watershed scale are greater than 90 percent (Table 3-50).

Table 3-50. Current Hydrologic Recovery for the Five Subwatersheds.

Watershed	Subwatershed	Area (acres)	Hydrologic Recovery
Clearwater	Clearwater Headwaters	11,324	90%
	Stump Lake	9,404	87%
Lemolo Lake	Lake Creek	23,543	98%
	Lemolo Reservoir	11,926	92%
	Thirsty Creek	15,320	99%

The desired condition is the protection of flow regimes in keeping with ACS objective 6, while addressing the growing fuel load associated with the beetle infestation and moving these forest stands toward the desired range of natural variability.

Indirect Effects and Cumulative Effects

Peak flows represent an indirect effect rather than a direct small-scale effect. The LRMP (USDA, Forest Service, 1990) identified an analysis area of at least 1,000 acres to evaluate potential peak flow response. As such, only downstream indirect effects and cumulative effects are discussed for the peak flow analysis.

The overall hydrologic recovery analysis of snow accumulation and melt utilized research that was done on the Umpqua and Gifford Pinchot national forests. This research indicated that a shelterwood canopy can allow about 60 percent greater snowpack runoff than mature forest (Storck, et al., 1999) at the site scale. Therefore, the analysis for the action alternatives assumed at least a combined 40 percent canopy recovery condition for proposed thinning units and no recovery for heavier thinning (less than or equal to 20 TPA). These conservative assumptions allowed for a margin of safety in the analysis to address scale difference from the original study (site response

versus larger area) and treatment difference (shelterwood versus thinning). In addition, the slow responding streamflow regime of the High Cascade streams also lessens the peak flow response.

Under both action alternatives the proposed silvicultural treatments would increase the potential for snow accumulation in the thinned areas where overall canopy closure from 40-70 trees per acre would be less than 70 percent. However, the remaining leave trees in the thinned areas would buffer any snowpack from rapid snowmelt during rain-on-snow events. The leave trees would break up the flow of warm wind across the snow pack and substantially mitigate the rapid melt process. Because of the thinning treatment and the recovery of past harvesting, the resulting reduced hydrologic recovery level in the planning area would remain above the level of concern at the subwatershed and watershed scales.

The combined loss of canopy from the D-Bug thinning, recent harvest activity under the Lemolo Watershed Project EIS, and the current recovery of past harvesting (Table 3-1) would slightly reduce the hydrologic condition about 1-2 percent at the watershed and subwatershed scales. However, the hydrologic recovery would not drop below 75 percent at any of these scales.

Therefore, the hydrologic recovery would maintain current peak flows and avoid adverse change to physical channel conditions and associated factors such as water quality and fish habitat (consistent with S&Gs 2 and 4, listed above). No cumulative peak flow effect is expected under the action alternatives when considering past, present, or reasonably foreseeable future activities (tables 3-1 through 3-3).

The action alternatives would result in less predicted stand replacement fire, which is a long-term beneficial effect. Under the action alternatives, if a wildfire occurred in the planning area, the thinning, fuel treatments, and fire breaks would modify dense stand conditions that could cause a surface fire to torch into the crowns and carry across many acres. As such, a future wildfire under the action alternatives is more likely to create smaller pockets of stand replacement fire compared to Alternative 1. Thus, the action alternatives exert less chance of future peak flow increases and the potential impacts to the beneficial uses of water compared to Alternative 1.

Annual water yield increase studies in Western Oregon have usually evaluated clear-cut harvesting. These studies showed considerable annual water yield increases following harvest (Beschta, et al., 1995) because of reduced evapotranspiration[61] with the loss of trees. Beschta et al. (1995) cited a review of over 90 watershed studies by Bosch and Hewlett (1982), which concluded that water yield increases are only detectable when at least 20-30 percent of a watershed has been harvested. However, Beschta (1995) also concluded that increased soil moisture from thinning or small group harvest would likely be utilized by the remaining trees and vegetation and have little effect on the annual water yield. Under similar soil and bedrock characteristics as the planning area, Fowler (1987) found, when 22-50 percent of an area was harvested, no measurable water yield response occurred. It was felt that the local geology, which consisted of fractured bedrock with deep water movement as in the D-Bug planning area, contributed to the lack of water yield response. However, local soil moisture did seasonally increase.

[61] Evapotranspiration is the removal of water from the soil by plant roots and the use of that water in the growth process (transpiration) plus the evaporation of any excess water from the surface of leaves. When trees are harvested in a clearcut, little to no evapotranspiration takes place until the regenerating stand of trees and shrubs reestablishes.

Alternative 1 would not affect annual water yield since evapotranspiration would not be reduced. However, if wildfire occurred, Alternative 1 would likely bring to bear more chance of annual water yield increase than the action alternatives with reduced evapotranspiration from loss of continuous areas of trees.

Under alternatives 2 and 5 the increased snow accumulation and reduced interception of precipitation in the thinned areas (previously discussed under the peak flow) would likely extend the time of soil moisture at the site scale but not increase the amount of annual water yield from the overall harvest areas at larger scales. The amount of thinning in the three watersheds would be about 2-5 percent of the area. Therefore, no annual water yield increase, which could seasonally influence local stream, water-body, or wetland volumes, would be expected from the action alternatives.

The similar action common to the action alternatives is the decommissioning of 0.8 miles of Road 6592-100, which is an abandoned segment of old Highway 230. This road segment was built through a wetland. The original construction placed fill in the wetland that interrupted surface and subsurface flow paths, which dried part of the wetland. The decommissioning would remove the road fill and reconnect these flow paths to restore wetland function consistent with ACS objective 7, which calls for the restoration of water table elevation in meadows and wetlands.

Under Alternative 1, the loss of wetland function because of Road 6592-100 fill would not be corrected. The direct and indirect effects are the existing loss of wetland function over time. The cumulative effect is the potential additive loss of wetland acres at the subwatershed and watershed scales.

For all action alternatives, the fill removal would remove existing non-wetland vegetation, which is rooted in the dry fill, and potentially disturb the immediate wetland vegetation and soils adjacent to the road fill. A limited amount of fill soil and rock would likely remain in the wetland after fill removal. However, water would move more freely, allowing wetland plants to reestablish. The positive indirect effects would be the future wetland function and wetland plant establishment.

Therefore, the decommissioning of Road 6592-100 would likely have a small short-term direct effect on the existing wetland vegetation during the fill removal period. After fill removal, the indirect response of reconnecting the wetland flow paths and establishing wetland vegetation would be a long-term benefit.

The cumulative response would be the gain of wetland acres at the subwatershed and watershed scales. The decommissioning and reconnected flow paths are consistent with Watershed Analysis recommendation listed above.

Aquatic Conservation Strategy

As disclosed above in this stream flow section, no impacts to flow regimes or the associated beneficial uses of water are expected from any of the proposed activities in any of the action alternatives including those actions occurring in riparian reserves such as density management, underburning, and other fuel reduction activities such as hand piling/burning, chipping and mastication. As such, the timing, magnitude, and duration of peak, high, and low flows are protected under all action alternatives, consistent with ACS objective 6. Moreover, the road decommission in a wetland would restore the presently impacted water table of that area, proactively addressing the requirements of ACS objective 7. Alternative 1 would not address this conservation strategy.

EROSION AND SEDIMENTATION

Sedimentation is the delivery of upslope materials into the aquatic environment. The sediment in streams originates from mass wasting (landslides), fluvial erosion (scoured stream channels), and surface erosion; all natural processes that can increase with management activities. Mass movement hazard throughout the planning area is low, and not considered to be a factor potentially affected by any of the alternatives. Both fluvial and surface erosion can occur, so they are addressed in this section. Road-related sedimentation from the existing road network, new temporary roads, and the reconstruction and maintenance of the log haul roads can contribute to the overall sediment regime in the planning area.

Surface Erosion

Surface erosion occurs when mineral soil is exposed to the erosive forces of water, wind and gravity. Surface erosion can result from logging and fuel treatments when the protective surface layer of duff and other materials such as wood and rock is removed or displaced exposing mineral soil to erosive forces. Activities such as dragging trees across the ground during yarding, burning activity-created fuels, road building, reconstruction, or decommissioning, and timber haul on existing dirt or gravel roads all can result in sedimentation of the aquatic environment where surface erosion is a concern. Wildfires can also result in surface erosion (tables 3-42 and 3-43).

Relevant Standards and Guidelines

The relevant standards and guidelines related to surface erosion are found in the LRMP.

Soil standard and guideline 2 requires the establishment of a minimum amount of effective ground cover in order to meet acceptable levels of surface soil loss resulting from gravity, water, or wind action. The ground cover must exist within the first year following the end of a ground disturbing activity. Based on the low level of erosion risk in proposed units, effective ground cover (EGC) levels would be 25 percent in all gentle-to-moderately steep side slopes. However, 65 percent has been prescribed as a site productivity standard in the harsh site conditions on the flats due to frost cold pockets in the lodgepole and mountain hemlock sites. Prescribed underburning would be expected to maintain an average effective ground cover of 70 percent while other prescriptions are expected to increase the ground cover from logging slash and mastication.

Soil standard and guideline 11 requires monitoring during and immediately following the implementation of individual unit burning to assess the adequacy of EGC during under burning with adjustments, as needed, in order to meet the requirements.

Soil standard and guideline 13 requires the use of erosion control measures such as seeding with native plants, weed-free straw, or other form of mulch, where existing ground cover is lost in area in excess of 0.5 acres.

Soils standard and guideline 16 requires the identification of erosion control in existing developed areas where pre-existing surface erosion is ongoing.

Existing Conditions

Soils in the D-Bug planning area formed from Mt. Mazama pumice and ash deposits that overlay substrata material which vary by landform position. This substratum range from bedrock, old buried soils, to glacial deposits. Water infiltration and soil drainage is usually excessive. Water from precipitation and snow melt is quickly absorbed by the soil

with little if any concentrated surface water flow potential unless the soil is left in a compacted condition.

Surface water erosion and the potential for sediment delivery to streams are low. Based on field review of these existing disturbances sediment delivery to streams was determined to be a low risk throughout the planning area. Surface erosion that would occur on skid trails, landings, and roads where the soil is compacted would quickly be absorbed once it flowed onto more porous soil, with little risk of sediment delivery to streams. Concentrated areas of compaction were found to persist in units that were originally tractor harvested, on snow mobile trails, and in unclassified roads around the lake and around resort facilities, summer homes, and campgrounds.

Direct and Indirect Effects

Direct effects are defined as the short-term effects of sedimentation that might occur within planning area streams as an immediate result of the proposed road work, timber haul, logging and treatment of activity fuels with fire. Indirect effects would occur over longer periods. Surface erosion associated with roads can last much longer because revegetation is typically limited. Indirect effects are also those that may be expressed downstream of the management activity.

All alternatives, including Alternative 1, are considered to have a low risk of generating or delivering sediment to streams. All action alternatives are expected to exceed the soil erosion prescription for effective ground cover (*see* soil/site productivity section in this chapter).

An analysis of soil erosion potential considers soil texture, slope steepness, changes in topography, precipitation and runoff potentials, vegetation cover, and incorporates disturbances previously discussed such as exposed, compacted, and severely burned soil. The risk of fire effects to the soil environment was evaluated for each alternative using FOFEM (Keane, et al., 1997). FOFEM modeling provides an average risk summary of the potential for direct effects as a result of wildfire and prescribed burning. The analysis showed that though bare ground would be created by wildfire under Alternative 1 as well as the two action alternatives, the potential for sediment delivery to streams is extremely low. This is because of the gentle and flat topography, the high water infiltration capacity of planning area soils, and the lack of overland flow of water to carry soil into streams. As such there is generally no mechanism for the surface erosion associated with a fire to deliver sediment to planning area streams.

The primary source of stream sedimentation would come from roads. The potential for hill slope erosion and runoff from roads to deliver sediment to streams was evaluated using WEPP models (Eliot, 2005). Temporary roads would be mostly located away from streams. However, there are two new temporary stream crossings that would be constructed across intermittent channels under all action alternatives. Mitigation measures require that temporary roads and landings be subsoiled to a minimum depth of 20 inches and planted to restore water infiltration and prevent surface water runoff. Also, mitigation measures call for minimizing landings and skid trail locations near streams, and establishing native vegetation and/or other forms of ground cover following treatments to breakup soil compaction. These mitigation measure, incorporated into all action alternatives, would lessen the length of time sediment would be delivered to these two intermittent streams.

Existing roads are another source of surface erosion that can lead to sedimentation of streams. Grading roads surfaces under the action alternatives to reduce wheel rutting

would help decrease ongoing erosion by more effectively dispersing surface water before it becomes concentrated runoff that can carry sediment to streams. The potential benefit from increased road maintenance in the planning area would be similar among the action alternatives. Under Alternatives 2 and 5, most haul roads that access landings (60 to 70 percent) would use existing roads.

Increased logging traffic on roads located near streams, where surface water runoff could reach the stream, was modeled as a worst-case scenario. The haul near streams could increase sediment delivery potential from 0.004 to 0.007 cubic yards at temporary stream crossings and from 0.06 to 0.10 cubic yards at permanent stream crossings located on system roads during the time of harvest and haul (Table 3-51). It is expected to subside the following year and continue to improve as riparian vegetation and soil rooting reestablishes. At existing stream crossings, such as snow trails and other native surface roads, the sediment delivery potential would be expected to reduce from 0.1 to 0.006 cubic yards with the decreasing truck traffic and improvements in road drainage from surface grading.

Stream crossing improvements on existing system roads (Table 3-51) would have a net benefit of reducing the potential sediment delivery over the long term (five years) once the soil disturbance associated with the reconstruction has revegetated. In the short term, the reconstruction of one existing crossing (under alternatives 2 and 5) located in intermittent channels, would result in the production of sediment equal to about 2.5 cubic yards (equal to 2½ pickup loads per site). This amount of sediment could potentially be delivered during spring snowmelt to downstream perennial channels in the Silent Creek and Lake Creek drainages. Culvert replacement may be the largest individual source of sediment delivery.

Road maintenance and reconstruction would result in beneficial effects for the action alternatives, because there would be less long-term road-related sediment. This is because the road maintenance activities associated with the action alternatives actually lessen long-term levels of surface erosion (Table 3-51). Overall, the total five-year sediment delivery prediction is expected to decrease by 0.05 cubic yards with alternatives 2 and 5 when compared with Alternative 1 due to the road maintenance associated with the action alternatives.

Table 3-51: Predicted cubic cards of road-related sediment delivery.

Roads	Alt 1	Alt 2	Alt 5
Undisturbed sediment balance, yd^3 Existing unused roads, yd^3	0.08 4.07	0.08 0.34	0.08 0.34
New temporary road construction/obliteration*, yd^3	0.00	0.10	0.08
Reuse existing roads/snowtrails, keep for future use, yd^3	0.00	2.18	2.18
Reuse existing road, obliterate after use Net decrease in existing roads, miles	0.00 [-0 mi]	0.62 [-11.8 mi]	0.62 [-11.4 mi]
Reconstruct existing system road, yd^3 (number of stream crossing replacements--intermittent streams)	0.00 [0 xing]	0.60 [1 xing]	0.60 [1 xing]

Roads	Alt 1	Alt 2	Alt 5
Road Maintenance before and after sale activities, yd^3	0.2	0.2	0.2
Net 5-year sediment total from roads, yd^3 Net decrease in road sediment, yd^3***	4.35* (0)	4.12 (-0.05	4.10 (-0.06)

*The term obliteration is used to describe the activities involved in restoring a road that is not part of the recognized transportation system such as an abandoned, unclassified road, or a temporary road.
**The term decommission is used to describe the activities involved in restoring the soil, water routing, and potential vegetation of a recognized system road.
*** One cubic yard (yd3) of sediment is approximately equivalent to a large pickup load.

Cumulative Effects

The potential of the D-Bug alternatives to result in cumulative effects in terms of the surface erosion process is addressed at the scale of the planning area over five years. This is the primary time scale that the D-Bug alternatives could influence surface erosion processes.

Considering the sum of the various mechanisms of surface erosion and associated sediment delivery, the action alternatives would all potentially deliver extremely low amount of surface erosion. The sediment sources associated with the action alternatives (the use of roads near stream and that cross streams and road work at stream crossings) would only last for 1-2 years following implementation, and best management practices (Chapter 2) would help mitigate this to the extent practical. Given the very limited or benign effects of the action alternatives associated with surface erosion and the lack of past and future actions in the area, it is unlikely that any of the D-Bug alternatives would result in an incremental additive impact to the aquatic environment in terms of surface erosion.

Aquatic Conservation Strategy

At the scale of the 5th level watersheds, fire was the primary mechanism that triggered surface erosion during historic reference conditions. The historic sediment regime was one of occasional, but episodic, sediment delivery following large-scale fires in conjunction with spring snow melt that delivered the surface erosion to streams. Most of the sediment delivery probably came from fluvial erosion (triggered by large post-fire spring runoff), rather than from surface erosion. Such episodic sedimentation occurred in particular drainages, followed by years of little to no disturbance in nearby recovering areas (Reeves, et al., 1995). The episodic pulses of sediment have been curtailed due to fire exclusion and replaced with sedimentation mostly from roads.

The action alternatives have an extremely low potential to deliver short-term increase in sedimentation due to road activities with essentially no impact to aquatic environments. Over the long-term, the action alternatives help to lessen chronic sediment delivery from surface erosion associated with roads through road maintenance and road reconstruction. These actions are responsive to road-related Watershed Analysis recommendations in terms of managing fuel accumulations. The road work that would be done within riparian reserves is in full compliance with Northwest Forest Plan riparian reserve standards and guidelines. Moreover, the action alternatives respond to Aquatic Conservation Strategy objective 5 by accomplishing work on system roads that would incrementally affect the sediment regime in small localized areas.

FLUVIAL EROSION

Fluvial erosion is the erosion of stream banks and beds from the forces of water. Stream channels change, both spatially and temporally, under the fundamental influences of climate, geology, and topography. These factors help determine the streamflow and sediment regimes, as well as riparian vegetation, which provides in-stream wood. Disturbances can affect stream channel form and the equilibrium between sediment input and output.

Relevant Standards and Guidelines

The relevant standard and guideline from the LRMP related to fluvial erosion is watershed cumulative effects and water quality S&G 2: Beneficial uses of water and aquatic habitats would not be degraded by scoured stream channels caused by timber harvest, road construction, and related activities.

Existing Conditions

The proposed thinning units in the D-Bug planning area are generally located on a gentle landscape with surficial deposits that cover the young bedrock at varying thicknesses. The surficial deposits include variably compacted glacial deposits, weakly consolidated ash flow, and well stratified lake deposits.

The more sensitive channels are associated with volcanic ash deposits, which tend to lack various sized substrates (cobbles and small to large boulders). These channels include perennial, intermittent, and interrupted streams. The interrupted channels are not connected downstream by surface flow. The interrupted channels are typically small and flow during the snowmelt season, which is similar to the intermittent channels. The flow in the interrupted channels eventually drains back into the soil and becomes subsurface water. The beneficial use of these interrupted channels is locally focused on wildlife and not downstream delivery to larger bodies of water.

Channel stability and fish habitat inventories provide insight into the erosional and channel morphological processes within headwater streams in these watersheds (USDA, Umpqua National Forest, 1998). The inventories have shown that stream channel stability is moderate to high for all types of geologic settings surveyed with little evidence of considerable slope failure or mass wasting.

Channel adjustment from former heavy grazing by sheep in the watershed during the late 1800s and early 1900s may still be occurring to riparian areas (soil compaction) and stream channel (width/depth ratio). Major adjustment in channel morphology following elimination of grazing disturbance has occurred on a decadal time scale.

The pool/riffle ratio appears low for the stream types in these watersheds when compared to other streams in different watersheds. The low representation of pools is not likely a result of a deficit in large woody material. Large woody material across these watersheds is moderately present. However, the inherent nature of the geology, with slow responding runoff events, does not often have sufficient stream energy to scour pools and maintain existing pools. Therefore, pools do not tend to dominate the channels.

Overall, channel stability within the managed watershed areas is similar to those in unmanaged areas and is relatively stable with properly functioning systems, which efficiently process both flow and sediment under the current condition (USDA, Umpqua National Forest, 1998). These channels appear to be inherently stable due to the nature

of the streamflow regime, which is characterized by peak flows that generally are not high energy but rise and fall gradually in response to both snowmelt and rainfall events.

Direct and Indirect Effects

Direct effects from fluvial erosion are described at the scale of stream segments within or adjacent to harvest units and during the activity. Indirect effects are downstream of the unit at the subwatershed scale and greater, and occur over the next two to three decades after treatment.

Alternative 1 would not change existing fluvial erosion processes that are currently occurring. Future recruitment of large channel wood that would stabilize and provide storage of channel sediment would be delayed where the riparian is densely stocked. However, over the long-term, fluvial erosion could potentially increase as a result of Alternative 1 if the expanding mountain pine beetle infestation area experienced a stand replacing wildfire in large portions of the planning area. In this case, a loss of riparian root strength and potential increase in peak flow would risk changing the fluvial erosional balance that exists.

Alternatives 2 and 5 would thin riparian reserves (see Riparian Forest Conditions in this Chapter). The riparian reserve thinning would retain no-harvest buffers along all perennial streams and some of the intermittent stream channels with steep and/or potentially unstable banks. The no-thin stream buffers ensure that harvest activity would not disturb stream banks or beds and the streamflow/sediment balance. The exception is where intermittent channels are gentle and bank and bed erosion has been determined to not be a risk. Thinning would occur along these channels with no buffers, but these streams would be identified for operation protection, which includes stream course identification, limited operations near streams, yarding away from channels, and directional falling, where applicable.

None of the action alternatives would increase peak flows or accelerate sedimentation that would affect fluvial erosion (water quality S&G 2). The riparian reserve thinning would improve overall health and vigor of the riparian leave trees and the potential future channel recruitment of large wood, while reducing the long-term risk of wildfire impacts on the riparian reserves. Therefore, no direct or indirect effects associated with fluvial erosion in the planning area streams would occur.

Cumulative Effects

Alternative 1 would not incrementally add to past, present, or reasonably foreseeable future activities to cause a cumulative fluvial erosion effect since no action would occur.

Since Alternatives 2 and 5 would not cause any indirect fluvial erosion (as described above) that would incrementally add to past, present, or reasonably foreseeable future activities, no cumulative fluvial erosion effect at any of the analysis scales would occur.

Aquatic Conservation Strategy

The historic sediment regime was one of occasional, but episodic, sediment delivery following large-scale fires. Wildfire occurred in particular drainages, followed by years of recovery with little to no disturbance (Reeves, et al., 1995). Fire exclusion has temporarily curtailed the pre-management sediment regime of occasional, episodic sedimentation. Yet, as fire hazard builds due to the lack of natural fire in combination with the pine beetle outbreak, more extreme sediment pulses may be possible once wildfire escapes control efforts.

As discussed in the Forest Vegetation, Fuels, Riparian Reserve, and Erosion and Sedimentation sections on this chapter, the D-Bug alternatives were purposely designed to lower hazardous conditions and reduce the chances of uncharacteristic fire effects, which in turn, are expected to help maintain or restore the sediment regime. Moreover, the long-term benefits of the road maintenance and reconstruction activities under the action alternatives outweigh the small short-term impacts of road work to be implemented. As such, the action alternatives are consistent with ACS objective 5 which calls for the restoration of sediment regimes. Alternative 1 would not proactively address the Aquatic Conservation Strategy.

RIPARIAN RESERVES

During scoping, concerns were raised that thinning operations and associated slash burning and road building could impact riparian areas and other aspects of the aquatic environment. This issue was addressed by the application of best management practices, mitigation measures, and project design features that lessen impacts from logging, fuel treatments, and temporary road building. The effects related to riparian areas are disclosed in this section.

The riparian reserve land allocation was established in the Northwest Forest Plan as part of the Aquatic Conservation Strategy (USDA/USDI, 1994). This riparian reserve analysis is based on the guidance in the Northwest Forest Plan, which defines a riparian reserve as one site-potential tree height on non-fish-bearing streams (either perennial or intermittent) and two site-potential tree heights on fish bearing streams. No changes to these guidelines were made with either the 1998 Diamond/Lemolo Watershed Analysis or its 2008 iteration. A site-potential tree height is the average maximum height of the tallest dominant tree at 200 years or older for a given area. The height of site-potential trees used for analysis purposes was averaged at 180 feet. Site potential trees in the planning area actually vary in height from the shorter lodgepole pine forest type to the more productive white fir plant series.

The Aquatic Conservation Strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems. This strategy is based, in part, on natural disturbance processes. Proposed riparian actions are assessed in relation to the watershed's existing condition and any short or long-term effects to such conditions.

Existing and Desired Conditions

About 17 percent of the riparian reserves along streams in the combined watershed areas of Clearwater, Lemolo Lake, and Diamond Lake have been affected by previous clearcuts and roads, with the amounts varying by watershed (Table 3-52). In the smaller D-Bug planning area, 4.1 percent of the riparian reserves have been previously affected by clearcutting and roading.

Table 3-52. Summary of Past Riparian Reserve Harvest and Roading by Watershed and Planning Area.

	Clearwater	Lemolo Lake	Diamond Lake*	Planning Area
Acres of Riparian Reserve Along Streams	5,108	7,210	1,163	4,025
Acres (%) Stream-Related Riparian Reserve Clearcut	859 (17%)	153 (2.1%)	5 (0.4%)	134 (3.3%)

	Clearwater	Lemolo Lake	Diamond Lake*	Planning Area
Acres (%) Stream-Related Riparian Reserve in Permanent Roads	846 (16%)	331 (4.6%)	111 (9.5%)	31 (0.8%)
Total Acres (%) of Stream-Related Riparian Reserve Impacted	1,705 (34%)	484 (6.7%)	116 (10%)	165 (4.1%)
	2,305 acres (17%)			

*Statistics for the Diamond Lake watershed only include lands managed by the Forest Service; Crater Lake National Park manages a portion of this watershed.

Previously clearcut riparian reserves are now either Douglas-fir plantations or lodgepole pine regeneration sites, presently in the stem exclusion stage. These stem exclusion stands are very dense and generally lack tree species diversity due to planting and pre-commercial thinning practices, coupled with the lack of natural fire that would have helped thin and diversify the dense second-growth. If left untreated, many stands are on a track to develop as closed, unnaturally dense and homogeneous stands that do not represent desired conditions for the riparian reserve land allocation.

A portion of the system road network[62] occurs within riparian areas. System roads have the potential to limit shade and deposition of large wood and debris to streams and riparian forests over long time periods, since these roads are long-term features. These conditions are usually only alleviated by road decommissioning, when roadbeds are converted back to tree growing sites.

The planning area also has 25 miles of unclassified roads within or leading to the proposed units. These dead-end roads were built many years ago and many are now either abandoned or they are being used as recreation trails. These roads are referred to as “unclassified roads” by the Forest Service because they were never evaluated as part of the long-term road system. Under today’s practices, many of the abandoned roads would have qualified as temporary roads that would have been obliterated following logging use under today’s standards. About 3.1 miles of these unclassified roads are located in the planning area’s riparian reserves, equating to about 7.5 acres of land.

The desired condition for riparian reserves is increased species and structural diversity that would approximate the effects of fire that has been excluded, decrease the area occupied by permanent and unclassified roads, and lower the risk of stand-replacement fire in keeping with ACS objectives 2, 3, 8, and 9.

Relevant Standards and Guidelines

The standards and guidelines for riparian reserves (as per the1994 Northwest Forest Plans) specifically related to the D-Bug alternatives include:

Northwest Forest Plan TM-1 (c). Prohibit timber harvest except where silvicultural practices are applied to control stocking, to reestablish and manage stands, and to acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives.

Northwest Forest Plan FM-1. Design fuel treatments to meet Aquatic Conservation Strategy objectives, and to minimize disturbance of riparian ground cover and

[62] System roads are defined as permanent roads that are needed for the long-term transportation system.

vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression could be damaging to long-term ecosystem function.

Northwest Forest Plan FM-4. Design prescribed burning and prescriptions to contribute to attainment of Aquatic Conservation Strategy objectives.

Northwest Forest Plan FM-5. Rehabilitation treatment plans are prescribed as needed to attain ACS objectives whenever Riparian Reserves are significantly damaged by wildfire.

Northwest Forest Plan RA-2. Fell trees in Riparian Reserves when they pose a safety risk.

Watershed Analysis Recommendations

1998 Diamond Lake-Lemolo Lake Watershed Analysis:

- An accepted approach to minimizing wildfire size and of minimizing the impacts of fire suppression is to reduce the amount or continuity of ground and ladder fuels prior to the start of a wildfire in riparian reserves (p. 219).
- Active silvicultural programs will be necessary to restore large conifers in riparian reserves.
- Prescribed fire for ecosystem maintenance and restoration should be allowed to burn within riparian reserves as fire did historically. These fires will be utilized to restore function and diversity to the system (p. 220).
- Hazard reduction is recommended along the north shore of Diamond Lake due to high fuel loading, heavy public use and the existing fire hazard. Hazard reduction treatments should also include the riparian reserve.
- The fire hazard around existing buildings in the Diamond Lake composite cannot be alleviated without treatment occurring within riparian reserves due to the proximity of the buildings to the reserve or the buildings actually being in the reserve. Areas of riparian reserve with high fuel loading on the west (by the summer homes) and south sides of Diamond Lake (around Teal Lake) should be treated. These areas have high public use and due to improvements (summer homes and other developments/facilities), values at risk are high.

1996 Upper Clearwater Watershed Analysis

- Riparian vegetation should be restored to a fully functioning status throughout the area. Fully functioning status would include a range of conditions, from areas of early successional vegetation through mature old growth stands. Many stream segments currently have clearcut harvest units that have been cut down to, and in some cases across, the stream banks.
- Prescribed burning could help maintain this strategy by reducing the risk of stand replacement fires in or near riparian reserves. Planning prescribed burns in natural or activity fuels when conditions are right to meet resource objectives such as hazard reduction, maintenance of large coarse woody material, and protecting the riparian zone, is a far better alternative than an unplanned ignition during periods of high fire danger.

Proposed Riparian Reserve Treatments

The action alternatives would apply thinning and/or non-commercial fuel reduction to riparian reserves along streams were riparian conditions are presently outside the range of natural variability due to fire exclusion or previous management (Table 3-53).

Table 3-53. Proposed Vegetation and Fuel Treatments within Riparian Reserves of Streams.

Actions	Alternative 1 (acres)	Alternative 2 (acres)	Alternative 5 (acres)
All Commercial Harvest in Riparian Reserves (Rx 1-4,9-13)	0	450	283
Lodgepole Thinning (Rx 1, 2)	0	219	112
Mixed Conifer Thinning (Rx 9, 10, 11 & 13)	0	231	170
Non-Commercial Fuel Treatments in Riparian Reserves (Rx 5, 6, 7, 8)	0	285	324
Grand Total All Riparian Reserve Treatments Along Streams	0	735	607

The riparian reserve acres located in the proposed treatment areas would be treated under the action alternatives in order to attain the long-term objectives of the Aquatic Conservation Strategy. The riparian reserve thinning prescriptions would be the same as in the adjacent uplands, which involves low thinning (where the smaller trees are harvested) in mixed conifer stands and heavy thinning in stands with lodgepole overstories that are susceptible to mountain pine beetle mortality (Table 3-53).

All perennial streams where commercial harvest is proposed would receive 50-60 foot no-cut buffers to maintain the primary shade zone under the action alternatives. On some of the intermittent streams, commercial treatments would occur along the channels with stable streambanks on gentle to flat slopes. Thinning would occur along these channels with no buffers in order to maximize the long-term positive effects of the thinning. No trees would be yarded across the channels, and no equipment would operate within 40 feet of a channel, except at existing stream crossings.

Road work in the riparian reserve would be necessary in order to access the treatments areas for log removal and haul (Table 3-54).

Table 3-54. Road Activities within Riparian Reserves to Provide Access for Treatments.

	Alternative 1	Alternative 2	Alternative 5
New permanent roads	0	0	0
New temporary roads (obliterated following use)**	0	1.5 acres	0.5 acres
Reuse unclassified road, retain	0	2.9 acres	2.0 acres
Reuse unclassified road, decommission	0	1.8 acres	1.6 acres
Change from existing condition	**0**	**- 1.8 acres of road in riparian reserve**	**- 1.6 acres of road in riparian reserve**

*A 20-foot road width was used to calculate the road acreage figures displayed in this table. This is a liberal estimate of the combined area of the actual road surface (typically about 14-feet wide) and additional width where trees on either side would be cut to allow truck passage.

**Temporary roads were not used in the calculation of net change from the existing condition since they are not long-term, permanent features.

Finally, there is a potential that some log landings would occur in the outer portions of riparian reserves; these landings would all be less than 1/8 acre in size and rehabilitated by subsoiling and revegetated as necessary or appropriate. None of the larger, one-acre landings proposed for the processing of biomass would occur within the riparian reserve land allocation.

Direct and Indirect Effects

The direct effects to riparian forest conditions are defined as those occurring within the riparian reserve of treatment units over the short-term. The indirect effects are those that would occur within the riparian reserves of the treatment units over the long-term (more than two decades), or that would occur beyond the immediate location of the treatment areas.

Under both action alternatives, the construction of temporary roads within riparian reserves would result in short-term impacts to riparian forest conditions by disturbing soil, vegetation, and changing localized habitat conditions at the site scale. No such impacts would occur under Alternative 1 where no temporary roads would be built. The action alternatives would result in immediate losses of small-sized organisms, habitat, and site productivity at the immediate site of the road prisms. The duration of these impacts are expected to last up to two decades. The roads would be subsoiled following use and some of the displaced wood and duff would be pulled back across the roads (see soil mitigation measures in Chapter 2) accelerating recovery from the impacts. There is essentially no difference among the action alternatives with respect to the amount of new temporary road impacts. The acres displayed in Table 3-54 include the cutting of trees parallel to the temporary road prisms to allow room for truck passage. Since the linear openings created with temporary road building can be expected to be at most 20 feet in width, the change in riparian forest crown closure associated with the temporary road building would be essentially no different than the crown closure changes from the thinning treatments, discussed below.

The thinning in the riparian mixed conifer stands under the action alternatives would lower the existing overstory canopy closure, (ranging from 50-60 percent today) down to between 25 and 45 percent. This drop in overstory canopy closure would gradually recover over several decades, as long as no fires or follow-up treatments occur. These changes in canopy closure would allow more light penetration in these mixed conifer stands, resulting in warmer and dryer riparian forest conditions compared to Alternative 1.

In contrast, the thinning under the action alternatives in commercial lodgepole pine stands would result in little overstory change compared to Alternative 1. This is because the thinning of the lodgepole pine overstory would approximate the loss of overstory trees from the mountain pine beetle infestation, which would proceed unchecked under Alternative 1. As such, there would be little difference in riparian reserve overstory canopy closure where lodgepole is thinned compared to no action where the beetle infestation is predicted to kill most of the overstory lodgepole.

The understories of lodgepole stands would be more affected by the action alternatives compared to Alternative 1. Under no action, the dead and toppling overstory lodgepole pine would add shade, habitat structures, and moisture retention to the forest floor that would be removed or interrupted under the action alternatives. During logging, the understory vegetation would be crushed, knocked down, and killed. Also, the fuel treatments such as mastication, grapple piling, hand piling, and chipping would further clear understory vegetation. This understory effect would also occur in mixed conifer understories where logging activities and fuel treatments would promote warmer, drier conditions in the forest of riparian reserves compared to Alternative 1.

The ground-based logging using mechanized and cut-to-length systems would be used to implement most all of the commercial thinning of riparian reserves under the action alternatives. These systems would exert direct impact to riparian reserves due to soil and vegetation disturbance. Soil disturbance results in a loss of site productivity, and vegetation clearing results in habitat modification. The action alternatives would result in essentially the same amount of riparian impacts (Table 3-53). The actual amount of disturbance expected with the ground-based logging would be about one-tenth of the total ground-based logging acres displayed in Table 2-1, because skid trails typically affect about 10 percent of the area logged with ground-based systems. With the cut-to-length logging system, soil disturbance is lower compared to other ground based logging, because the equipment operates on top of a bed of tree branches that are laid in front of the machine as it works through the stand (USDA, Forest Service, 2003a). The tree branches provide a cushion resulting in less displacement and compaction of soil, but vegetation clearing is still an impact.

Both the thinning and fuel reduction treatments under both action alternatives would also lower the rate of litter input to streams and the riparian forest floor which represents important nutrient cycling and food bases for aquatic and terrestrial organisms. This thinning effect may lower local populations of dependant aquatic organisms. Such effects would gradually subside over a period of 30 to 40 years.

Under the action alternatives, the various thinning and fuel prescriptions applied to the riparian reserve land allocation are not expected to exert unusual or extraordinary impacts to riparian forest conditions. This is because the thinning would approximate more open stand conditions desired in riparian areas, lower the risk of severe fire effects in the riparian reserves, and help introduce landscape-level pattern diversity in an

otherwise homogenous landscape of mostly dense mature forests in the lodgepole pine areas.

The amount of prescribed underburning in the riparian reserves of streams is very limited in extent (approximately 26 acres) under the action alternatives. The small amount of underburning is expected to negatively affect existing down wood by consuming some of the advanced decay class logs now present on the riparian forest floor. Underburning is expected to create exposed soil in about 18 percent of the treatment area. Such areas are more prone to surface erosion and noxious weed introductions. These effects are typically short term, since ground vegetation quickly recovers in the first two years following burning, so the magnitude of such effects would be limited. These impacts are described further in the soil and noxious weeds sections of this chapter.

The fuel treatments that apply fire to concentrated slash piles, with handpile burning (28 acres in Alternatives 2 and 87 acres in Alternative 5) and grapple pile burning (127 acres in Alternatives 2 and 81 acres in Alternative 5) would also result in direct effects to riparian reserves in terms of site productivity and bare soil exposure. Such concentrated pile burning typically removes the soil duff, mineral soil can be exposed, and small, low-mobility organisms can be killed. The extent of these impacts in riparian reserves is very limited since grapple piles can be expected to affect about five percent of the acres listed above and hand piles about three percent of the treatment area listed above.

Disturbance of riparian ground cover, vegetation, and small organisms associated with the fuel treatments are minimized through mitigation because the concentrated slash piles would be burned during wet weather when site impacts are minimized. A mitigation measure incorporated into the action alternatives requires that underburning occur during moist conditions when large down wood and duff are less likely to be completely consumed. This measure is expected to lessen impacts and meet standard and guideline FM-1.

Standard and guideline FM-4 would also be met with the action alternatives since the fuel prescriptions in riparian reserves would lower activity fuels and other fuel accumulations to levels that would more closely approximate fuel loads in a natural fire regime. These activities are necessary in order to contribute to meeting the desired riparian forest conditions of improved species and structural diversity and lowering the risk of crown fire that could impact such diversity.

The amount of treatment in the context of the riparian reserves in the planning area equates to between 14 and 16 percent of the overall riparian network. These are relatively small-scale effects for the riparian reserve network. Moreover, the 50-60-foot no-cut buffers on all perennial streams and some of the intermittent streams would help moderate these effects providing a cooler, dense forest paralleling all the buffered channels.

Mitigation measures to minimize impacts from ground-based logging include limiting the density of skid trails, restricting equipment entry to no closer than 40 feet from stream channels, and subsoiling of skid trails after use. These measures, detailed at the end of Chapter 2, are included in all action alternatives and function to lower the extent and intensity of the impacts disclosed above.

Under Alternative 1, no soil disturbance or vegetation removal from logging or activity fuel reduction would occur, thus no organisms would be killed, no bare soil would be exposed, and no productivity losses would occur in riparian reserves.

Under Alternative 2, approximately 1.5 acres of riparian reserve would be affected by temporary road construction and follow-up obliteration, and only 0.5 acres under Alternative 5 (Table 3-54). In the high-elevation pumice soils, the effects from these temporary roads would be realized for several decades, because these unproductive soils are generally not resilient to impacts. As such, the adverse effects to riparian forest conditions, such as loss of habitat, site productivity, and potential weed introductions, are expected to continue for at least a decade following temporary road building/obliteration.

Though the action alternatives would result in new impacts to riparian vegetation and sites, they would also decommission currently existing, long-term road surfaces, ultimately resulting in a net decrease of permanent road in the riparian reserve allocation (Table 3-54). Action Alternatives 2 and 5 would result in the net decrease of 1.8 and 1.6 acres, respectively, of existing riparian roads, responding to the desired condition of decreased area occupied by permanent roads and addressing several aspects of the ACS. Alternative 1 would not construct any new temporary roads, nor would it result in any beneficial long-term effects from decommissioning existing road beds in the riparian reserves of streams.

Thinning the mixed conifer stands under the action alternatives would lower snag and down wood recruitment rates compared to Alternative 1 by removing trees that would die from suppression mortality or from pine beetles. The majority of the snag recruitment loss from the low thinning in mixed conifer would be from smaller-sized trees because suppression mortality typically kills smaller, suppressed trees rather than the larger dominant trees. The lodgepole thinning would occur in the overstory, and would remove trees that would become snags and down wood recruitment to the riparian forest floor and streams. The loss of wood recruitment to perennial stream channels would be largely mitigated by the 50-60-foot no-cut buffers, because most of the wood that naturally recruits to streams comes from within the first 65 feet of the stream (Murphy and Koski, 1989; McDade, et. al., 1990).

The effects of this snag and down wood recruitment loss include the loss of habitat for aquatic and terrestrial species that depend on these habitat structures. Although habitats and habitat quality would be diminished, the relatively small amount of the thinning is not expected to result in riparian species population declines. In the context of the riparian reserve network of Diamond Lake, Lemolo Lake, and Upper Clearwater watersheds, this amount of potential recruitment loss is inconsequential.

The action alternatives in the mixed conifer stands would result in long-term beneficial effects to riparian forest structure and composition with increased fire resiliency and improved stand structural characteristics that more closely approximate the natural disturbance regime compared to more closed stand conditions under Alternative 1. As such, under the action alternatives, S&G TM-1 (c) would be met because the silvicultural practices applied to control stocking in the riparian reserve contribute to meeting the desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives. Over time, the commercial thinning of the mixed conifer riparian stands would result in stands that are more likely to attain the characteristics of late seral forests compared to Alternative 1, thus meeting desired conditions for riparian reserves. These beneficial effects would help to maintain habitat connectivity for riparian-dependant species that rely on late-successional forest conditions. The magnitude of these beneficial effects from the action alternatives are limited since only 4-5 percent of the riparian reserve land allocation in the planning area would experience the benefits and the rate at which these effects would accrue over time is gradual.

Perhaps the most profound indirect effect to riparian reserve forest conditions under the D-Bug alternatives are the effects to fire behavior that would operate over several decades at both the stand and broader landscape scale. Dense homogenous forests have dramatically altered how wildfires burn today compared to how they burned historically under more open and heterogeneous forest structures. The homogenous forest structures that proliferate today exert increased potential for crown fires (Peterson, et al., 2004; Powell, et al., 2001). Moreover, areas of older lodgepole pine are likely much more extensive today due to fire exclusion. As such, insect mortality is predicted over larger areas with more severe fire effects compared to a more natural fire regime. Such uncharacteristic effects would be realized within the riparian reserves as well as the uplands. This is discussed in the Fuels section of this chapter. Alternative 1 would do nothing to change this adverse trend. The chances of severe fire effects to forest floor soils and associated organisms would be elevated in the stands containing stem exclusion and mature lodgepole due to predicted fuel build-ups from the beetle infestation.

The combined effects of the thinning and treatment of fuels, plus the fuelbreak implementation under the action alternatives, would help modify fire behavior to reduce the likelihood that future wildfires might result in severe fire effects within the treatment areas and at the broader landscape level (*see* Fuels section in this chapter).

Under Alternative 1, the amount of the landscape likely to burn as a stand-replacement fire, which includes riparian reserves, would be higher than under the action alternatives. In particular, such beneficial effects can carry over to larger areas, especially where treatment areas are clumped, such as along the Highway 138 and Highway 230 evacuation routes and the Thirsty/Kelsey fuelbreaks. This is because treatments applied on a substantial scale, as proposed under the action alternatives, can modify the spatial pattern of fuels over a landscape area that can modify wildfire behavior (Peterson, et al., 2004). As such, nearby untreated forests and their riparian areas are expected to benefit from adjacent treatments where fuels have been reduced and canopy base heights increased. As a result, wildfire behavior in the area would burn at a lower intensity, spreading slower, which locally delays the forward progress of a fire and creates variability in the intensity of a wildfire as it moves across the landscape (Peterson, et al., 2004), and as described in the fuels section of this chapter. Thus, the action alternatives would likely result in reduced fire intensities (in terms of heat generated and rate of spread), increased ability to manage wildfire and use future fires for their ecological benefits, and reduced fire severity (in terms of the fire effects on killing trees and impacting site productivity).

The riparian reserve network for the three fifth-level watersheds that D-Bug overlays (Diamond, Lemolo, and Upper Clearwater) equates to 13,480 acres. At this larger watershed scale, all the above direct and indirect effects to riparian reserves would be very diluted and limited in extent and magnitude. The possible exception to this conclusion might be the beneficial indirect effect of reduced fire behavior both within and adjacent to fuel reduction treatments. Such an effect may be realized at the watershed scale if fire behavior is substantially modified by the fuelbreaks and the concentrated thinning treatments around the lakes. In this case, Alternatives 2 would result in slighty greater beneficial effects than Alternative 5. Scientific publications have concluded that fuelbreaks (that are maintained over time) are generally effective at modifying fire behavior except under the most extreme conditions (Weatherspoon and Skinner, 1996), and in areas where thinning and fuel treatments are consolidated without a lot of untreated edge, overall mortality is less (Agee and Skinner, 2005).

In summary, several types of localized direct and indirect adverse effects to riparian forest conditions can be expected to occur under all three action alternatives. The magnitude of these effects at the site-scale in relation to the planning area and the broader watershed scale are inconsequential. This is because both the extent and the duration of these impacts (as described above) are expected to be low. In contrast, the predicted changes to fire behavior as a result of the action alternatives could result in beneficial effects that operate at larger scales potentially over several decades.

STREAM CHANNELS

During scoping, several conservation groups were concerned that building new temporary spur roads, along with the retention of old abandoned roads, could cause numerous environmental impacts including impacts to streams. The impacts to streams from the various forms of road construction and road work are disclosed in this section.

Streams in the planning area are primarily affected by roads that cross them or that exist near them, by the age of the adjacent forest that provides bank stability and large wood input, and by the effects of disturbance such as floods and fire.

Existing Condition and Desired Condition

Extensive stream surveys were done for the 1998 Diamond Lake/Lemolo Lake Watershed Analysis, which found channel stability in both managed and unmanaged area was stable with properly functioning systems that effectively process both flow and sediment. (USDA, Umpqua National Forest, 1998). These surveys also found functioning levels of instream wood in most channels surveyed.

A survey of system roads that represented all potential haul roads was carried out to assess reconstruction needs. Aquatic connectivity is considered very good since only two problem stream crossings were found.

The desired condition for stream channels in the planning area are: 1) decreased risk of road-related stream diversion and stream crossing failure, in keeping with ACS objective 5 that addresses the sediment regime; 2) improved levels of large instream wood recruitment potential in keeping with ACS objective 2 that addresses stream bed and bank conditions.

Riparian Reserve Road Standards and Guidelines from the Northwest Forest Plan

RF-2a. For each existing or planned road, meet Aquatic Conservation Strategy objectives by minimizing road and landing locations in riparian reserves.

RF-2e. For each existing or planned road, meet Aquatic Conservation Strategy objectives by minimizing disruption of natural hydrologic flow paths, including diversion of stream flow and interception of surface and subsurface flow.

RF-3a. Meet ACS objectives by reconstructing roads and associated drainage features that pose a substantial risk.

RF-3c. Meet ACS objectives by closing and stabilizing, or obliterating and stabilizing roads based on the ongoing and potential effects considering short-term and long-term transportation needs.

Roads Analysis and Previous NEPA Decisions

Since no road management activities would occur that would change access, current use, or changes in traffic patterns or road standards, no roads analysis is needed to

support the D-Bug project (USDA, Umpqua National Forest, 2008). The NEPA accomplished for the re-issuance of the recreation residences special use permits resulted in a decision to decommission a portion of a system road that closely parallels the west shore of Diamond Lake (4795-300) and some of its spurs. Some of this same road would be used for D-Bug haul and presumably decommissioned at some point in time after D-Bug haul is done. The decommissioning under this previous decision is listed as the first two similar actions for each action alternative (tables 2-3 and 2-6) since it has the potential to be accomplished in coordination with D-Bug operations.

Proposed Road Treatments in Stream Channels

Alternative 2 would construct two temporary stream crossings in two different intermittent stream channels. Alternative 5 would only construct one new temporary stream crossing. These crossings are necessary to meet the overall objectives of the project. If these crossings were not constructed, more miles of temporary road construction would be necessary to provide access to the thinning areas. These temporary crossings would be obliterated following the log haul.

The action alternatives would also implement routine road reconstruction to achieve safe and effective haul conditions as described in Chapter 2. Specifically, in streams, alternatives 2 and 5 would both replace an existing stream crossing in an intermittent tributary of Silent Creek on Road 4795-300, which accesses units 61 and 62 west of Diamond Lake. This action is proposed, in part, because the crossings both pose some risk of erosion in their current condition.

Several mitigation measures are included as part of this instream road work in the intermittent channels (as detailed in the Road Construction and Reconstruction mitigation measures of Chapter 2) to lower or minimize the risk of water contamination and turbidity when equipment and workers are working in and near these streams.

Direct and Indirect Effects

The direct effects to stream channels are defined as those short-term effects at the immediate location of instream work areas over a period of up to five years. This is based on observations of the recovery time for in-channel and bank disturbances associated with temporary road construction at stream crossings and road reconstruction at crossings. The indirect effects to stream channels are defined as the long-term effects of the instream road work that could last longer than five years, plus any downstream effects in perennial streams in the planning area.

The effects to stream channels associated with temporary road construction, which includes two new crossings of intermittent channels, would result in direct impacts to channel banks and beds with equipment used to construct either temporary fords or temporary culverts. The work at stream fords and sections of road leading to the fords plus the subsequent haul across these small dry channels would result in new disruption of these previously unaltered channels. Rock and other nearby fill would be placed in small intermittent streams to allow trucks to cross the small channels. The placement of rock and/or culverts and the shaping of the fords/crossings with heavy equipment to prepare them for truck traffic would result in sedimentation at the time the work is done and again once late summer and fall rains begin. In addition, direct sediment input to the channels would occur while building the stream crossings and hauling logs and machinery across these two streams. Bare soil exposure would exist throughout the area of the stream crossing work and in the road approaches to the crossings. These direct effects to the banks and beds of the intermittent channels at these temporary

crossings are predicted to deliver a relatively small amount of sediment (Table 3-51). The effects to channel beds and banks are expected to last for at least a decade until the channels redistribute bed materials and bank-side vegetation returns, while the effects of sedimentation are expected to dissipate within a few years.

For the existing stream crossings that would be reconstructed on the system road that crosses the Silent Creek tributary, channel banks and beds would be modified during the culvert replacement by equipment working on banks and within the channels to excavate fill material surrounding the existing culvert and backfill around the new culvert. The installation of a culvert at the non-functional ford in the intermittent channel south of Lemolo Lake would also result in increased surface erosion, but the small snow-melt channel is presently ill-defined, and barely formed as a channel, so effects to stream banks and beds would be very limited. These effects are expected to last for about two years, but the amount of actual sedimentation for the reconstruction is also relatively low (Table 3-51). Moreover, the erosion control measures and restrictions on the timing of work (listed at the end of Chapter 2, under road reconstruction) would effectively lower both the extent and duration of the work-site sedimentation. No short-term sedimentation would occur under Alternative 1 since no ground disturbing activities would take place.

Over the long-term, the action alternatives would result in beneficial effects to stream channel connectivity and to the sediment regime as a result of work done to improve existing stream crossings and road maintenance conducted near streams compared to Alternative 1, where no such work would occur. The action alternatives would result in improved stream connectivity due to increased culvert capacity and longevity in the Silent Creek drainage. These represent minor channel improvements, consistent with standard and guideline RF-3a. These minor benefits would not occur under Alternative 1. Moreover, the lower amount the predicted stream sedimentation as a result of road maintenance (Table 3-51) would also be a minor beneficial effect relative to Alternative 1, which has no haul-related road maintenance.

The short-term effects to both riparian conditions and stream channels, taken in total (Table 3-55), are generally outweighed by the longer-term beneficial effects. For instance, the accelerated attainment of desired riparian forest conditions through thinning of the mixed conifer riparian areas outweighs the short-term adverse effects, such as small-scale habitat losses, microclimate changes, and sediment delivery because the beneficial effects operate over a longer period of time resulting in more overall net benefits. More importantly, the beneficial effects of lowering stand densities and fuel loads in both the mixed conifer and lodgepole forest types, which would lower the risk of uncharacteristic fire effects in riparian areas and streams, outweighs the localized, short-term impacts described above.

Table 3-55. Summary of Riparian and Stream Actions and Effects.

Riparian Actions	Riparian/ Stream Change	Primary Effect (Beneficial and/or Adverse)	Duration	Amounts by Alternative		
				1	2	5
Com-mercial thinning	Less tree density & less crown closure. Equipment operations	Beneficial—improved species and structural diversity/late successional characteristics, lower risk of severe fire effects. Adverse—dryer microclimate, less litter to streams/forest floor, soil disturbance, risk of weed introductions	20-30 years 10-20 years	0 ac	450 ac	283 ac
	Lessened snag and down wood recruitment process	Beneficial—accelerated growth of leave trees for future recruitment of larger snags/down wood Adverse—loss of suppression mortality in smaller-sized trees and in overstory lodgepole	up to 60 years 30 years			
Non-commer-cial fuel treatments	Lower surface and ladder fuels via mastication	Beneficial—moves stands to more fire resilient condition Adverse--soil disturbance, loss of site productivity, risk of weed infestations	20-30 years	0 ac	285 ac	325 ac

Riparian Actions	Riparian/ Stream Change	Primary Effect (Beneficial and/or Adverse)	Duration	Amounts by Alternative		
				1	2	5
Road work	Obliteration of existing roads	Beneficial—improved riparian habitat connectivity	perpetuity	0 ac.	1.8 ac.	1.6 ac.
	New temp rd construction and obliteration	Adverse—loss of vegetation/habitat connectivity	20 years	0 ac	1.5 ac	0.5 ac
	Recon-struction of stream cros-sings/fords	Adverse—small scale sediment delivery and channel changes Beneficial—sm. scale erosion risk reduction	5 years 20+ years	0 ac	1 site	1 site
	Reuse and retain unclas-sified roads & trails	Adverse—continued impacts to riparian vegetation	40+ years	0 ac.	2.9 ac.	2.0 ac.

Cumulative Effects to Streams Channels and Riparian Forest Condition

The potential of the D-Bug action alternatives to result in either adverse or beneficial cumulative effects to riparian forest and stream conditions is addressed at the scale of the planning area. Since the direct and indirect effects of the action alternatives would result in a low magnitude of effects (as detailed above), it is reasonable to assume that these effects would only overlap with the effects of other past, present, and foreseeable future activities at the scale of the planning area rather than at the larger scale of fifth-level watersheds.

The adverse effects of the D-Bug action alternatives on riparian forest conditions such as lower snag and down wood recruitment levels, would overlap with the 134 acres of past riparian clearcutting and riparian area occupied by system roads (Table 3-52). This is because the past clearcut areas are not yet producing a full complement of snag and down wood habitats and the system roads are producing no vegetation or wood recruitment potential. The added impacts from the D-Bug action alternatives on these habitat features would combine with the past impacts, resulting in an incremental additive impact to snags and down wood habitat structures in the riparian reserve network of the planning area. Likewise, the direct and indirect effects associated with the fuel treatments of the D-bug action alternatives would incrementally add to the ongoing riparian effects associated with the 25.7 acres of underburning/handpile burning

in riparian reserves under the Lemolo EIS in the vicinity of Lemolo Lake. However, since no riparian thinning is occurring with the sales of the Lemolo EIS, no additive effects from thinning are possible with that project.

The adverse effects of the D-Bug action alternatives to riparian forest conditions could also incrementally add to the ongoing recreation impacts to riparian reserves resulting from human use and maintenance that occurs within developed and dispersed recreation sites along streams in the planning area. However, the potential of additive, cumulative effects in this situation are considered low because the extent and magnitude of the ongoing recreational impacts are very limited in area and magnitude.

On the other hand, the beneficial effects of thinning and fuel reduction under the D-Bug action alternatives in both riparian and upland locations are expected to combine with the beneficial effects of both riparian and upland burning and fuel reduction of the Lemolo Lake and Diamond Lake Hazardous Fuels Projects and the Lemolo EIS activities. Taken together all these projects could help to lower the probability of stand-replacement fire in the planning area's riparian reserves, incrementally improving riparian conditions over the long-term.

Impacts to streams and riparian forests have resulted from past road building and timber harvest in the D-Bug planning area (Table 3-1). The existing road network continues to exert local effects to streams at stream crossings and continues to impact riparian forest conditions in the planning area. The direct and indirect effects to streams and riparian forest conditions from the D-Bug action alternatives would add to the ongoing impacts of the road system, resulting in low-level cumulative effects to stream channels and to riparian forest conditions. The magnitude of these cumulative effects is considered limited because the additive effects from D-Bug are minor. Moreover, the existing road network exerts low-levels of impact to riparian areas with only 31 acres of riparian reserve occupied by permanent roads in the planning area (Table 3-52). Likewise, the low road density found in the planning area does not presently exert a profound influence on stream channels due to a low number of stream crossings and the very gentle terrain found in the planning area. As such, the additive effects from D-Bug, though cumulative, are minor with very limited consequence to both riparian forest conditions and stream channel conditions.

The direct stream channel effects of the D-Bug action alternatives would also incrementally add to the impacts of work done in Lake Creek under the Diamond Lake Restoration EIS. This work was localized to the outflow of Diamond Lake, where Lake Creek begins. No D-Bug work would occur in Lake Creek, but the low-level instream work in the planning area under the action alternatives is considered cumulative in terms of the overall stream network in the planning area. As such, the additive effects from D-Bug are minor with very limited consequence to the stream channel network.

Under the Lemolo EIS, none of the new system or temporary roads crossed any streams, and no reconstruction or maintenance occurred at stream crossings. As such, no additive effects would be realized with projects covered under the Lemolo EIS in terms of stream channels.

Alternative 1 has the potential for future wildfires to result in more severe fire effects in riparian reserves than under the action alternatives. The lack of action under Alternative 1 would add to the effects of decades of fire exclusion. The uncharacteristically dense mixed conifer stands developed in the absence of fire are more susceptible to crown fires. Fire exclusion in the lodgepole forests has allowed more contiguous acres of stem exclusion and mature stands than would have occurred under the natural disturbance

regime. Both these stand-level and landscape conditions would continue unchecked under Alternative 1 and present more long-term risk to riparian forest conditions.

Aquatic Conservation Strategy

The riparian reserves included in this project have developed unnaturally dense conditions (in the mixed conifer types), which do not reflect the historic disturbance regime. Similarly, the exclusion of fire in the lodgepole landscape has made large areas susceptible to pine beetle mortality and created a landscape with uncharacteristically heavy fuel loads including riparian areas. The proposed thinning and the fuels treatments in the reserves under the action alternatives would implement Watershed Analysis recommendations (USDA, Umpqua National Forest, 1996 and 1998) to restore riparian conditions and to reduce risk of severe wildfire behavior.

These actions in riparian reserves are in compliance with Northwest Forest Plan riparian standard and guideline TM-1c which calls for the application of silvicultural practices to acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives.

As disclosed above under the Riparian Reserve discussion, the action alternatives would restore species composition and structural diversity of plant communities, and would continue to supply sufficient coarse woody debris in riparian areas. As such they are consistent with ACS objective 8. In addition, the restorative riparian thinning in mixed conifer stands would be consistent with ACS objective 9, because the thinning would provide long-term habitat for riparian-dependant plant and animal species. By restoring more open stands, like those that historically developed following disturbance, the dense stem exclusion and mature mixed conifer stands would be less prone to stand-replacement fire, and more likely to develop habitat characteristics needed by riparian-dependant species. Finally, at the broader scale, the riparian forest treatments under the action alternatives advances the role of riparian reserves in providing connectivity within and between watersheds, consistent with ACS objective 2. By maximizing the amount of riparian treatment in uncharacteristically dense mixed conifer stands and by lowering densities of older lodgepole overstories, portions of the riparian reserve network in the planning area would be more representative of the lodgepole and mixed conifer disturbance regimes of both mixed conifer and lodgepole pine forest types. The Aquatic Conservation Strategy is based on natural disturbance processes (USDA/USDI, 1994).

Alternative 1 has the potential for future wildfires to result in more severe fire effects in riparian reserves than under the action alternatives. The lack of action under Alternative 1 would maintain the adverse trend of decades of fire exclusion. Uncharacteristically dense mixed conifer stands would continue to be susceptible to crown fires. Fire exclusion in the lodgepole forests has allowed more contiguous acres of stem exclusion and mature stands than would have occurred under the natural disturbance regime. Under Alternative 1, both these forest types would sustain more long-term risk to riparian forest conditions. As such, Alternative 1 would not proactively advance ACS objectives.

The instream road work (construction of temporary crossings, re-use of existing stream fords and crossings, and reconstruction of abandoned stream crossings) follows riparian reserve standards and guidelines for roads. Though short-term, small scale adverse effects are expected under the action alternatives, the broader long-term objective of moving riparian stands toward more open conditions and less prone to severe fire effects addresses the overarching intent of the Aquatic Conservation Strategy.

FISH

There are five species of fish within the planning area--brown trout *(Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), kokanee (*Oncorhynchus nerka kennerlyi*), and tui chub (*Gila bicolor*). It is uncertain whether any native fish existed in any of the planning area streams before the advent of fish stocking. Though rainbow trout have been extensively introduced, a native strain may have been present. Diamond Lake is known to have been fishless prior to rainbow trout stocking in 1910.

The species currently present and their distribution are the direct result of fish stocking practices. Eastern brook trout overwhelmingly dominate rainbow trout wherever they overlap. Rainbow trout alone exist only in the Clearwater River above Stump Lake. Brook trout appear to have eliminated rainbow trout and any other fish species that may have been historically present from areas they have been able to access. In the few areas where rainbow trout are coexisting with brook trout, it appears to be the result of a low level of immigration from upstream areas. Also, the introduction of non-native fish to previously fishless lakes and streams has undoubtedly altered the structure and composition of the aquatic insect and amphibian communities originally present.

Brown trout are present in Lemolo Reservoir, Lake Creek, and the North Umpqua River. Brown trout distribution extends upstream from Lemolo Reservoir for approximately six miles in the North Umpqua River and approximately 11.5 miles in Lake Creek. Brown trout spawning has been observed in Spring River.

Rainbow trout are present in Diamond Lake, Silent Creek, Lemolo Reservoir, Thielsen Creek, and Lake Creek (Figure 3-24).

Brook trout are present in Lemolo Reservoir, Pit Lakes, Lava Creek, the Clearwater River, the North Umpqua River from its origin at Maidu Lake to Lemolo Reservoir, intermittently in Lake Creek, Thielsen Creek, and Poole Creek (Figure 3-24).

Kokanee reside in Lemolo Reservoir and enter the upper North Umpqua River and Spring River to spawn (Figure 3-24).

Tui chub are present in lower Lake Creek, Lemolo Reservoir and possibly Pit Lake #2.

The segment of the North Umpqua River between Soda Springs Dam and Lemolo Dam is dominated by resident trout, but it is not considered to be part of the affected environment because project effects are not expected to be realized anywhere below Lemolo reservoir.

Soda Springs Dam, located 22 miles below Lemolo Reservoir, is a complete barrier to upstream fish passage, and consequently, represents the upper extent of anadromous fish in the North Umpqua system today. Three of the fish species that occupy the North Umpqua River below the hydroelectric development (22 miles downstream of Lemolo) have special status. Oregon Coast (OC) coho salmon are listed as a Threatened species under the Endangered Species Act, while Oregon Coast steelhead and Umpqua chub are recognized by the Forest Service as sensitive species. None of these species are within the affected environment of the D-Bug project because of the sheer distance downstream from the project.

AQUATIC INVERTEBRATES

There are currently two aquatic invertebrates listed as sensitive by the USDA Forest Service Region 6 Regional Forester for the Umpqua National Forest:

Western ridged mussel *(Gonidea angulata*)

Western ridged mussels occur in streams of all sizes and are rarely found in lakes or reservoirs. They are found mainly in low to mid-elevation watersheds, and do not often inhabit high elevation headwater streams (Nedeau, et al., 2000). As such, the planning area is unlikely to provide habitat for this freshwater mussel and is not considered to be part of the D-Bug affected environment.

Rotund Lanx (*Lanx subrotunda*)

The rotund lanx is a small freshwater limpet (length 10-20 mm). Current distribution appears to be scattered and local in portions of Little River and the North Umpqua River below the confluence with Little River. It is not likely that this invertebrate occupies any of the streams in the planning area, since a 2006 aquatic mollusk survey found this species in mainstem locations. As such the planning area is unlikely to provide habitat for this freshwater mussel and is not considered to be part of the D-Bug affected environment.

AQUATIC HABITATS

Existing Conditions

Diamond Lake and Lemolo Lake are the two largest fish-bearing lakes in the analysis area, both representing long-term recreational fisheries. Diamond Lake was infested with tui chub, a small fish native to the Klamath basin that was inadvertently introduced in the early 1990s. In 2006, the water level of the lake was drawn down by eight feet in order to eradicate the chub with rotenone to kill all fish. In 2007, Diamond Lake was re-stocked with rainbow trout and the fishery has rebounded. Lemolo Reservoir is created by the Lemolo 1 diversion dam of the Toketee hydroelectric project. It also provides an important recreational fishery, but contains a population of tui chub, that remains fairly stable, presumably due to deeper shorelines with less potential spawning habitat than Diamond Lake. Pit Lakes #1 and #2 are former gravel pits developed as small lakes that have been stocked with rainbow trout. They are located south of Lemolo Reservoir.

A detailed discussion of Lemolo Reservoir and Diamond Lake is available in the Lemolo/Diamond Lake Watershed Analysis and the Diamond Lake Restoration Final Environmental Impact Statement (USDA, Umpqua National Forest, 2004).

Most of the planning area streams flow through the High Cascade Geologic Province, which is characterized by low stream density and slow storm runoff response in contrast to the more rapidly responding Western Cascades province (see section on Fluvial Erosion). There are approximately 47 miles of fish bearing stream (Table 3-48) that make up the various subwatersheds that D-Bug overlays (Figure 3-24).

Brief descriptions of the habitat contained in each stream are provided below. For detailed descriptions, see Appendix A of the Lemolo/Diamond Lake Watershed Analysis and Appendix E of the Upper Clearwater Watershed Analysis.

North Umpqua River

The North Umpqua River upstream from Lemolo Lake has a main stem length of approximately 9.8 miles. The river originates at the outflow from Maidu Lake. Summer water temperatures are cold throughout most of the channel main stem, typically ranging from 6-14ºC, with temperatures above 15ºC being rare to very rare.

The occurrence of instream large woody material in the North Umpqua River above Lemolo Reservoir is at fully functional levels throughout the low-to-mid reaches, with somewhat high levels present in the upper half of the channel main stem. The pattern of pool frequency is unusual in the channel main stem; in that pool frequency is inversely proportional to woody debris frequency. Pool frequency ranges from low in the lower reaches to very low in the upper reaches.

Downstream from Lemolo Lake, the North Umpqua River flows for roughly 16 miles before entering Toketee Reservoir. From Toketee Reservoir, the river flows for another 4.5 miles before entering Soda Springs Reservoir. From Lemolo Reservoir, downstream to the end of the hydroelectric project at the Soda Springs dam, the North Umpqua River has been highly modified by dams, diversions, low flows, and canals.

Upper Clearwater River

The Clearwater River mainstem above Stump Lake has a main stem length of approximately five miles. It is a fundamentally intact cold water system. The North Umpqua Hydroelectric project minimally affects only the lower few hundred feet of habitat by slowing water velocity as it enters Stump Lake. Very little riparian timber harvest has occurred and riparian road construction has been limited. Only one timber harvest unit near the downstream end of the reach is partially within designated riparian reserves.

Lava Creek

Lava Creek, which is tributary of the Clearwater River, has a channel length of about 4.7 miles. Functioning woody material levels are very low and fine sediment deposition is high. It is likely that spawning habitat for rainbow trout and rearing space have been somewhat reduced from a combination of instream salvage, stream cleaning, and a stand-replacing fire in portions of the watershed that occurred in 1910. High levels of fine sediment deposition most likely resulted from a combination of fire history, geologic factors, timber harvest, and road construction. Since most of Lava Creek mainstem flows through ash deposits, it is naturally susceptible to a high fine sediment load.

Spring River

Spring River originates from a large spring complex that produces the vast majority of the stream flow. Water emerging from the spring source is cold, approximately 5ºC. The water warms considerably, most likely due to a very high width/depth ratio, in the short 1.0 mile channel length during the summer. Spring River is believed to be an important spawning area for brown trout and kokanee. Both species are known to enter the Spring River to spawn, and juvenile rearing is also likely to occur. The preference for spawning in Spring River is most likely due to a combination of stable flow, extensive deposits of spawning sized gravel and appropriate water temperature.

Poole Creek

Poole Creek has a channel length of approximately 1.2 miles, and is a tributary to Lemolo Reservoir. The lower half of the stream is low gradient with high sinuosity, while the upper portions channel gradient increases to over ten percent with only about 25 percent of the stream classified as pool habitat.

Lake Creek

Lake Creek has a channel length of approximately 11.6 miles. Lake Creek originates at the outlet of Diamond Lake, and empties into Lemolo Reservoir. Lake Creek naturally contains warmer water because it is fed by the warm surface waters of Diamond Lake. Stream habitat is fairly consistent as the stream passes primarily through low gradient topography. A considerable amount of stable, hydraulically functioning woody debris is present.

Thielsen Creek

Thielsen Creek has a channel length of approximately 12 miles, and is a tributary to Lake Creek. Summer stream temperatures are generally cold (5-9ºC) with temperatures above 10°C occurring rarely. Large woody debris frequency is high in the lower reaches of the stream, declining to a moderate level in the upper reaches. Woody debris appears to be the dominant pool creating feature throughout the stream.

Silent Creek

Silent Creek has a mainstem length of approximately two miles. It originates in pumice flats southwest of Diamond Lake and empties into the southwest corner of Diamond Lake. Summer water temperatures in Silent Creek are cold with temperatures of 4.5 to 7° C. It is mostly a wide, stable stream without scoured bed or banks.

Direct and Indirect Effects

For this analysis, direct effects are those potentially occurring in the immediate vicinity of the aquatic habitat type over the short-term. Short-term is considered to be during project implementation which could proceed for five years or more and shortly after implementation (within about two years of implementation). Indirect effects considered in this analysis are those effects that may occur over longer time periods (more than two years) or that may occur downstream of the immediate project area.

None of the action alternatives have the potential to affect any of the physical habitats occupied by resident fish and other aquatic organisms because all four road stream crossings occur in intermittent channels well away from fish and well away from perennial water and associated aquatic life. All perennial streams would have no-cut buffers averaging 50 feet on either side of the stream, which would mitigate any direct effects to aquatic organisms during thinning and fuel treatment operations.

No direct effects to physical stream habitats from peak flow increases are expected as a result from any of the action alternatives (as discussed in the section of stream flows) thus, increased peak flows originating from the D-Bug alternatives would not occur in any project area streams or in any downstream areas either. Any turbidity or sedimentation associated with work in intermittent channels or log haul in the vicinity of streams is not expected to arrive perennial downstream areas in any appreciable quantities to affect physical aquatic habitats where fish and other aquatic life occur. Similarly, no water quality impacts are expected to occur in any streams or lakes as a result of any of the D-Bug alternatives (as disclosed in the section on water quality).

The four impoundments that exist between the D-Bug area and where anadromous threatened and sensitive fish species exist completely eliminate any risk of effects from peak flows, sedimentation, and turbidity to fish listed as threatened or sensitive and to any other aquatic organisms. The impoundments between the project area and Toketee Falls moderate the potential effects of water enrichment from both nutrient leaching and

erosion. Before reaching the point of effect for the threatened Oregon Coast coho salmon and the sensitive salmonid fish species, runoff from the analysis area is influenced by impoundments in Lemolo, Toketee, and Soda Springs reservoirs, and diversion through approximately 20 miles of canals and four generators. A result of reservoir impoundment is that most fine sediment is removed from the system before reaching areas downstream, thus making it nearly impossible for any effects of this project to impact threatened or sensitive species downstream.

None of the connected actions proposed under any of the action alternatives, such as reforestation, down wood creation, subsoiling, noxious weed control, native species revegetation, and precommercial thinning, would result in any direct or indirect effects over the long-term or in downstream areas. All of these connected actions are minor activities of limited scope and duration that would result in no direct effects. As such, these connected actions would have no chance of resulting in either long-term effects or downstream effects to water quality, fish or fish habitats. No direct or indirect effects associated with Alternative 1 to fish or aquatic organisms are expected, because no ground disturbing activities would occur.

Cumulative Effects

Since no direct or indirect effects would occur to fish or aquatic organisms, no cumulative effects are possible under any of the D-Bug alternatives.

ESSENTIAL FISH HABITAT (EFH) UNDER THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (MSA)

The MSA requires Federal agencies to consult with the Secretary of Commerce regarding any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat (EFH) identified under this law. The MSA defines adverse effects as any impact, which reduces the quality and/or quantity of essential fish habitat. Adverse effects include direct, indirect, site specific or habitat wide impacts, including individual, cumulative or synergistic consequences of actions. This law deals with commercial fisheries. Coho and Chinook salmon are considered for this project.

Based on the above discussion of direct, indirect, and cumulative effects, the D-Bug project is expected to have no chance of causing an effect upon essential fish habitat, the species considered, and their major freshwater prey species. Major prey species are considered to be a variety of aquatic macroinvertebrates, including but not limited to the aquatic and winged adult phase of the following insect groups: stoneflies, mayflies, caddisflies, and midges. No direct, indirect, cumulative, or synergistic effects to EFH are anticipated under the project. Coho and Chinook salmon are not found in the vicinity of the project planning area; and the chances of any effect being realized are so small as to be considered discountable and insignificant. Therefore, all action alternatives have been given the following EFH effects determination: Would Not Adversely Affect.

Social Environment

ECONOMICS

The disclosure of economic effects of each alternative is detailed in this section. This economic analysis focuses on the direct, indirect, and induced costs and benefits of the alternatives and the connected and similar actions described in Chapter 2. Since the purpose and need for action includes many activities that are not directly related to commercial timber harvest, impacts will be displayed as a "least cost" analysis. Net present value is normally used to compare the direct effects of the alternatives to the Federal Government, and is termed economic efficiency analysis. Net present value will be displayed as a means of comparing alternatives and as a measure of how much of the non-timber harvest activities can potentially be paid for with timber value. Impacts to the general economy of the area are modeled using IMPLAN Professional, an input/output model developed by the Forest Service (IMPLAN 2000). Assumptions regarding the economic analysis are footnoted where appropriate.

Affected Environment

Most timber sales from the Diamond Lake Ranger District are purchased and operated by individuals and companies based in Douglas and Jackson Counties. The D-Bug project area is centrally located for several industrial centers in Douglas, Jackson, and Klamath counties. This analysis will address all three counties as the economic area.

Table 3-56 describes the population and employment statistics for the economic area as of 2008, according to the IMPLAN data. Total employment in the economic area is difficult to quantify exactly, as the Oregon Labor Market Information System (OLMIS), Census Bureau, and IMPLAN use different criteria to measure employment. Because of this, percentages and relative differences are used for analysis where possible.

Forestry and wood products sectors have declined in the last two decades in the economic area. Still, the logging, forestry and wood products sectors provide more than five percent of the economic area's employment, and 12 percent of the overall industrial output, according to the 2008 IMPLAN data. Total forestry and wood products industrial output for the economic area in 2008 was $1.9 billion, down from $2.6 billion in 2006.

Table 3-56. 2008 Population and Employment (IMPLAN).

County	Total Population	Total Employment	Logging & Forestry Employment	Wood Products Mfg Employment	Forestry & Wood Products Empl %
Douglas	104,059	47,559	1,838	2,716	9.6
Jackson	201,138	122,500	2,993	1,689	3.8
Klamath	66,425	32,284	735	760	4.6
Totals	371,622	202,343	5,566	5,165	5.3

Douglas County continues to be more dependent on the wood products sectors than the rest of Oregon, and the other counties in the economic area. The trends in employment in the area show an ongoing shift from logging and wood products manufacturing toward retail sales and service sectors (OED 2002). Although overall non-farm employment in

Douglas County is expected to grow by nearly 12 percent between 2002 and 2012, lumber and wood products occupations are expected to decline by 3.4 percent. IMPLAN data through 2008 show total employment in the analysis area declined by three percent since 2006, the data year described in the DEIS. Douglas County employment declined 8.6 percent in the same period, the most of the three counties in the analysis area. The most severe decline in employment occurred in the wood products manufacturing sectors in Douglas County where more than 36 percent of the 2006 jobs were lost by 2008.

The Umpqua National Forest timber sale program has increased from nearly zero in 2002 to a fairly stable program of about 45 MMBF per year. The action alternatives as described represent a large portion of the Umpqua's potential sale program from 2011 through 2012. Douglas County would receive 25 percent of the gross receipts from the sale of timber through non-stewardship contracts from the project. These payments would be from money returned to the Federal Treasury as shown in Table 3-57.

Economic Efficiency Analysis

The direct economic effects of the alternatives are displayed in Table 3-57. The standard criterion for deciding whether a government program can be justified on economic principles is net present value (NPV) minus the discounted[63] monetized[64] value of expected net benefits (OMB A-94).

Many factors affect the NPV of a commercial timber harvest alternative, including what revenues and costs to include, the timing of these events, the species, size, and volume per acre harvested, and the logging systems used. Logging and transportation of logs to mills is by far the largest cost center in the commercial harvest treatments. Harvest volume per acre is a critical component in that low volumes, such as most of the lodgepole pine areas, push the logging costs per MBF very high. The action alternatives have been designed with the least-cost logging methods that are consistent with standards and guidelines. Generally, mechanical, ground-based logging methods are the lowest cost. Helicopter logging in low-volume, low-value stands would cost as much as twice the value of the timber and would make any such project impossible to sell.

Biomass harvest has been modeled in this analysis. Biomass is considered small diameter trees, tops, and other woody material that does not meet sawlog specifications. Biomass can be used for energy production, fuelwood, pulp, or other specialty products. Generally, if this material is brought to the landing as part of the sawlog harvest operation, it may be economical to haul this material to a facility for production when the markets are favorable. Table 3-57 displays biomass amounts that may be economically feasible to produce.

The non-commercial harvest treatments are primarily fuel reduction operations. These are included in this analysis as they represent costs to the federal government, although not associated with any sale of timber.

[63] Discounting is the process of calculating the present value of a future amount of money. 4% is the standard discount rate for long-term projects (OMB A-94).
[64] Lit. "to give the character of money to." A cost or benefit is monetized when it is expressed in terms of money.

Table 3-57. Economic Efficiency Analysis.

	Alt 2	Alt 5
Timber Volume (MBF)[65]	45,664	29,033
Total Commercial Harvest Acres	6,989	4,850
Volume (MBF)/Acre	6.5	6.0
Potential Biomass (green tons)	13,500	6,850
Total Treatment Acres	9,019	7,755
Total Present Value Benefits		
Gross Benefits	$12,092,820	$7,749,670
Value/MBF[66]	$265	$267
Value/Commercial Harvest Acre	$1,730	$1,598
Total Present Value Costs		
FS Contract Prep & Admin	$1,208,594	$773,190
Logging	$8,394,048	$5,730,724
Timber Sale Slash Disposal	$997,947	$791,627
Road Work	$82,408	$80,012
Reforestation	$82,028	$0
Non-Timber Sale Treatments	$1,453,821	$1,218,347
Total Cost	$12,332,216	$8,696,942
Cost/MBF	$270	$300
Total Cost/Commercial Harvest Acre	$1,765	$1,793
Total Cost/Total Treatment Acre	$1,367	$1,121
Net Present Value	-$239,396	-$947,272
NPV/ Commercial Harvest Acre	-$34	-$195
Stumpage (2010 dollars)	$2,681,909	$1,090,802
Predicted Stumpage Price/MBF	$58.73	$35.57
Potential Return to the Federal Treasury (2010 dollars)	$1,640,771	$535,412

Forest Service planning costs are not included in the economic efficiency analysis because they are considered sunk (OMB A-94). It is estimated that this project has cost about $950,000 to plan over the last three fiscal years. Based on the expected return to the federal government shown in Table 3-57, all alternatives are close to or below cost, including planning, sale preparation, and administration, assuming the entire amount

[65] MBF is thousand board feet. The Forest Service estimates MBF using east-side Scribner rules, therefore the volume as shown, is higher than if west-side, long log Scribner rules would be applied.
[66] West side delivered log prices have been adjusted to reflect equivalent east side values due to the differences in scaling rules.

available for other treatments were sent to the Treasury instead. Alternative 1 is also below cost, because there would be no return to the U.S. Treasury with expenditures for planning.

Both action alternatives show a negative net present value and would not be considered advantageous to the U.S. government from an economic standpoint, due to the current low log market and relatively low-value tree species. Low timber prices, low-volume stands, and mitigation could make the timber sales uneconomic or too risky for purchasers, and could result in no bids for some or all of the sales.

The action alternatives would be marketed as up to seven individual contracts. These sales would be offered in a public auction to achieve the highest return possible[67]. It is anticipated that some of the post-sale mitigation requirements and other treatments would not be fully paid for by stumpage[68] from the timber sales, especially the sales that are mostly low-volume lodgepole pine stands. At first-quarter 2010 log prices, Alternative 2 would need about $179,000 of funding from other sources to complete slash work associated with the commercial lodgepole treatments. Alternative 5 would need about $390,000 from sources other than timber sale receipts to complete the slash work. If these other funds are not available at the time of sale, the timber sales risk being nonviable.

Log prices fluctuate due to a variety of market forces, many of which are external to the market area and Oregon. The recent decline in nation-wide housing has caused the local log market to fall drastically. Figure 3-25 displays a composite log price average ($/mbf) for the local southern Oregon market since 1990 using Oregon Department of Forestry log price information. (ODF, 2010) The data in Figure 3-25 are not adjusted for inflation and are equated to west-side long-log Scribner scaling rules. The economic efficiency analysis displayed in Table 3-57 uses average local log prices from the most recent quarter (first quarter, 2010).

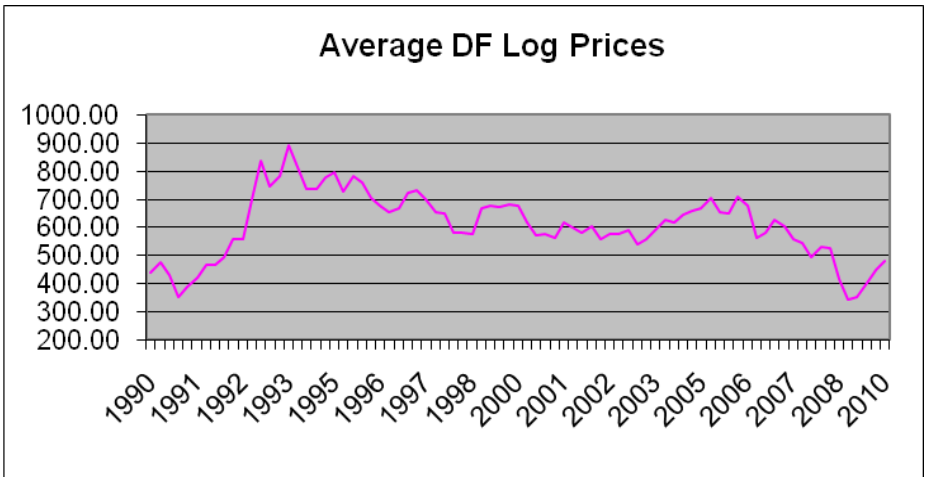


Figure 3-25. Average Composite Log Prices, Southern Oregon Market Area.

[67] Individual timber sales would be appraised and offered at fair market value, or the minimum to cover reforestation costs and a $0.50/ccf return to the Treasury, whichever is higher.

[68] Stumpage is the value of the timber "on the stump." It is the timber sale contract minimum value and is determined by subtracting logging, road work, and slash disposal costs from the delivered log price. Timber sale purchasers may bid more in a competitive auction. The actual monetary return to the U.S. Treasury is determined by subtracting all post-sale costs from the stumpage.

ODF data as of the first quarter of 2010 show the downward trend in log prices has reversed. The low point in the local market occurred in the first quarter of 2009 and there has been a marked recovery since then. Recent indications, however, are for continued uncertainty in the market, as the overall economy will recover slowly. The decline in local log prices from recent high levels in 2005 and 2006 has impacted the potential timber sale viability of both action alternatives. Less money is available for post-sale activities, and the value of the timber is such where an individual sale may not be marketable. It would be highly speculative to predict the local markets at the time of sale offer or operation.

In terms of economic efficiency, Alternative 2 has the highest net present value, and has the potential to return the most money to the Treasury. Alternative 2 has the highest predicted stumpage price, which would give it more of a cushion in this uncertain log market. This is due primarily to the stands that are commercially harvested, the slightly higher volume per acre and the species makeup in these stands.

In terms of a least-cost analysis, several measures are important: total cost of all treatments and cost per acre. Table 3-57 displays these measures for the action alternatives. Alternative 5 is the least total cost action alternative and has the least cost per treated acre, but treats fewer acres than Alternative 2.

The minimum payments to the Treasury, payments to Douglas County, and legal and administrative rules for receipts from certain contracts limit how much of the stumpage from any particular sale can pay for other work. It is estimated that from 40 to 50 percent of the stumpage value would actually be available for other treatments through KV or stewardship receipts. Therefore, Alternative 2 would need an additional $292,000 from other sources, and Alternative 5 would need up to an additional $1,100,000, to fully implement the prescribed treatments. These amounts are in 2010 dollars, and could be spread over several years of implementation.

Economic Impact Analysis

The economic impact analysis using IMPLAN considers changes in employment and income due to changes in the economic activity of the county from each alternative. An individual timber sale may not substantially change the overall economic activity of the county, because the amount of timber volume represents a small percentage of the total demand. Timber sales from the National Forest are viewed as raw material available for the local industry, allowing production and support for jobs in the local economy to be sustained. Local National Forest timber would offset logs imported to the area, potentially reducing overall costs and increasing production.

Table 3-58 displays the results of the economic impact analysis by alternative. In general, the sale of timber from the National Forest would result in sustained or increased employment in the logging and wood products manufacturing sectors, in the forestry services (slash treatment, planting, etc.) and indirect and induced employment in many other sectors. Payments in lieu of taxes due to the counties in the economic area from timber receipts are not included in these figures, as they are accounted for in the return to the Treasury shown in Table 3-57.

Other direct, indirect, and induced benefits are derived from road maintenance, reconstruction, fuels treatment, and other connected or similar activities (tables 2-2, 2-3, 2-5, and 2-6) that may be funded by revenue from the timber sales or other funding sources. These work activities are treated as costs in the benefit/cost analysis because they reduce the revenue to the Treasury, but they have economic benefits to the local

community because most are contracted services. These benefits are included in the economic impact analysis and in the numbers reported in Table 3-58. The IMPLAN output files that document the complete analysis by sector are part of the Economic analysis file.

The numbers in Table 3-58 are not intended to be absolute. The analysis should be used to compare the relative differences among alternatives. The value of each activity included in the impact analysis was estimated from the cost and benefit analysis spreadsheets. An estimate was made of the percent of each activity's value that would be spent locally. The value to the wood products manufacturing sector was estimated to be 40 percent of the delivered log price, reflecting the difference between end-product value and log cost to the mill. This difference can be widely variable based on mill efficiency and the choice of end products, but it approximates the value given for all of Oregon in 1998 (Gebert, 2002).

Table 3-58. Economic Impact Analysis.

	Alt 2 Value/%		Alt 5 Value/%	
Change in Total Industrial Output	$21,856,000	0.10	$15,007,000	0.07
Change in Employment (# jobs)	151	0.08	112	0.06
Change in Labor Income	$6,673,000	0.09	$4,822,000	0.07

Direct, Indirect, and Cumulative Effects

Alternative 1 is not shown in Table 3-58 because by definition it would not change the conditions or level of economic activity in the project area. This alternative may, however, contribute to a decline in the local timber industry, because it would keep federal timber from the market, at least in the short term. No attempt was made to quantify that impact, as it would be speculative to estimate the current and reasonably foreseeable timber supply in the local area.

Alternative 2 would provide the highest level of beneficial, direct and indirect effects to the local economy. These effects are relatively small in terms of the percentage of the economic area activity in each category, however the effects to particular sectors is much greater. Logging contractors, log truck operators, slash treatment contractors, mill workers, and other forestry services located in the economic area would be impacted directly. Alternative 2 would provide 115 direct and indirect jobs in these sectors, or 2.2 percent of the total sector employment; and $5,352,500 in labor income.

Implementation of either of the action alternatives would contribute to a beneficial cumulative effect of sustaining the wood products infrastructure in the economic area.

ACCESS FOR MANAGEMENT AND THE TRANSPORTATION SYSTEM – TRACKED AS A SIGNIFICANT ISSUE

During scoping, several conservation groups expressed concern over the construction of new temporary roads and the retention of existing unclassified roads, stating that they cause numerous environmental impacts including erosion, channeling water, spreading noxious weeds, and reducing wildlife habitat. This significant issue was addressed in

the development of Alternative 5. The environmental effects of roads are disclosed in numerous places in this Chapter including the sections on forest wildlife, botany, water quality, mass wasting, surface erosion, riparian reserves, and fisheries. This section displays the overall effects of the alternatives in terms of miles of roads, access, and economics then displays the acres treated by miles of temporary road built, in response to a request from conservation groups for this type of analysis.

Access for Management

To help quantify and track the issue of road use for thinning activities through the analysis the following indicators were developed:

- Miles of temporary road built.

Direct and Indirect Effects

Chapter 2 summarizes the road activities and effects to access in the planning area by alternative. Alternative 1 has no direct or indirect effects to the total miles of road in the watershed.

Access for management under the action alternatives would increase access for forest management activities only, as all new temporary road construction and reuse would be blocked and/or obliterated after use, with the exception of Trail 1457, which is an old road currently designated as an OHV trail. The current road density in the planning area is 2.52 miles/mile^2. Decommissioning the three segments of road described in Chapter 2 would reduce the road density to 2.5 miles/mile^2 for alternatives 2 and 5, slightly decreasing access for management. The effect of this decreased access for land managers is minimal, as the two roads are short spurs and one is currently blocked.

In addition to disclosing the amount of temporary road built, the acres accessed by the temporary roads were analyzed for full disclosure. Alternative 2 constructs and obliterates, after activities, 15.4 miles of temporary road, which would access about 1,883 acres of commercial and non-commercial stands. This results in about 122 acres of treatment accessed per mile of temporary road. Under Alternative 5, about 8.1 miles of temporary road is constructed and obliterated after activities, which accesses about 1,685 acres of commercial and non-commercial stands. This results in treating 208 acres per mile of temporary road built.

In comparing the action alternatives, Alternative 5 constructs and decommissions 7.3 fewer miles of road than Alternative 2.

Transportation System

The transportation system in the D-Bug planning area provides access for commercial users, including forest product harvesters. Recreational use includes hunting, hiking, fishing, winter sports, and driving for pleasure.

The transportation system is described in the Forest Roads Analysis and in the Diamond Lake/Lemolo Lake and Clearwater River Watershed Analyses. These documents are included in the Project Record and are incorporated by reference.

The transportation system is a network of existing roads, referred to as “system roads” because they are classified for long-term use. System roads are categorized and managed for various levels of access; from closed roads that are only intended for administrative use, such as logging or fire fighting (maintenance level 1 roads), to open roads maintained for either high-clearance vehicles (maintenance level 2 roads) or

passenger cars (maintenance level 3 - 5 roads). This section discloses the effects of the alternatives on public access.

Relevant Standards and Guidelines

Transportation system standards and guidelines are listed on pages IV-81 to IV-85 of the LRMP. Of note are the following:

Road density should be the most economical system necessary to meet land management objectives. Evaluation of road development alternatives will be made for the planned uses considering safety, costs of transportation, and the effects upon lands and resources.

Assure short-term (temporary) roads are closed within one year of when the timber purchaser has completed contractual requirements for the portion of the timber sale served by the road. Re-establish vegetation cover to put land back into production within ten years of contract, lease, or permit termination on roads not remaining a permanent part of the Forest transportation system.

Forest development roads (system roads) will generally be open to use by vehicles licensed for highway travel, except when closed for one of the following reasons:

1. The mode of access causes unacceptable damage to, or negates adequate protection and management of Forest resources.
2. Safety hazards to the road user exist.
3. Prescriptions in the Forest Plan recommend closures in elk winter range.
4. To provide security to contractors/cooperators, special use permittees, private land owners, and Forest Service administrative facilities.
5. Road maintenance costs to keep a road open are high compared to existing or expected use of the road.

Roads closed for one of the above reasons may be closed either seasonally or year-round. Seasonal closures are preferred over year-round closures, wherever feasible, consistent with Forest Plan prescriptions, and if the objectives of the closure can be met.

Direct and Indirect Effects

Road reconstruction is generally intended to fix specific drainage concerns, perform deferred maintenance items, and bring the road surface to the design standard so it can facilitate timber haul. Specific road reconstruction activities are identified for each alternative in Chapter 2. Alternatives 2 and 5 both include decommissioning one stream crossing not associated with timber haul in the summer home area. The reconstruction and maintenance work would provide for safe and economical timber haul, as well as improved drainage capacity and lower risk of road failure.

Road maintenance is important for user comfort and safety as well as protection of resources and the road facility. The Umpqua Forest-level Roads Analysis (USDA, Forest Service, 2003) describes the current situation of declining budgets for road maintenance, the reduction in timber sale-related maintenance and the amount of maintenance that needs to be done on the Forest. Maintenance that would be performed by timber purchasers would provide a substantial portion of the total needs for several years. Alternative 2 would result in 67 miles of purchaser road maintenance over the period of the associated timber sales while Alternative 5 would result in slightly less purchaser maintenance totaling 61 miles. Alternative 1 provides for no purchaser

maintenance. Improved road maintenance results in higher degrees of user comfort and safety. In addition, well-maintained roads reduce the risk of road failures and the resulting ecological and economic effects. Alternative 1 would not result in any of these beneficial effects.

Under all action alternatives, road reconstruction would occur along 4.7 miles of system road, resulting in a beneficial effect of lowering the potential of road failure and loss of access along these haul routes. Alternative 1 would maintain the existing condition and not reconstruct these sites because no action would be taken under this alternative.

Cumulative Effects

The Diamond Lake/Lemolo Lake and Clearwater River Watersheds is the scale at which cumulative effects are analyzed for roads. The overall change in the number of total road miles in the planning area is small (less than one percent) for any of the action alternatives, when compared to Alternative 1. The decommissioning of the roads described in the similar actions under each action alternative reduces the existing road density by less than 0.08 miles/mile^2. Because of this small change, there would be no measurable decrease in road density, when combined with the lack of any present or future projects that would add or subtract from the road network (tables 3-1 through 3-3). None of the other connected actions affect access for management or the transportation system.

RECREATION

Recreation opportunities and use within the watershed follow the goal outlined in the 1990 Land and Resource Management Plan (LRMP) for the Umpqua National Forest:

"…provide a broad spectrum of dispersed and developed recreation opportunities to all segments of society."

Forest Plan Standards and Guidelines

- Developed Recreation S&G #5: Sites will be administered and maintained to provide visitor safely, sanitation, and protection of facility and site resources.
- Trails S&G #2: Existing system trail tread must be relocated, reconstructed or restored after logging activities are concluded. Logging slash will be cleaned up and signing restored.

Existing Conditions

Approximately 70 percent of the planning area is managed primarily for recreation. It contains the Diamond Lake Recreation Area (Figure 3-26), Lemolo Lake Recreation Composite (Figure 3-27), dispersed recreation, the Mt. Thielsen Wilderness and Oregon Cascades Recreation Area (OCRA), extensive summer and winter trail systems and portions of the Rogue-Umpqua Scenic Byway. The Diamond Lake-Lemolo Lake and Clearwater Watershed Analyses, and the 2006 Diamond Lake Winter Use Guide provide a thorough description of the recreational opportunities found in the area and are incorporated by reference.

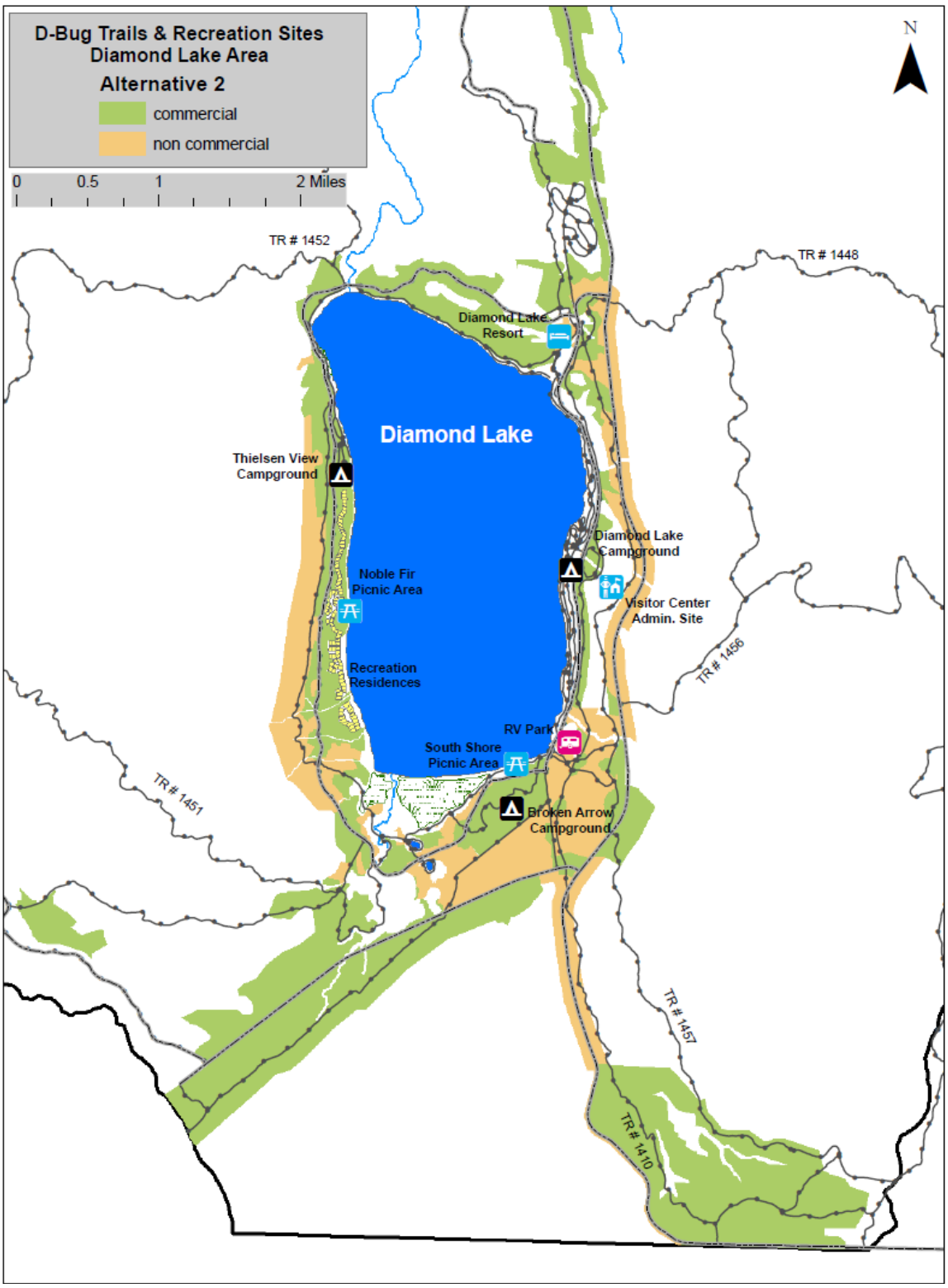


Figure 3-26. Major Recreation Sites and Trails in the Diamond Lake Recreation Area, with treatment areas under Alternative 2 shown as an example.

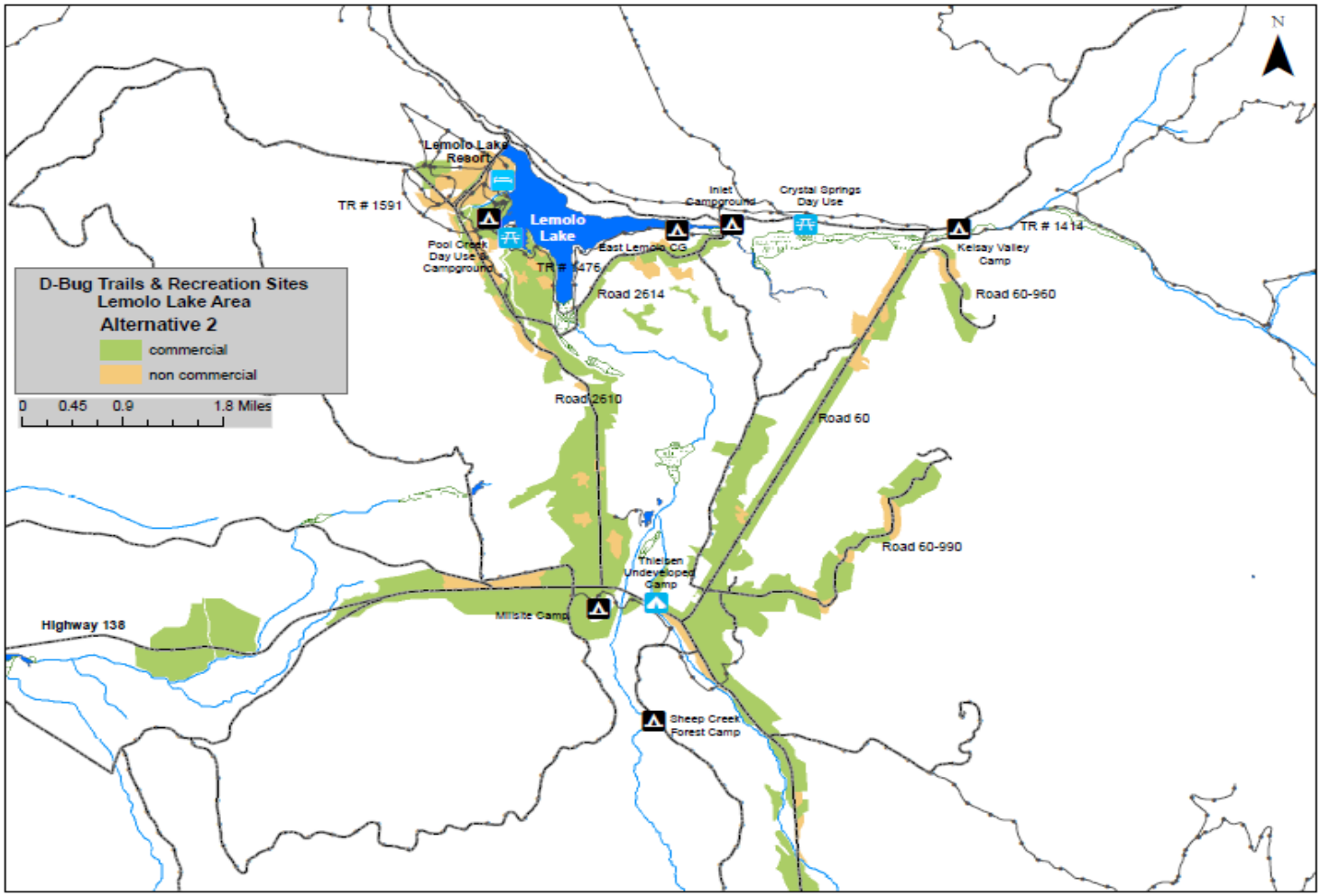


Figure 3-27. Major Recreation Sites and Trails in the Lemolo Lake Recreation Area, with treatment areas under Alternative 2 shown as an example.

Trails

During scoping, some conservation groups expressed concerned that log haul on top of existing trails and thinning next to existing trails will negatively affect the trails and the recreation experience due to the impacts from logging and other fuel reduction treatments.

Umpqua Watersheds and Klamath-Siskiyou Wildlands Center state that log haul on snowmobile trail #1457 (a segment of the Summit Trail) and thinning in the vicinity of cross country ski trail #1410 (a segment of the North Crater Trail) would affect the recreation users and that off-road vehicle use[69] would increase as a result of the thinning and the log haul. Further, Oregon Wild states that use of trail #1457 as a haul road would degrade the potential wilderness area characteristics in the vicinity.

The following indicators quantify and track this issue:

- Miles of trail used for logging access.
- Acres of commercial and non-commercial treatment within 200 feet of trails.

Trails within the planning area comprise approximately 70 percent of the total number of trail miles within in Diamond Lake Ranger District. Trails vary from wilderness to paved handicap-accessible trails, accessing numerous lakes, creeks, mountains, and other points of interest. There are both motorized and non-motorized trails throughout the watershed, used in summer and winter by hikers, bicyclists, Off Highway Vehicles (OHVs), motorcyclists, cross-country (Nordic) skiers, and snowmobilers. Approximately 60% of these trails are part of the Winter Trails System. Many of the winter trails are groomed for motorized and non-motorized users by Diamond Lake Resort and snowmobile associations in cooperation with the Oregon State Snowmobile Association (OSSA).

Specific to the D-Bug project, the following trails (hiking and/or Nordic) are located in the planning area (figures 3-26 and 3-27):

Diamond Lake area: North Crater Trail - # 1410; Howlock Mt. Trail - #1448; Mt. Bailey Trail - #1451; Mt. Thielsen Trail - #1456; Summit Trail - #1457; Dellenback Trail (including Diamond Lake Loop, North Shore, Thielsen View Connect, Silent Connect, and Broken Arrow North & South) - #1460; Pacific Crest Trail - #2000. Road 4793, Cinnamon Butte Road, is used as a Nordic trail in the winter.

Lemolo Lake area: The 860 spur (Pipeline Trail) and 800 spur (Basket Trail) are used by Nordic skiers. Other trails include the #1476, #1589, #1591 and portions of the Sidewinder Trail, the Poole Creek Loop Trail, and the Resort Connect Trail.

Clearwater area: Road 4785, and its spurs, 010, 012, and 060 are all used as Nordic trails in the winter.

Snowmobile (and/or ATV) routes include Road 4795 (Diamond Lake Loop Road), Crater Trail - #1457, Lake West Trail (along the 100 spur and Road 760), Road 4792 (Lemolo Lake Road); and the road system near Windigo Pass, including Roads 60, 430, 970, 2614, 1612, 410, 411, 570, 3401, 200, 500, 800.

[69] The Umpqua National Forest has begun the Travel Management process as required. A final determination of areas where summer OHV use is allowed will be made by September of 2009. Until such time, district travel management maps display areas that are open or closed to summer OHV use. Winter OHV use will not be considered during this planning process and will continue to follow existing use designations.

As stated above, scoping comments focused primarily on impacts from use of the Summit Trail (#1457) as a haul route, and thinning along the North Crater Trail (#1410).

Direct and Indirect Effects

Direct effects are those that would occur immediately at the trail site, while indirect effects are those that would occur in the future both at the stand and trail scale as vegetation grows over time.

Alternative 1 would have no direct effects on any trails as no activities would occur. Indirectly, the mountain pine beetle outbreak would continue to spread, killing trees across the landscape under no action. These dead trees may be a hazard to people where they are within falling distance of a trail. When they fall, these trees could damage or block the trail, and although remotely possible, people could be injured if they were present when the trees fell. In addition, as more trees die, the fire hazard increases. A widespread, high intensity fire would potentially damage existing trails, primarily through tree fall (trail blockage) after the fire has swept through the area.

There would be no direct effects to trails 1456 and 2000, as no activity would occur along these trails. Indirectly, sounds may travel during operation of equipment under the action alternatives. However, given that one can hear the sounds of Highway 138 for almost one-quarter mile up the trail, this impact is considered minor. No other activities and no past or future projects would affect these trails except for regular, routine trail maintenance; therefore, because the direct impacts are minor and there are no other impacts, there would be no cumulative effects to these trails.

In general, under the action alternatives, impacts to trail users include: tree felling across or along trails; visible slash, stumps, and burned areas (after slash treatment); more open tree spacing; increased sunlight; increased snow interception; increased noise from populated areas or roads; decreased feelings of solitude; and increased sight distance and visibility. These effects would last anywhere from five to 30 years, depending on the forest vegetation; impacts would decrease as vegetation grows. All direct impacts to the actual trail footprint, such as trees felled across the trail, would be mitigated by the purchaser, who would be required to return the trail to its pre-treatment condition (Forest Plan S&G Trails #2). To mitigate for safety concerns, all trails that cross areas of treatment or are within 200 feet of a treatment area would be signed as closed until the trail was safe for use. The details of these requirements are described at the end of Chapter 2.

The action alternatives would result in the beneficial effect of improving stand resiliency, reducing fire hazard, and decreasing the number of hazard trees that pose toppling hazards to trail users. Trails that have not been maintained due to lack of trail maintenance funding would potentially be improved by reducing the number of trees that may block the trail and by clearing of the trail if it is used during haul or movement of equipment.

Where trails coincide with a fuelbreak, the maintenance of the fuelbreak would periodically alter vegetation over time, causing a long term indirect effect. Once a fuelbreak is established, the maintenance can occur predominately through non-commercial methods. The continued maintenance would maintain a more open forest that may be visually pleasing to some, while to others, it may detract from the visitor's experience. Overall, the beneficial effect of lowering the fire hazard and having evacuation routes accessible for those using the area outweighs any negative impacts from non-commercial maintenance of fuelbreaks.

In the Diamond Lake area, trails 1410, 1448, 1451, 1457, and 1460 are the primary trails that would be directly affected by the D-Bug action alternatives (Figure 3-26). Currently, portions of trails 1410 and 1457 that are directly adjacent to Diamond Lake (between Road 4795 and Highway 138) are being heavily impacted by the current mountain pine beetle infestation, as are other trails in the vicinity. Trees are dying at rapid rates and the hazard from these trees is growing. As dead trees fall across the trails, funding for clearing these trees is diminishing, reducing the ability of users to maneuver over the trails.

Umpqua Watersheds and Klamath Siskiyou Wildlands expressed concern about trails 1410 and 1457, primarily where they run adjacent to the Highway and along the OCRA boundary, south of the Highway 138/230 junction. Both of the action alternatives would impact Trail 1410 through thinning or fuels treatments, which parallels Highway 138. Within 200 feet (either side) of the trail[70], commercial activity would occur under Alternative 2 on 281 acres, while non-commercial activity would occur on 92 acres parallel to Trail 1410. Under Alternative 5 within 200 feet of Trail 1410, hazard tree removal and fuels reduction activities would occur on a total of 51 acres, lodgepole thinning will occur on 8 acres, and 30 acres will have non-commercial treatments. Impacts include those listed above and include visible stumps and slash, increased sight distances and increased sounds; however, no haul would occur on the trail. Instead, under Alternative 2 temporary roads would cross the trail along five locations. Any direct impacts to Trail 1410, such as felled trees or disrupted tread, would be rehabilitated to its pre-disturbed state, as required by Forest Plan Trails S&G #2.

Under Alternative 2, the 8.7-mile winter trail 1457 would be used as a haul route for 7.9 miles (see photo below). This trail is primarily within the footprint of the old Highway 138 and all of this trail can be driven today by a four-wheel drive vehicle. Using this trail as a haul route would require very limited widening of the trail and felling of hazard trees, which would be a beneficial effect to snowmobile users, as the trail would be cleared and the potential for hazard trees to fall would be reduced; no haul would occur during winter, so there would be no direct impact to users from trail closures. The use of Trail 1457 for haul would be a negative impact for summer users, as the trail would be closed for summer use, primarily impacting mountain bike riders. However, these riders would also benefit in the long term by having the road cleared. Within 200 feet (either side) of the trail, commercial activity would occur on 201 acres, while non-commercial activity would occur on 134 acres. Under Alternative 5, haul would occur along 7.9 miles of Trail 1457. Alternative 5 proposes hazard tree removal and fuels reduction within 200 feet of the trail on 123 acres. Impacts include those listed above and also include visible stumps and slash, increased sight distances and sounds. Any direct impacts to the trail, such as felled trees or disrupted tread, would be rehabilitated to its pre-disturbed state, as required by Forest Plan Trails S&G #2, which would likely improve the condition of the trail for many users.

[70] Both commercial and non-commercial activities extend beyond 200 feet in most places. Two-hundred feet was chosen as it represents the distance that most users would 'feel' an effect from activities.

Figure 3-28. Trail 1457, formerly State Highway 138

Trail 1460, the paved Dellenback Trail, would also be directly affected by the action alternatives, as would the extensions of this trail that are located south of Diamond Lake. No equipment would be run on the trail surface, so no direct effects to the paved trail are expected to occur. Under all action alternatives, within 200 feet (either side) of the trail, commercial activity would occur on 274 acres, while non-commercial activity would occur on 194 acres. One haul road would cross the trail in Unit 33; however, this haul road is an existing paved road and no additional impacts would be expected. In addition, commercial activity would occur within 200 feet of trails 1460J, 1460K, 1460L, 1460H, 1481, and 1589L, which are all extensions or winter use loops that spur off of the Dellenback Trail. Within all these trails, commercial activity would occur alongside 98 acres and non-commercial activity along 48 acres.

Impacts to the Dellenback Trail and its' spurs include those listed above and involve visible stumps and slash, and increased sight distances and sounds. Some of the vegetation along this trail is quite dense. Thinning would potentially open up some vistas into the surrounding forests, possibly improving the scenic quality of the area for some users. The commercial and non-commercial activity that would occur along the trail under the D-Bug action alternatives would not be much different than the hazard tree falling that has been ongoing for several years at the Diamond Lake Campground. To mitigate for safety concerns, the trail would be detoured to the 4795 road and safety signs would be posted while workers are in the area. Work periods would be limited to Monday-Friday, 8:00 a.m. - 6:00 p.m., to alleviate safety concerns on the weekdays and to allow for use on weekends. This detour is expected to occur only for one season of work for the commercial activity. The non-commercial activity that extends beyond the Dellenback Trail involves using track mounted mastication machinery, chainsaws and hand tools to cut very small whips and brush; when track mounted machinery are working in the area, the segment of trail within 200 feet of where work is occurring may be closed for safety reasons.

Under Alternative 2, a short segment of Trail 1451, which leads to the top of Mt. Bailey, would also be affected by seven acres of commercial activity within 200 feet of the trail in Unit 29, as would the area surrounding the trailhead. About 0.2 miles of Trail 1451 lies within Unit 29; under Alternatives 2, the prescription would be overstory removal,

retaining around 20 of the largest and healthiest lodgepole pine per acre, thus reducing the density of trees, opening up the canopy, increasing sunlight, and increasing the visibility of stumps and slash. Within about 5 minutes of walking up the trail, these impacts would no longer be seen. Similarly, Trail 1479, a portion of the Silent Creek Trail near Trail 1451, would have work occurring along 0.3 miles of the trail and in the area where people park, with similar impacts to those described. The trails would be closed during periods of work and any impacts to trail treads would be mitigated by the operator following treatment. The length of trail affected by these treatments is small (0.5 miles between the two trails), when compared to the overall trail lengths (6.4 miles). Unit 29 is dropped from Alternative 5 and would have no impact on trails 1451 or 1479.

Trail 1448 that leads to Howlock Mountain, starts near the horse corrals and crosses Highway 138 before entering the OCRA and eventually the Mt. Thielsen Wilderness. About 1/3 of a mile of this trail runs through areas treated under all action alternatives. Within 200 feet of this trail, there would be 7 acres of commercial and 8.5 acres of non-commercial treatments. The effects to this trail would be the same as stated for other trails; this trail would also be closed during work periods.

Most of the trails used by snowmobiles are along existing roads that may be system roads or unclassified roads, such as the old Highway 138 and around Lemolo Lake (figures 3-26 and 3-27). In addition, the trails around Poole Creek and Lemolo Lake Resort would be affected by treatments; most of these trails parallel or are along existing roads where treatments would overlap. Effects to those users are similar in that sight distances would be increased. Most winter users would notice very little change as they travel over deep snowpacks and would not see stumps or slash. The treatments have the potential to open up the stands so that winter OHVs could travel deeper into the forest and move further off roads. However, this would only extend as deep into the stand as the treatment extends, which is generally less than 1500 feet from a main road. Beneficial effects of the action alternatives include better trail conditions as maintenance of the trail would occur during road maintenance or road reconstruction. In addition, there would be fewer hazard trees that would fall towards roads and the trail users, resulting in fewer trail blockages and blow down.

Cumulative Effects

Trail maintenance is the primary past, present, and reasonably foreseeable action that contributes to a beneficial cumulative effect to trails by maintaining trail conditions for users. Hazard tree felling along the Diamond Lake Campground is also beneficial for user safety, but the number of trees felled in the last two years may be detracting from the scenic experience for some users. The forest is also preparing an assessment of motorized vehicle use to comply with the Travel Management Rule. No decision has been made. However, this decision will result in determining where summer OHV use will be authorized, further limiting the impacts from illegal OHV use. There are no other past, present, or reasonably foreseeable actions that would impact the trails in the planning area. Therefore, because there are limited direct and indirect effects, mitigation would restore trail tread if damaged during operation, short-term trail closures would protect user safety, and trail maintenance is the only other action affecting trails in the area, there would be no potential for cumulative effects to trails in the D-Bug planning area.

Diamond Lake Recreation Area

The most concentrated developed recreation within this watershed is in the Diamond Lake Recreation Area (Figure 3-26). The Diamond Lake Recreation Area is approximately 8,100 acres and is centered around Diamond Lake with Mt. Bailey on the western side, Mt. Thielsen to the east, and Crater Lake National Park to the south. Diamond Lake is at an elevation of 5,182 feet, over 3,000 acres in size, and is approximately 3.5 miles long and 1.5 miles wide, and is surrounded by Road 4795. Diamond Lake is managed as a fishing lake by the Oregon Department of Fish and Wildlife (ODF&W) with a maximum speed limit on the lake of 10 mph.

Diamond Lake is a high use destination recreation area (approximately 700,000 Recreation Visitor Days [RVDs] per year). Diamond Lake has traditionally been recognized as a regionally and nationally renowned trout fishery with an average of over 100,000 angler days annually. Diamond Lake is identified in the LRMP as MA2, and is to be administered for concentrated developed recreation and has a Recreation Opportunity Spectrum (ROS)[71] class of Rural[72]. To meet the recreational demand, the Diamond Lake Recreation Area contains extensive USFS and private permittee developments.

Campgrounds: The USFS operates and maintains three developed campgrounds (Diamond Lake, Broken Arrow and Thielsen View – Figure 3-26) with a capacity of 446 sites; two Day-Use areas (South Shore and Noble Fir); a hiker/biker camp (six sites); three group reservation areas; five boat ramps and docks; an overflow camping area; a Visitor Information Center; an administrative work center; sewer and water systems; and a paved bike path around the lake (the Dellenback Trail – see trails discussion). Established Snow-Park sites include Three Lakes, South Diamond, North Crater, and Mt. Thielsen. The Diamond Lake Viewpoint and the Mt. Thielsen Viewpoint are pullouts or viewpoints that provide visitors with panoramic views of the area. Currently, there are hundreds to thousands of dead and/or dying trees within or adjacent to these campgrounds and/or other recreation sites. More trees continue to die every year from the mountain pine beetle outbreak.

The Diamond Lake area provides a wide variety of year-round recreational opportunities including: fishing, swimming, boating, camping, hiking, scenery viewing, birding, mountain biking, horseback riding, hunting, cross-country skiing, snowmobiling, dog-sledding and other snow play. Normal operating season for the USFS facilities is mid-April (depending on snow) through October, coinciding with the fishing season. During the winter months the campgrounds are closed and used for cross-country skiing and other winter sport activities.

Special Use Permit Areas: Other developments in the area are the Diamond Lake Resort (Diamond Lake Improvement Company), Diamond Lake RV Park, Summer Home Recreation Residences, and ODF&W. These developments operate under special use permits, and, with the exception of ODF&W, are privately owned facilities.

The Diamond Lake Resort (Figure 3-26), located primarily at the northeast corner of Diamond Lake, is a full service resort with 92 lodging units with capacity to lodge 500.

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[71] The ROS is an array of recreational activities, settings, and experiences used as a basic framework in planning and managing the recreation resource, and divided into the following classes: primitive; semiprimitive non-motorized; semiprimitive motorized; roaded modified; roaded natural; rural; and urban.
[72] Rural is an area characterized by substantially modified natural environment, with sights and sounds of humans readily evident and interaction between users often moderate to high.

There are four restaurants with a combined seating capacity of 665, two grocery stores, two marinas with a capacity for 186 boats, a gas station, 46 employee-housing units and miscellaneous support buildings. The resort has a water system and is connected to the USFS central sewer system. The resort has a total permit area of approximately 234 acres. Diamond Lake Resort operates year round. Major summer activities and services, in addition to lodging and fishing, are convention and reunion facilities, swimming, horse and bicycle rentals, charter boat service, boat and canoe rentals, and special events such as a square dance festival, a dock-dog competition, and a 4th of July Celebration. Major winter activities and services include snowmobile tours and rentals, inner tube sledding hill, ice skating, cross-country skiing and equipment rentals, and snow cat skiing on the west slope of Mt. Bailey.

Diamond Lake RV Park (Figure 3-26) is located at the southeast end of Diamond Lake on the east side of FSR 4795. The park has 140 spaces with full hook-ups (water, sewer, and electric), shower and laundry facilities and living quarters and maintenance building. It has a water system and is also connected to the Forest Service central sewer system. The permit area is 22.9 acres and is operated seasonally from mid-May through mid-October and closed during the winter months.

Diamond Lake Recreation Residences (Figure 3-26) are located along the west side of Diamond Lake between the lake shore and FSR 4795. There are 102 privately owned residences in the tract along the west shoreline of Diamond Lake that operate under a special use permit. Home lot sizes average approximately one-half acre with total permit acreage in the tract of 52 acres. Many of the summer homes have water and septic systems while others have no water and pit toilets. The residences are accessed by a series of unimproved roads off of Road 4795. Full-time occupancy of the residences is not allowed and many are used only occasionally while others are used off and on year-round. Major uses are relaxation, fishing, biking, and winter sports (primarily snowmobiling). Access to the tract is closed by snow during the winter months with access by snowmobile or skiing.

ODF&W owns and manages a cabin, out building, and lake level control structure on the northwest corner of Diamond Lake at the outflow of Diamond Lake into Lake Creek. The cabin has a well and septic holding tank. Permit acreage is three acres. Use is primarily during the fishing season by Oregon State employees engaged in the management of the Diamond Lake fisheries.

The Lemolo Lake Recreation Area

The Lemolo Lake Recreation Area is approximately 1,290 acres and is centered around Lemolo Lake (Figure 3-27). Lemolo Lake is a man-made reservoir operated by PacificCorp as a hydroelectric facility. The lake is approximately 419 acres in size at an elevation of 4,230 feet. ODF&W is responsible for the fisheries management of Lemolo Lake and the lake has a maximum speed limit of 40 mph. The Lemolo Lake Recreation Area is identified in the LRMP as a MA2 and is to be administered for concentrated developed recreation. The ROS class is roaded natural (RN). There are also two special interest areas that do not overlap with the planning area: Crystal Spring and Spring River, identified in the LRMP as special management area MA6 to be managed for recreation with an ROS class of Roaded Natural[73]. Though PacifiCorp created Lemolo Lake for hydroelectric purposes, it has become a popular destination recreation

[73] Roaded natural is an area characterized by predominantly natural-appearing environments with moderate evidences of the sights and sounds of people. Such evidences usually harmonize with the natural environment.

area attracting both summer and winter recreationists. Similar to Diamond Lake, Lemolo Lake has both Forest Service and private permittee facilities to meet the recreational demand.

The USFS operates and maintains five campgrounds (Poole Creek, East Lemolo, Kelsay Valley, Inlet, and Bunker Hill – Figure 3-27) in the area with a combined capacity of 95 sites. Major activities during the summer include camping, boating, fishing, biking, OHV use, swimming, and sightseeing. The main winter activities are cross-country skiing and snowmobiling. The campgrounds usually operate from mid-May (once snow-free) until the end of October or November. Because of the high popularity of the area for fall elk hunting, the campgrounds will often remain open until the end of November, weather permitting. There are also approximately 20 dispersed unimproved campsites throughout the area.

Lemolo Lake Resort is a privately owned facility operating under a USFS special use permit, located along the north shore of Lemolo Lake. It is a full service facility with a capacity to lodge 32, and a restaurant and bar with seating capacity of 48. It has a trailer park with 36 spaces with full hook-ups and shower and laundry facilities, gas station, grocery store, boat ramp and docks, employee housing, and shop buildings. The resort has its own water supply and has septic tanks with drainfields. Major summer activities and services include fishing, boat rentals, water skiing, swimming, sightseeing, bicycling, ATV riding, and hiking. During the fall, the primary activities are fishing and hunting. During the winter, snowmobiling and cross-country skiing dominate the activities in the area.

Environmental Effects – Diamond Lake and Lemolo Lake Recreation Areas

Direct effects are those that would occur immediately at the recreation area, while indirect effects are those that would occur in the future both at the stand and recreation area scale as vegetation grows over time.

Alternative 1 would have no direct effects on any recreation area as no activities would occur. Indirectly, the mountain pine beetle outbreak would continue to spread, killing trees across the landscape. Although hazard trees adjacent to buildings, roads and campsites are felled, the Forest has not been able to keep up with the number of trees dying. When they fall, these trees could damage structures or improvements, and although remotely possible, people could be injured if they were present when the trees fall. In addition, as more trees die, the fire hazard increases. A widespread, high intensity fire would potentially damage structures and other improvements, through direct consumption of structures, and through tree fall after the fire has swept through the area. If a fire occurred, the roads designated as evacuation routes may not be passable if fire were burning in the areas where high concentrations of fuels currently exist, endangering people living and recreating in these areas.

Effects Common to All Action Alternatives for the Diamond Lake and Lemolo Lake Recreation Area

In general, the primary effect to people living and recreating in the Diamond Lake and Lemolo Lake Recreation Areas would be from the sights and sounds of the commercial and non-commercial operations. The rural ROS would not change under any of the action alternatives for Diamond Lake, and the roaded natural ROS would be maintained at Lemolo Lake. Operating restrictions help reduce the impacts to visitors as work near the campgrounds would be prohibited between Memorial Day and Labor Day in the special use permit and developed recreation sites.

Under both action alternatives, the evacuation routes leading out of the recreation sites would be thinned or treated, reducing the fuels along to the evacuation routes, which gives people more time to evacuate under less extreme fire conditions. Hazard trees posing safety risks would continue to be felled as funding allows, thus meeting the purpose and need.

Where recreation sites coincide with a fuelbreak or an evacuation route, the maintenance of the fuelbreak would periodically alter vegetation over time, causing a long term indirect effect. Once a fuelbreak is established, the maintenance can occur predominately through non-commercial methods. The continued maintenance would maintain a more open forest that may be visually pleasing to some, while to others, it may detract from the visitor's experience. Overall, the beneficial effect of lowering the fire hazard and having evacuation routes accessible (thus meeting the purpose and need) outweighs any negative impacts from non-commercial maintenance of fuelbreaks.

Campgrounds: None of the action alternatives would have a direct effect on Diamond Lake Campground, Inlet, East Lemolo, Bunker Hill, or Crystal Springs Campgrounds at Lemolo Lake, as no activities are proposed in these area. Indirectly, the sounds from the commercial and non-commercial activities may be heard in the distance. However, this impact is anticipated to be small, as work hours would be limited to weekdays in any developed recreation sites, and currently, ongoing campground and road maintenance activity sounds can be frequently heard during the daytime. This indirect effect, combined with the past, present, and future hazard tree falling that occurs when the campgrounds are closed, would not contribute to a cumulative effect as these activities would not overlap.

The area behind the Visitor's Center that is directly across from the entrance to the Diamond Lake Campground would also be treated. Currently, many trees are dead and many hazard trees have been felled around the Visitor's Center and administrative site that has camping and trailer spots for employees. Hazard trees would continue to be felled as safety concerns are raised. The thinning and fuels treatment proposed near this site under all action alternatives would reduce the concentration of hazard trees and improve the safety of the area, along with the evacuation routes leading out of the area.

Commercial activities, predominantly thinning of lodgepole pine, would occur around the Broken Arrow Campground and overflow area on about 118 acres, with some minor non-commercial activities near the road. At the Thielsen View Campground, 24 acres of commercial activity would occur. At Poole Creek Campground, commercial activities would occur on about 18 acres. At all campgrounds, activities would only occur before Memorial Day or after Labor Day, limiting the direct effects of noise and disturbance to few campers. The campsites within 200 feet of a work area would be closed while operations occur to minimize safety concerns. Indirectly, campers would notice more stumps and have a more open view of the stands adjacent to the campsites, although some screening vegetation would be left between campsites, to the extent practical. There would be fewer dead trees, with the scenic emphasis on the remaining green trees, which may make the area more scenically appealing to some users. In addition, the thinning and fuels reduction would directly and indirectly improve the evacuation routes leading out of this area by reducing fuels, thereby improving visitor safety. These direct and indirect effects, combined with the past, present, and future hazard tree falling that occurs when hazard trees are present and with other campground maintenance activities, would contribute to a beneficial cumulative effect of making the campgrounds safer from hazard trees and potential fires, thus meeting the purpose and need. There would also be a small cumulative effect of reduced vegetation as more hazard trees are

felled over time in these developed campgrounds. This would reduce the scenic quality for some visitors.

Special Use Permit Areas: Table 3-59 displays the locations of the Diamond Lake Resort, and Diamond Lake RV Park where treatments would occur within the permitted area. Under the action alternatives, the direct effects would be similar to those described under the campgrounds – people in the area during the operating period would be exposed to the sights and sounds of the operations. Mitigation includes no operation between Memorial Day and Labor Day in the permitted areas, limiting the extent and duration of this impact. Indirectly, people in the area would see more stumps, fewer snags, and a more open forest. Snag falling is permitted for safety reasons and is a past, present, and future action that is predicted to continue as trees continue to die. Indirect effects related to fuel reduction, reduced fire hazard, and evacuation routes are similar to those stated above.

Table 3-59. Commercial and Non-Commercial Treatments in Designated Recreation Areas Under the Action Alternatives.

Designated Recreation Area	Acres of Designated Recreation Area	Acres Commercial Treatment	Acres Non-Commercial Treatment	Total Acres of Treatment
Diamond Lake Resort	234	125	94	219
Diamond Lake RV Park	23	12	8	20
Recreation Residences	52	0 (110 acres treated around permitted lots)	0 (1 acre treated around permitted lots)	0 (111 acres treated around permitted lots)

The impact to the recreation residences occurs primarily adjacent to their permitted areas. No activities are proposed on the actual permitted area, primarily because of contract limitations and liabilities associated with logging close to structures, and because some permit holders are being proactive about managing vegetation on their permitted area in cooperation with the Forest. Activities would only occur before Memorial Day and after Labor Day, minimizing the impacts to permit holders.

The area surrounding the recreation residences would be treated primarily by commercial treatments under both action alternatives (Table 3-59). Short term impacts from commercial treatments include visible stumps and slash, increased visibility through the forest which increases visibility between the cabins and the road, decreased canopy closures which allow additional sunlight into the area, and for some residences, improved access through the use of the access roads (driveways) as haul routes. Slash treatment would be prioritized in this area, to reduce the visual impact for permit holders. If funded, planting and seeding of vegetation following final slash treatments would occur to encourage shrub growth along skid trails.

After completion of the project and over the long term, the ability of firefighters to potentially defend this WUI during a fire would increase. The defensible space created by thinning and fuels reduction, combined with the work some of the permit holders have been doing on their permitted areas, would result in a cumulative beneficial increase in

the chance that firefighters could defend structures in the area. Maintenance of the fuelbreaks and defensible space would need to continue in order to maintain these beneficial cumulative effects (see Fuels section). Once a fuelbreak is established, non-commercial treatments can be used for maintenance.

Two connected actions of decommissioning the road south of the Noble Fir picnic site and decommissioning the ford crossing at the south end of the summer homes would restrict access; however, these two actions are authorized under a previous NEPA document[74] that the recreation residences permittees had input into; no other effects are anticipated.

Dispersed Recreation/Other Sites – Affected Environment and Environmental Effects

Within the watershed there are also other smaller developed or dispersed campsites, a communications site, and Oregon Department of Transportation (ODOT) maintenance facility. Other developed sites affected by the project include Thielsen Forest Camp and Millsite Camp (surrounding the ODOT maintenance facility). These are mainly small campsites near streams and lakes, with improvements limited to vault toilets, tables, and fire rings. In addition, there are numerous dispersed sites within the watershed, primarily located along streams and rivers with numerous hunting camps in the Lakeview, Natural, and Lake Creek sub-watersheds. The major use activities for these areas are camping, hunting, hiking, and fishing. There are also seven snow parks located along Highways 138 and 230. Other uses include a power transmission line corridor along Road 2610 and Highway 138 from Lemolo Lake to Diamond Lake, and an ODOT maintenance building and sand shed located at the junction of Road 2610 and Highway 138. ROS designations vary from Rural to semi-primitive motorized and semi-primitive non-motorized[75].

All of these types of dispersed recreation sites, overlooks, viewpoints, trailheads, snowparks, and/or picnic sites would be directly affected through the sites and sounds of the commercial and non-commercial activities that would occur surrounding these sites under the action alternatives. These impacts would be limited to when the treatments were actually occurring. The visual changes to the area would last until low vegetation grew in the area. The indirect effect would be similar to those stated above for areas within evacuation routes and fuelbreaks, benefiting users by providing better egress in case of a fire. ROS designations of semi-primitive motorized and/or roaded natural would not change under any action alternatives. Alternative 1 would have no direct or cumulative effects to these areas. However, the indirect effects would be similar to those described for the other recreation sites.

The Rogue-Umpqua Scenic Byway and Volcanic Legacy Scenic Byway

Affected Environment and Environmental Effects

The Rogue-Umpqua National Scenic Byway (Byway) extends 172 miles through the Rogue River and Umpqua National Forests, the Medford and Roseburg districts of the

[74] These two road projects were authorized under the 2006 Decision Memo for the Special Use Permit Re-Issuance for the Recreation Residences; this Decision Memo is incorporated by reference.

[75] Semi primitive motorized is an area characterized by predominantly unmodified natural environment of a size or location that provides a good-to-moderate opportunity for isolation from sights and sounds of people except for facilities essential for the use of motorized equipment. Semi primitive non-motorized is an area characterized by predominantly unmodified natural environment of a size or location that provides a good-to-moderate opportunity for isolation from sights and sounds of people. Motorized use is not permitted.

Bureau of Land Management, and local lands. The Byway forms a partial loop, off Interstate 5, between Roseburg on State Highway 138 and Gold Hill on State Highway 234. A 2.5 mile segment of the Volcanic Legacy Scenic Byway (VLSB) also lies in the planning area and runs from the junction of Highway 138 and 230 to the east toward Highway 97.

The Byway parallels 40 miles of the North Umpqua Wild and Scenic River, famed for its remarkable emerald green waters and steelhead trout habitat. The D-Bug planning area lies above the area designated as a Wild and Scenic River. Approximately 18 miles of the Byway lie within the planning area, within the segment known as the "High Cascades". The Byway is known for its Natural, Scenic, and Recreational values. The 2002 corridor management plan describes the existing and desired future condition for the Byway and is incorporated by reference. The plan makes note of the importance of maintaining natural beauty of the area and makes reference to public safety, primarily in the form of providing safe enhancements, appropriate services, as well as sanitation in the area. Unlike the Diamond Lake Winter Recreation Plan, it does not make note of the deteriorating condition of the lodgepole forests around Diamond Lake, nor the hazard inherent with the build-up of the fuels within the evacuation routes (which are the roads in the Byway) for the area.

Alternative 1 would have no direct or cumulative effects to either Byway. Indirectly, as vegetation continues to grow and tree densities increase, more trees would die from the beetle infestation, negatively impacting some users. If a large scale fire were to burn through the area, the scenery would be dramatically changed from the green of a coniferous forest, to a landscape dominated by black or brown trees and vegetation. Given that the Byways are evacuation routes for the WUIs, an uncontrolled fire could pose a hazard to people trying to evacuate, if vegetation close to the Highways caught fire and burned.

The primary direct and indirect effects to both Byways would be to the change in scenery caused by vegetation management under all action alternatives. The D-Bug project proposes to amend the 1990 LRMP, as much of the Byways are designated as 'retention' under the Visual Quality Objectives (VQO). By amending the LRMP, vegetation management would be allowed to occur in this area, which is not scenically stable. Many visitors would notice the change in vegetation. Treatments would open up views onto the large conifers that are currently hidden behind smaller diameter trees, improving the quality of the scenic environment for many users. More stumps would be visible (as they are now) after the project, detracting from some users' experiences. If funded, stumps would be flush cut within 50 feet of seen areas off of highways 138 and 230 to minimize the visual impact. However, given that the speed limit is 55 mph, some drivers won't notice the small stumps in the area, but would be more inclined to notice the large diameter trees in the more open forest that would be created after the project was implemented.

The Diamond Lake Viewpoint opened in 2007 just off of Highway 138 near the entrance to Diamond Lake; it did not degrade the view from the highway and added a recreational point of interest for visitors. The Cinnamon Butte Snowpark is scheduled to be improved (widened) within the next several years and would have minimal to no impact on the views experienced along the Byway. The Oregon Department of Transportation felled hazard trees along the Byway west of the project area, but not within it. There are no other past, present, or reasonably foreseeable projects would overlap with the D-Bug project to contribute to a cumulative effect to the Byway; therefore, because the past projects have had no effect on the Byway, no cumulative effects to the Byway would

occur with this project. The Winema National Forest has been conducting vegetation treatments similar to those proposed under the D-Bug project along the segment of the Volcanic Legacy Scenic Byway for several years. Crater Lake National Park has been using prescribed fire to thin vegetation along one segment of Highway 138 outside of the planning area. These two projects, when combined with the D-Bug project would contribute to a cumulative effect to the scenery of this segment of the VLSB, but that effect has generally been positive for most visitors.

OCRA, IRAS, AND POTENTIAL WILDERNESS AREAS – TRACKED AS A SIGNIFICANT ISSUE

During scoping, a number of conservation groups raised concerns that the proposed management in the Oregon Cascades Recreation Area (OCRA), Inventoried Roadless Areas (IRA), potential wilderness areas (PWA) and areas proposed as wilderness would impact the ecological importance and roadless characteristics of these areas.

Forest Plan Standards and Guidelines

- Dispersed Recreation S&G #3: The Oregon Cascades Recreation Area (OCRA) shall be jointly managed by the Deschutes, Willamette and Umpqua National Forests as directed by the management plan shown in Appendix E, and SPM no harvest and SPNM no harvest.
- Dispersed Recreation S&G #4: Unroaded recreation management areas (URMA – MA1) shall be managed in accordance with SPM-no harvest, SPNM-no harvest and unroaded concentrated direction.

Oregon Cascades Recreation Area Management Plan Goals

- Thirsty Point Zone 6 and West Thielsen Zone 7: Harvest of catastrophic timber loss consistent with management prescription. No scheduled regeneration harvest activities. No scheduled salvage harvest. Harvest is allowed to prevent and control insects, diseases and other damaging agents and to prevent catastrophic mortality from insects, disease, or fire. Salvage of major timber mortality caused by fire, insects, disease, blowdown, or other causes is allowed when the scenic characteristics of the Recreation Area are significantly affected, or the health and safety of the public is threatened, or the overall protection of the forested area inside or outside the recreation area might be adversely affect by failure to remove the dead or damaged timber.

The Oregon Cascades Recreation Areas

Cascadia Wildlands Project states that in the OCRA, scheduled timber harvest activities on a programmed basis are not permitted. They state that the fuelbreaks located in the OCRA will require additional maintenance treatments that represent programmed harvest, which is in violation of direction in the 1984 Act creating the OCRA.

As noted below in the Affected Environment section, legislation which established the OCRA allows for activities “necessary to prevent and control wildfire, insects, disease, soil erosion, and other damaging agents including timber harvesting activities necessary to prevent catastrophic mortality from insects, diseases, or fire.” Additionally, the goals in the OCRA Management Plan for the two zones affected allows for harvest and salvage consistent with the proposed actions proposed in this FEIS. Furthermore, the proposed timber harvest for this project is not occurring on lands determined suitable for timber

harvest in the Umpqua LRMP; therefore, this action is not considered programmable timber harvest.

Fuelbreak maintenance is anticipated to be infrequent. Maintenance activities could occur every 10 to 30 years, depending on the site conditions and would involve non-commercial treatments including cutting small trees and shrubs. When maintenance is needed in the future, the objective would be to prevent or control future wildfires and reducing the threat to health and safety; thus meeting the intent of the OCRA legislation.

While the management actions proposed in this FEIS are compliant with the OCRA laws and regulations, because of the public's interest in management in this area, this will be tracked as an issue. The following indicator quantifies and tracks this issue:

- Acres of commercial thinning in the OCRA.

Affected Environment

The OCRA, created in the same legislation that enacted the Mt. Thielsen Wilderness (Oregon Wilderness Act of 1984, Public Law 98-328, Section 4), is along the west side of the Wilderness, and forms the eastern edge of the planning area (Figure 3-29). The OCRA boundary is set back at least 500 feet from Highway 138, and 200 feet from Road 60-990 (Thirsty Point Road). It is divided into seven management zones, of which two (zones 6 and 7) are within the planning area. They are defined within the LRMP as MA-5 with the objective to *"…manage the area so as to maintain a near natural state while providing for a wide range of recreation activities."* Use varies throughout the zones, with the primary activities being camping, fishing, hiking, hunting, horseback riding, snowmobiling, and cross-country skiing.

In zones 6 and 7, harvest of timber is allowed to prevent and control insects and to prevent catastrophic mortality from insects, disease, or fire; and/or when salvage of dead or damaged trees is done where leaving these trees threatens the health and safety of the public (USDA Forest Service, 1990 - Appendix E - 20, 22). In the Oregon Wilderness Act of 1984, the language creating the OCRA specifically states that the Secretary of Agriculture may permit activities "necessary to prevent and control wildfire, insects, disease, soil erosion, and other damaging agents including timber harvesting activities necessary to prevent catastrophic mortality from insects, diseases, or fire."

The goal for the OCRA in Zone 6 is to emphasize opportunities for semi-primitive motorized recreation and improve wildlife habitat. The goal for the OCRA in Zone 7 is to provide a variety of opportunities for non-motorized uses in close proximity to the Diamond Lake Composite, and serve as a transition between the concentrated developed recreation use at Diamond Lake and Mt. Thielsen Wilderness.

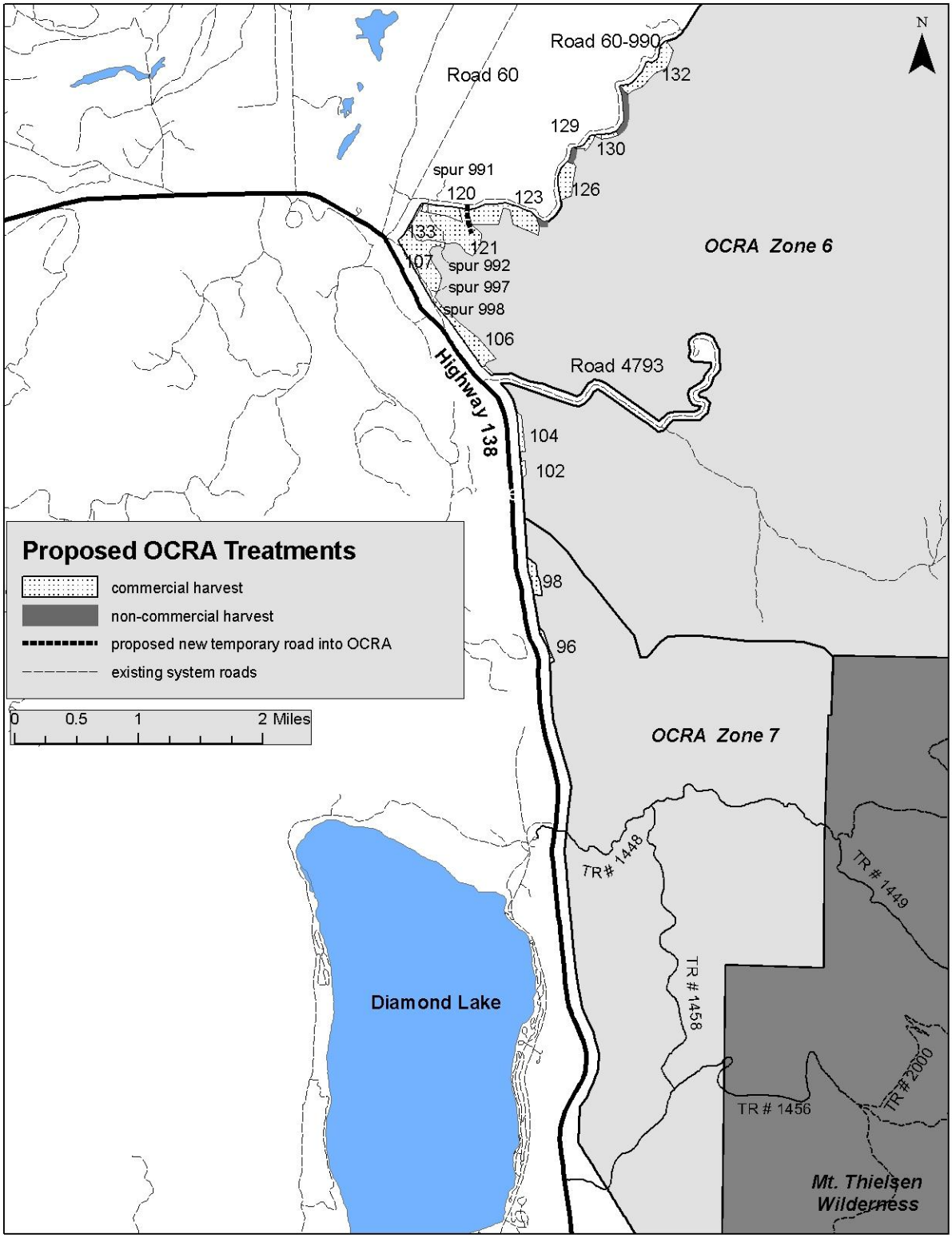

Figure 3-29. Location of the OCRA and proposed treatments under Alternative 2. There are no treatments under Alternative 5. See discussion for details.

Direct and Indirect Effects

Direct effects are those that would occur immediately following the activity at the stand scale, while indirect effects are those that would occur in the future both at the stand and OCRA scale. Effects are measured in terms of acres treated and the duration that the treatment would have on vegetation. Under alternatives 1 and 5, no action would occur that would directly affect the OCRA. This would maintain the present opportunities for solitude and would not increase sight distance into the stands. Indirectly, there is a high likelihood of the area experiencing uncharacteristic wildfire effects. Given the lack of direct effects and that only indirect effects are present, plus the lack of past and future actions, no cumulative effects would occur under alternatives 1 and 5. None of the connected or similar actions associated with any of the action alternatives occur in the OCRA, thus there would be no direct, indirect, or cumulative effects from those actions.

In response to the issue raised during scoping, Table 3-60 displays how each zone of the OCRA is affected by treatment activities by the alternatives.

Table 3-60. Treatments in the OCRA by Alternative.

Alternatives	Zone	Acres Commercial (Prescriptions 1-4, 9-13)	Acres Non-Commercial (Prescriptions 5-8)	Total Acres
2	6	301	15	316
2	7	17	0	17
1,5	All Zones	0	0	0

Under Alternative 2, the direct effects of the commercial thinning and non-commercial treatments would impact both the visual quality (see Visual Quality section) and increase sight distance into the thinned stands and reducing closed forests. Indirect effects include increased fire resiliency of the treated stands over time, as described in the fuels section. However, there would continue to be a high likelihood of the remaining area experiencing uncharacteristic wildfire. The direct effects are limited in extent, given that all proposed treatment units extend no further than about 3,100 feet into the OCRA and 333 acres of the 157,000 acre OCRA would be treated. The sounds and sights coming from Highway 138 are heard up to one-half mile from the highway, depending on slope and aspect. Opening up the stands through thinning which increases the distance between trees may result in an increased distance one has to travel into the OCRA to find solitude.

<u>Zone 6</u>

For the 12,806 acre Zone 6, recreation is managed as semi-primitive motorized, where there are moderate opportunities for solitude, tranquility, and closeness to nature. Under Alternative 2, the 316 acres of proposed treatments in the OCRA (Table 3-60) are within about 3,100 feet or less of an existing road. Given that there is already a 200- to 500-foot buffer between existing roads and the boundary of the OCRA, most users would not be able to distinguish this reduction in solitude. Furthermore, Unit 121, which extends the furthest into the OCRA, is surrounded by roads and includes an existing spur road that is within the OCRA, already limiting the ability to experience solitude in that location. The direct effect of opening the canopy under Alternative 2 would allow for additional sight distance and noise disturbance but only occur as far as the treatments extend into

the OCRA, limiting the magnitude of this effect. All effects to solitude would diminish in one to two decades following treatment, as crown closure increases and sight distance decreases.

There is also a potential effect to winter OHV users, because use by winter vehicles is currently allowed on and off of designated trails in Zone 6. However, most users stay on designated trails and permitted areas. Most summer users utilize the single-lane gravel roads as their primary travel route. Road 60 is heavily used as a winter OHV route and is also used by summer/fall OHVs, particularly during hunting season. The existing spur roads 992, 997 and 998 within the OCRA boundary lead to several D-Bug units and would be brushed out for logging. The use of these roads during logging, combined with opening of the canopy from thinning, would provide the largest opportunity for OHVs to go off road and into the forest during both summer and winter. However, this opportunity would be limited in extent, as the treatments extend less than 3,100 feet from the OCRA boundary. These existing spur roads are permanent roads that would not be decommissioned with this project, so the ability to use these roads would be long term; however, OHV use of this area is not expected to increase because it is focused on Road 60.

One new temporary spur road (0.22 miles) would be constructed and subsequently decommissioned in this zone (Figure 3-29). The direct effects of temporary road construction would reduce canopy closure by removing all vegetation from the width of the road, resulting in increased sight distance and decreased solitude. This would potentially have a longer impact than some of the thinning prescriptions, as it may take 15 or more years until natural shrubs and/or small trees would re-grow on the site; less if vegetation is planted.

Zone 7

For the 7,059-acre Zone 7, the area is managed as semi-primitive non-motorized. About 17 acres are affected by commercial treatment (Table 3-60) under the action alternatives. The effects of thinning and fuels reduction on these 17 acres, along Highway 138, would predominantly be to increase sight distance. The extent of the treatment into Zone 7 is within 420 feet of the OCRA boundary, substantially limiting the magnitude and intensity of this effect. It is likely no users would notice this impact because it is so limited in extent. No motorized vehicles are allowed in this zone, so there would be no effect to OHV use either in winter or summer. In addition, no new temporary roads would be built into this zone.

Cumulative Effects

Overall, the D-Bug project would treat 2.6 percent of Zone 6 and less than one percent of Zone 7. This limited amount of treatment in the OCRA, along an existing state highway, constitutes very minor direct and indirect effects. There are no past or future projects that would overlap with the D-Bug project that would contribute to a cumulative effect, other than travel management which would have a positive effect from eliminating cross-country travel. The overall cumulative effect of Alternative 2 would be positive; the negative effects from the action proposed in this FEIS would be counteracted by eliminating cross-country travel. Because there are no activities in the OCRA under Alternative 5, there cannot be any cumulative effects.

During scoping, Cascadia Wildlands Project indicated maintenance would be needed in the fuelbreaks and would represent programmed timber harvest in the OCRA. While fuelbreak maintenance is not a reasonably foreseeable action that can be analyzed in

this project, it is important to note that, once a fuelbreak is established, maintenance can occur primarily through non-commercial methods. The maintenance would be done to meet the objective of reducing the risk of catastrophic wildfire on the health and safety of the public, which is consistent with the OCRA Management Plan.

Inventoried Roadless Areas (IRAs)[76] – Tracked as a Significant Issue

Umpqua Watersheds and Klamath-Siskiyou Wildlands Center state that putting fuelbreaks along the Thirsty Creek Road and Kelsey Point Road along the edge of the Inventoried Roadless Areas (IRAs) violates the 2001 Roadless Area Conservation Rule (RACR). Tim Ballard, Kim Treadwell, Randall Ballard, and Linda Quintero are concerned over the precedent that active management within IRAs would establish.

The Roadless Area Conservation Rule sets forth particular requirements when timber may be cut, sold, or removed within Inventoried Roadless Areas. Following are the requirements which apply to this project and will be used as indicators of compliance with the 2001 Roadless Area Conservation Rule. They are further explained below.

- The purpose is to maintain or restore the characteristics of ecosystem composition or structure, such as to reduce the risk of uncharacteristic wildfire effects, within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period. *36 CFR 294.13 (b)(1)(ii).*
- The timber is generally small diameter. *36 CFR 294.13 (b)(1).*
- Timber cutting, sale and/or removal are needed to maintain or improve one or more of the roadless area characteristics. *36 CFR 294.13 (b)(1)*.
- The cutting, sale, or removal of timber is incidental to the implementation of a management activity not otherwise prohibited. *36 CFR 294.13 (b)(2).* This criteria will be only applied to cutting and removal of roadside danger trees.
- The cutting and sale of timber is expected to be infrequent. *36 CFR 294.13 (b).*

These criteria only apply to the management within IRAs. To track the extent of the effects the following indicator will be used:

- Acres of forest treated within Inventoried Roadless Areas.

Within both action alternatives, there would be no temporary roads constructed or existing non-system roads reused because the harvest units are close enough to existing system roads for the timber to be yarded to the road. Therefore, no criterion is needed to address this concern.

Existing Condition

In 2001, the Roadless Area Conservation Rule (36 CFR §294.13) was developed, which provides direction for management within Inventoried Roadless Areas (IRAs). (See Chapter 1 for the current status of direction regarding roadless areas.) In this Rule, inventoried roadless areas were identified based on areas analyzed in the Land and Resource Management Plans (LRMPs). Two of these inventoried roadless areas, Mt. Bailey and the Thirsty Creek Appendage, are identified in Appendix C of the 1990 Umpqua LRMP and are within the D-Bug planning area.

[76] See FEIS Chapter 1 for an update on the current status of the 2001 Roadless Area Conservation Act.

The RACR generally prohibits road construction and reconstruction and the cutting, sale or removal of timber in IRAs. One exception (36 CFR 294.13 (b)(1)(ii)) to this is when "the cutting, sale, or removal of generally small diameter timber is needed [for a specific purpose] and will maintain or improve one or more of the roadless area characteristics."

Maintaining or Restoring the Characteristics of Ecosystem Structure

As noted above, the specific purpose which applies to this project is: "To maintain or restore the characteristics of ecosystem composition or structure, such as to reduce the risk of uncharacteristic wildfire effects, within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period". Furthermore, the RACR (p. 3257) uses as an example "areas that have become overgrown with shrubs and small diameter trees creating a fuel profile that acts as a "fire ladder" to the crowns of the dominant overstore trees may benefit ecologically from thinning treatments that cut and remove such vegetation. The risk of uncharacteristic fire intensity and spread may thus be reduced, provided the excess ladder fuels and unutilized coarse and fine fuels created by logging are removed from the site."

Currently, decades of fire exclusion, combined with widespread mortality from past and ongoing mountain pine beetle infestation, has left the area in a condition where a stand-replacing fire would be of higher intensity and severity when compared to fires that burned under reference conditions (USDA, Umpqua National Forest, 2008).

The mixed conifer found within IRA in the planning area historically experienced more frequent fires of low-to-moderate intensity relative to current conditions. These fires consumed surface fuels, killed small patches of trees and tended to leave the largest fire-resistant trees, such as ponderosa pine and mature Shasta red fir and Douglas-fir. This dynamic tended to create a forest structure very resistant to large-scale stand replacement fire as well as widespread insect- or disease-related or competition-induced mortality. Fire exclusion has resulted in higher densities of shade-tolerant trees, such as white fir, with uncharacteristically high surface fuel loadings (USDA, Umpqua National Forest, 2008; Agee, 1993). Additionally, these stands currently sustain a higher percentage of fire-intolerant species than existed historically (USDA, Umpqua National Forest, 2008). Large-diameter fire-resistant trees are likely to continue to decline in many of the mixed conifer stands found in IRAs due to unnatural competition, high severity fires, bark beetles, and other related stressors. The current bark beetle activity is expected to increase surface fuel loadings where pine species are present, putting key ecosystem components, such as large trees, at increasing risk.

In lodgepole stands within IRA in the planning area, both low- and mixed-intensity and stand-replacement fire were historically common. Historically, these fires burned in a patchy mosaic creating patches of different age classes over the landscape (Arno, 2000; Agee, 1993) with different degrees of susceptibility at any one time to future insects and stand replacing wildfire. Prior to fire exclusion, most fuel conditions consisted of relatively light fuels in low quantities, while the vast majority of current conditions consist of relatively heavy fuels in higher concentrations (USDA, Umpqua National Forest, 1998, Appendix A). When large areas of a landscape are occupied by mature lodgepole, fires of uncharacteristic extent and intensity (at a landscape scale), and/or uncharacteristically widespread insect outbreaks, often occur. The combinations of fire exclusion and bark beetle activity have created, or are predicted to create, high surface fuel loads at an uncharacteristic extent that can set the stage for large fire growth that could create an even larger extent of even-age lodgepole and threaten key ecosystem components,

such as large trees, in adjacent mixed conifer stands. For more detail see the Fire and Fuels section of this FEIS.

Furthermore, treating in strategic locations within IRA will create valuable fuelbreaks between IRAs and areas where human-caused ignitions are likely. Proposed treatments will provide fire managers options to manage undesirable fire behavior that threatens key resource values such as habitat, large trees, and natural-appearing landscapes with high scenic quality within the IRA while providing a greater range of response options in dealing with fires that do not threaten these characteristics. Aggressive suppression often damages resource values, extinguishes desirable fire behavior, and exacerbates problems associated with fire exclusion. However, without a system of fuel breaks in place, fire managers most often have no option but aggressive initial attack due to public safety and high value improvements found adjacent to treatment units proposed within IRA.

Maintaining or Improving Roadless Area Characteristics

Uncharacteristic wildfires could adversely affect roadless area characteristics of the Mt. Bailey and Thirsty Creek Appendage IRAs. Roadless area characteristics are resources or features that are often present in and characterize inventoried roadless areas, including:

1) high quality or undisturbed soil, water, and air;
2) sources of public drinking water;
3) diversity of plant and animal communities;
4) habitat for threatened, endangered, proposed, candidate, and sensitive species and for those species dependent on large, undisturbed areas of land;
5) primitive, semi-primitive non-motorized and semi-primitive motorized classes of dispersed recreation;
6) reference landscapes;
7) natural appearing landscapes with high scenic quality;
8) traditional cultural properties and sacred sites; and
9) other locally identified unique characteristics.

Generally Small Diameter

The RACR did not specifically define what constitutes ‘‘generally small diameter timber,’’ “(b)ecause of the great variation in stand characteristics between vegetation types in different areas…” The Rule further states that project planning:

> [W]ill consider how the cutting or removal of various size classes of trees would affect the potential for future development of the stand, and the characteristics and interrelationships of plant and animal communities associated with the site and the overall landscape. Site productivity, due to factors such as moisture and elevational gradients, site aspect, and soil types, will be considered, as well as how such cutting or removal of various size classes of standing or down timber would mimic the role and legacies of natural disturbance regimes in providing the habitat patches, connectivity, and structural diversity critical to maintaining biological diversity. In all cases, the cutting, sale, or removal of small diameter timber will be consistent with maintaining or improving one or more of the roadless area characteristics (see Final Rule, Federal Register, Volume 66, No. 9, 3257).

Stand exams were conducted for a sample of stands within the D-Bug project area using Common Stand Exam data collection protocols. This stand exam data quantifies forest vegetation characteristics which are a result of site productivity. Silvicultural prescriptions (e.g., variable-density thinning, thinning from below) are assigned to each stand based on existing stand characteristics relative to the management objectives for the treated stand. Existing and future conditions were quantified and modeled using this stand exam data and the Forest Vegetation Simulator (Dixon, 2003). Data from stands in the IRAs and stands similar to those in the IRAs were used to model treatments to determine the pre-treatment Quadratic Mean Diameter (QMD), or arithmetic mean of tree diameters, and the post-treatment QMD for each prescription. If the weighted average QMD for all proposed treatments in each IRA increases as a result of treatment, this illustrates that the treatments' net effect is to remove the small diameter trees and shift the average QMD to a larger size. This would illustrate that the treatments meet the criteria of removing generally small diameter trees.

Cutting, Sale, or Removal of Danger Trees is Incidental

Cutting danger trees along roads and motorized trails can be necessary to remove trees which pose a danger to travelers. Danger trees are identified using the Field Guide for Danger Tree Identification and Response (USDA Forest Service Region 6 and USDI Bureau of Land Management). The primary objective of this activity is road and trail maintenance and the cutting, sale, or removal of the timber would be incidental to maintaining a road or trail for safe travel. This criterion applies only to the prescription that removes danger trees. Other criteria used for other prescriptions (e.g., generally small diameter) does not apply to the danger tree prescription.

Thirsty Creek Appendage IRA

The 2,257 acre Thirsty Creek Appendage IRA (Figure 3-30) is bordered by existing Forest Service roads around 80 percent of its perimeter. The distance between roads averages one mile. There are seven existing regeneration harvest units adjacent to its boundaries. Appendix C of the LRMP rates the opportunity for solitude in this area as poor, primarily because the area is surrounded by roads. This area is the appendage that is left over from the RARE II area and the enactment of the OCRA legislation. This area is less than 5,000 acres but is contiguous to the OCRA, much of which qualifies as Potential Wilderness, so the roadless characteristic of habitat for species dependent on large, undisturbed areas of land applies. The Recreation Opportunity Spectrum (ROS) for this IRA is roaded natural for the majority of the IRA, and Semi-Primitive Motorized for the northern tip of the IRA near Kelsey Point. The ROS roadless characteristics applicable to this IRA include the opportunity of semi-primitive motorized recreation. Under the LRMP, this area is in Management Area 10 and was not assigned a prescription of roadless. Appendix C of the LRMP recognizes the increased fire hazard in this IRA due to the mountain pine beetle infestation (USDA, Forest Service, 1990), and continued fire exclusion has exacerbated this hazard.

Mt. Bailey IRA

The 18,627 acre Mt. Bailey IRA (Figure 3-30) is bordered on its northern boundaries by existing roads and regeneration harvest units with multiple appendages into the IRA and on its east side by Road 4795. Immediately adjacent to Road 4795 is the Diamond Lake Recreation Composite with 102 recreation residences and a campground in close proximity. The closest recreation residence is within 150 feet from the Mt. Bailey IRA.

The IRA is influenced by motorized and non-motorized recreation. The paved Dellenback Trail #1460 lies inside the eastern edge of the IRA. Appendix C of the 1990 FEIS to the LRMP rates the opportunity for solitude in this IRA as moderate. The RARE II process indicated this area had a medium wilderness potential. The ROS for this IRA is divided between semi-primitive motorized, semi-primitive non-motorized, and roaded natural. Because this IRA is a large tract of unroaded land, the applicable roadless characteristics include habitat for TES species; species dependent on large, undisturbed areas of land; the opportunity of semi-primitive non-motorized and motorized recreation; reference landscapes; and in some portions, natural-appearing landscapes with high scenic quality. Appendix C of the 1990 LRMP discloses that about 40 percent of the Mt. Bailey IRA is assigned a roadless prescription, which is prescription A1-1 within Management Area 1 (the eastern portion of this IRA).

The Mt. Bailey IRA designation under the LRMP does allow semi-primitive motorized use in some areas. All parts of the IRA affected by the D-Bug project are categorized as semi-primitive non-motorized. No roads would be built in this area, complying with LRMP direction. The area east of the Dellenback Trail and all of the Diamond Lake Recreation Composite is categorized as rural, and there is very little chance for solitude given the extensive year-round use in the area. Forest Closure Order Number 204 closes the Dellenback Trail to motorized use. Road 4795, which forms the eastern border of the IRA, is used heavily as a snowmobile trail in the winter. Forest Closure Order Number 203 allows use by snowmobiles and Class I ATVs. None of these closures, restrictions, or permissions would be changed by this project.

The existing ROS of roaded natural, semi-primitive motorized, and semi-primitive non-motorized would be maintained under all alternatives. Snow cat skiing is offered on Mt. Bailey. However, this area would not be affected by the D-Bug project and will not be discussed further.

Appendix C of the LRMP also recognizes the increased fire hazard in this IRA due to the mountain pine beetle infestation (USDA, Forest Service, 1990) and decades of fire exclusion has exacerbated this hazard.

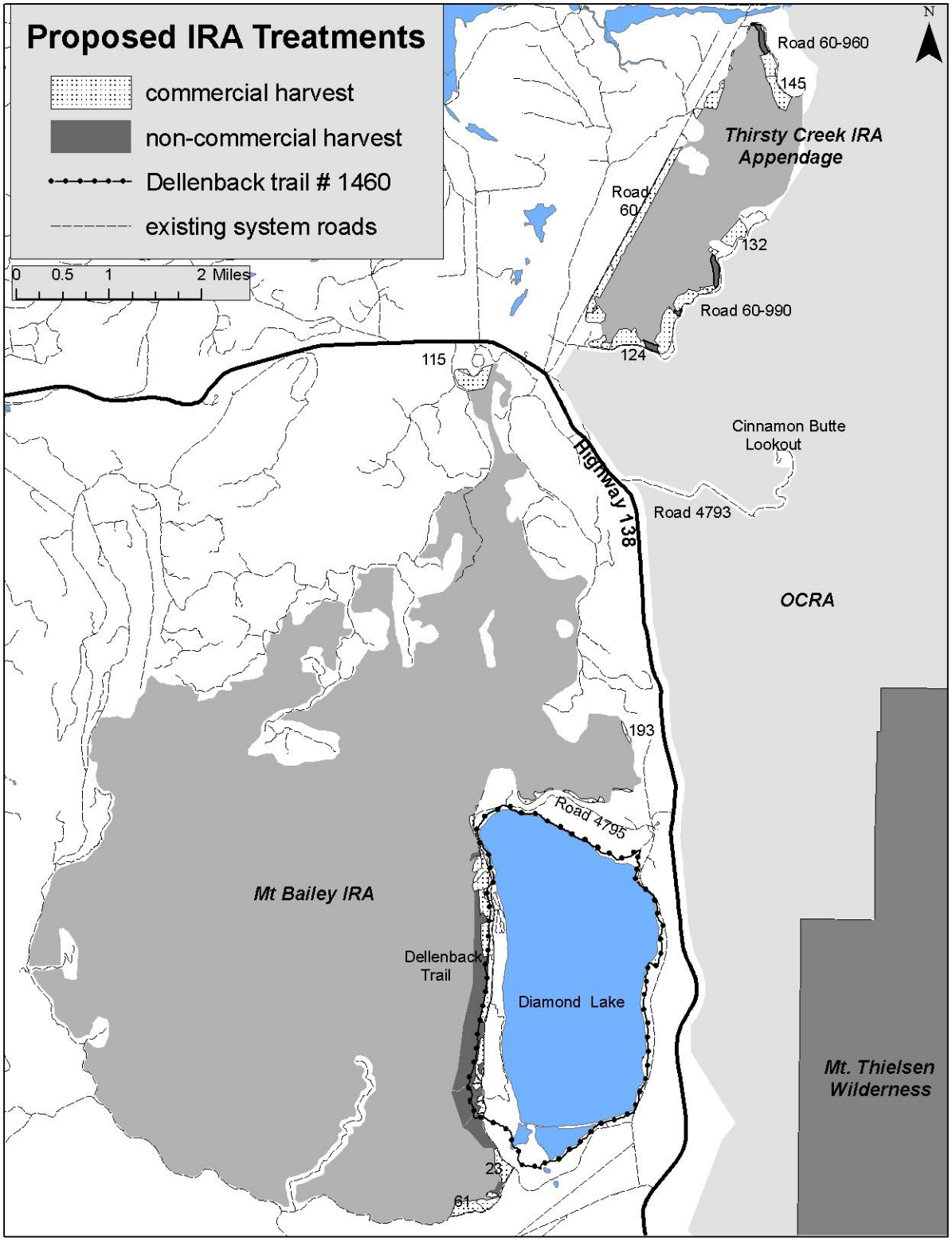

Figure 3-30. The Mount Bailey and Thirsty Creek Inventoried Roadless Areas and the proposed treatments under Alternative 2. Alternative 5 treats a small subset of this area. See discussion for details.

Direct and Indirect Effects

Direct effects are those that would occur immediately following activity at the stand scale, while indirect effects are those that would occur in the future both at the stand and IRA scale. Direct and indirect effects will discuss five indicators:

- The purpose is to maintain or restore the characteristics of ecosystem composition or structure, such as to reduce the risk of uncharacteristic wildfire effects, within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period.
- The timber is generally small diameter.
- Timber cutting, sale, and/or removal are needed to maintain or improve one or more of the roadless area characteristics.
- The cutting, sale, and/or removal of timber is incidental to the implementation of a management activity not otherwise prohibited.
- The cutting, sale, or removal of timber is expected to be infrequent.

To address the extent of the effects, acres will be used. Table 3-61 summarizes the acres treated in each IRA. There would be no temporary road construction or reuse of existing non-system roads with the action alternatives.

Table 3-61. Acres of commercial and non-commercial treatment by IRA by Alternative.

Alternative	Thirsty Creek IRA commercial treatment	Thirsty Creek IRA non-commercial treatment	Mt. Bailey IRA commercial treatment	Mt. Bailey IRA non-commercial treatment	Total IRA treatment acres
2	335	33	286	312	966
5	0	32	78	297	406

Effects of No Action

Alternative 1 would not remove any vegetation from either IRA and would retain all current roadless characteristics with the exception of cutting danger trees, which is an allowed activity under the RACR. Fuels would not be reduced and stands would continue along current trajectories as fire would continue to be excluded. The mountain pine beetle infestation would continue to progress and more trees adjacent to and within the Lemolo Lake and Diamond Lake WUIs would die. Fire hazard would continue to increase over time increasing the risk of a fire that is larger and/or more intense than occurred under reference conditions. Such a fire could cause loss of important roadless area characteristics including diverse plant and animal communities associated with large trees and natural-appearing landscapes with high scenic quality. Alternative 1 (No Action) will put these characteristics at increasing risk of being lost.

Additionally, with larger and/or more intense wildfires, fire suppression tactics would need to be more aggressive in order to safely evacuate people and protect infrastructure such as the Diamond Lake summer residence and Forest Service recreation facilities. It would be more likely that heavy equipment (e.g., bulldozers) would be used within the roadless areas under the no action alternative resulting in additional impacts to the roadless character.

Effects Common to All Action Alternatives

Maintaining or Restoring the Characteristics of Ecosystem Structure

Proposed treatments within IRAs are designed to alter fire behavior to a point where it is safe and manageable and to reduce fire effects within treatment units and potential loss of roadless area characteristics. Prescriptions are designed such that resulting stand conditions both meet fire behavior reduction goals and more closely mimic historical stand structures.

The direct effect of commercial and non-commercial removal of small-diameter trees under the action alternatives would be to open the stands and increase the distance between the tree canopies. The treatments would also decrease small trees that are likely to serve as ladder fuels, and reduce ground-level fuel loads. As described in the Fuels section, by reducing tree densities and ground fuels, there is an indirect beneficial effect of reducing the risk of uncharacteristic wildfire effects. In addition, acres outside of the areas treated would also benefit from reduced uncharacteristic wildlife effects (*see* Fuels section in this chapter). A widespread wildfire with uncharacteristic effects would have the potential to degrade the roadless characteristics in these IRAs.

Slash that results from both the non-commercial and commercial treatments would be treated through piling and burning within the IRAs, further restoring the ecosystem structure and reducing fire risk.

By treating the fuels in these strategic points in the IRAs, there will be more options available to fire managers to use more benign suppression strategies and manage undesirable fire behavior that threatens important roadless area characteristics.

Maintain or Improve Roadless Area Characteristics

Treatments within IRAs are designed to more closely mimic historic stand structures, reduce fire effects within treated areas, and/or increase the likelihood of stopping or managing large uncharacteristic fires that would affect the larger roadless landscape and threaten important roadless characteristics. Treated areas provide options for fire managers to use suppression strategies that are less obtrusive and provide a more complete range of response options to address fires that do not threaten roadless characteristics and may be beneficial. Large fires of uncharacteristic severity, intensity, and/or extent could have negative impacts to roadless characteristics because fire effects are outside the range of reference conditions. Reducing the potential for these fires will help maintain the presence of these characteristics.

Generally Small Diameter

Within the IRAs, Alternative 2 involves prescriptions that include commercial thinning (overstory removal and variable-density thinning) along with non-commercial understory thinning and salvage of dead and dying lodgepole pine. Additionally, non-commercial understory thinning would occur in commercial thinning units within the IRAs to reduce the smaller fuels. Prescription descriptions are found in Tables 2-1 for Alternative 2 and Table 2-4 for Alternative 5 and are further explained in the Forest Vegetation section of this EIS.

Existing and future vegetation conditions were quantified and modeled using stand exam data and the Forest Vegetation Simulator Model (Dixon, 2003). The metric of interest for the current analysis is quadratic mean diameter (QMD), or the arithmetic mean of tree diameters. GIS analysis was then used to identify the geospatial locations and total

acres of proposed treatments in IRA. A weighted average QMD was then calculated using the QMD metric from FVS modeling output, weighted by the number of acres treated by alternative.

Details on the weighted average QMD by IRA are described below and displayed in tables 3-62, 3-63, 3-64, and 3-65. Basically, the overall treatments within the IRAs results in a higher weighted average QMD following treatment. Individual treatments may not result in a lower average QMD; however, when considering all treatments proposed within the IRAs, there is an overall increase in average QMD. The objective of the treatments is reducing fire risk by reducing crown density and fire ladder fuels. These treatments generally involve removing the smaller trees in a stand. By removing the smaller trees, the average QMD increases indicating that the trees proposed to be removed are generally small diameter.

Cutting, Sale, or Removal of Timber is Infrequent

Several members of the public stated they were concerned that management within the IRAs would set a precedent for continued management within the IRAs. Once a fuelbreak is established, non-commercial methods, such as removing saplings or shrubs, are typically used to maintain the fuelbreak. In this situation, fuels would likely be treated every 10 to 30 years based on site productivity. The exact frequency of the maintenance cannot be predicted exactly because of the variability of site productivity and will be identified through time; however, 10 to 30 years is considered infrequent.

Thirsty Creek Appendage IRA

Tables 3-62 and 3-63 identify the units that are proposed to be treated under alternatives 2 and 5 within the Thirsty Creek IRA. The effects common to all alternatives would apply to the acres treated in this IRA. The existing ROS of roaded natural and semi-primitive motorized would be maintained under both alternatives.

Under Alternative 2, 358.4 acres would be treated commercially and 32.5 acres non-commercially. This equates to 15 percent of the IRA being managed. Alternative 2 increases the fire resiliency of the stands and decreases the risk of uncharacteristic wildfire effects by reducing ground and ladder fuels and by increasing the spacing between the trees. This helps to restore reference conditions (i.e., a more naturally occurring fire regime) both directly to the acres treated and indirectly to adjacent acres within this IRA.

This alternative includes treatments along two roads (Road 6000990 and Road 6000960) that are fingers into the IRA and along Road 60, which is the western border of the IRA. Treatments along these roads could affect the roadless characteristic of habitat for species dependent up on large, undisturbed areas of land.

Under Alternative 5, 32.7 acres of non-commercial treatment would occur in this IRA. This equates to 1.4 percent of the IRA being managed. Although there are benefits to the roadless characteristics from Alternative 5, it does not have as much of a beneficial effect on increasing stand resiliency and decreasing uncharacteristic wildfire effects as Alternative 2, resulting in a greater chance that this area would experience high-intensity fire. The treatment would be limited to immediately adjacent to Road 60 which limits the effect on the roadless characteristic of habitat for species dependent up on large, undisturbed areas of land.

As indicated above, there would be a larger quadratic mean diameter following treatment under both alternatives. Under Alternative 2, the weighted average QMD changes from

7.6 to 9.7 DBH. Essentially that means that following treatments, the remaining trees would be 2.1 inches greater DBH on average than before the treatment indicating that the trees removed would be of generally small diameter. Under Alternative 5, the weighted average QMD changes from 4.9 to 7.0 DBH. Trees would be 2.1 inches great DBH on average following treatments. This indicates that the trees removed during treatments would be of generally small diameter.

Table 3-62. Units within the Thirsty Creek IRA under Alternative 2.

Unit Numbers	Prescription (see Table 2)	Acres	Pre-Treatment Average QMD	Post-Treatment Average QMD
121, 136, 140, 141	2	45.2	4.9	7.8
134, 137, 138	3	76.8	5.4	8.2
130	4	3.5	5.4	8.2
125, 127, 131, 196	6 (non-commercial)	32.5	4.9	7.0
144	9	19.7	9.5	9.7
122, 126, 129, 132	11	121.2	9.5	9.7
124, 145	13	59.5	9.5	14.5
TOTALS		358.4 (335.9 commercial; 32.5 non-commercial)	Weighted Average- 7.6 DBH	Weighted Average- 9.7 DBH

Table 3-63. Units within the Thirsty Creek IRA under Alternative 5.

Unit Numbers	Prescription (see Table 2)	Acres	Pre-Treatment Average QMD	Post-Treatment Average QMD
134, 136, 137	5 (non-commercial)	31.6	4.9	7.0
190, 192	6 (non-commercial)	0.01	4.9	7.0
TOTALS		31.61 (noncommercial)	Weighted Average- 4.9 DBH	Weighted Average- 7.0 DBH

Mt. Bailey IRA

Tables 3-64 and 3-65 identify the units that are proposed to be treated under alternatives 2 and 5 within the Mt. Bailey IRA. The effects common to all alternatives would apply to the acres treated in this IRA. These effects are limited primarily to the eastern edge of the Mt. Bailey IRA. Most treatments would be between Road 4795 and the Dellenback Trail; however, there are non-commercial treatments west of the Dellenback Trail. The treatments extend no further than 1,900 feet into the IRA under Alternative 2, and no further than 1,000 feet into the IRA under Alternative 5. With the treatment adjacent to the road, this limits the effect on the roadless characteristic of habitat for species dependent upon large, undisturbed areas of land under both alternatives.

Both alternatives 2 and 5 increase the fire resiliency and decrease the risk of uncharacteristic wildfire effects by reducing ground and ladder fuels and by increasing the spacing between the trees. These treatments also extend into adjacent stands, providing additional effectiveness of the treatments.

Under Alternative 2, 283.5 acres would be treated commercially and 311.5 acres noncommercially. This equates to three percent of the IRA being managed. Alternative 2 increases fire resiliency of stands and decreases the risk of uncharacteristic wildfire effects by reducing ground and ladder fuels and increasing the spacing between the trees. This helps to restore reference conditions (i.e., a more naturally occurring fire regime) both directly to the acres treated and indirectly to adjacent acres within this IRA.

Under Alternative 5, 68 acres would be treated commercially and 306 acres of non-commercially. This equates to two percent of the IRA being managed. Although there are benefits to roadless characteristics from Alternative 5, it does not have as much of a beneficial effect on increasing stand resiliency and decreasing uncharacteristic wildfire effects as Alternative 2, resulting in a greater chance that this area would experience high-intensity fire.

Under both alternatives, a project design feature requires that stumps of harvested trees will be cut to six-to-eight inch height within 50 feet of Road 4795 and the Dellenback Trail. This design feature will lessen the visual impacts of the activities in the IRA over time.

As indicated above, there would be a larger quadratic mean diameter following treatment under both alternatives. Under Alternative 2, the weighted average QMD changes from 5.5 to 8.2 DBH. Essentially, that means that following treatments, the remaining trees would be 2.7 inches greater DBH on average than before the treatment. Under Alternative 5, the weighted average QMD changes from 5.4 to 7.3 DBH. Trees would be 1.9 inches greater DBH on average following treatments. This indicates that the trees removed during the treatments would be of generally small diameter.

Danger trees along approximately 2.4 miles of Road 4795 would be cut, sold and removed under Alternative 5. Stumps and slash (until burned) could be visible from the road from this road. However, because the activity is closest to the area within the IRA that is the most impacted already, this activity will have minimal affect on roadless characteristics. As noted above, this treatment is consistent with the RACR because the activity is incidental to the road maintenance and removing the hazard.

Table 3-64. Units within the Mt. Bailey IRA under Alternative 2.

Unit Numbers	Prescription (see Table 2)	Acres	Pre-Treatment Average QMD	Post-Treatment Average QMD
29	1	15	4.9	7.8
61	2	24.4	4.9	7.8
4, 12, 23, 85, 94, 116	3	118.9	5.4	8.2
1, 80, 93	4	25	5.4	8.2
199	5 (non-commercial)	280.5	4.9	7.0
13, 14, 20, 26	6 (non-commercial)	27	4.9	7.0

Unit Numbers	Prescription (see Table 2)	Acres	Pre-Treatment Average QMD	Post-Treatment Average QMD
92	7 (non-commercial)	4	4.9	7.0
8, 15, 86	9	41.9	9.5	9.7
3, 91, 115	10	53.9	6.1	14.1
193	12	4.4	9.5	9.7
TOTALS		595 (283.5 commercial; 311.5 non-commercial)	Weighted Average – 5.5 DBH	Weighted Average – 8.2 DBH

Table 3-65. Units within the Mt. Bailey IRA under Alternative 5.

Unit Numbers	Prescription	Acres	Pre-Treatment Average QMD	Post-Treatment Average QMD
5, 10, 85, 116, 203	3	1	5.4	4.1
1, 3, 4, 12, 199	5 (non-commercial)	272.1	4.9	7.0
13, 14, 20	6 (non-commercial)	22.6	4.9	7.0
92, 93	7 (non-commercial)	11	4.9	7.0
2, 8, 15, 86, 89, 94	9	41.5	9.5	9.7
91, 114	10	0.06	6.1	14.1
1, 3, 4, 12, 13, 14, 199	14[77]	25.1		
TOTALS		373 (68 commercial; 306 non-commercial)	Weighted Average – 5.4 DBH	Weighted Average – 7.3 DBH

Cumulative Effects

Thirsty Creek Appendage IRA

The only past action that involved cutting and removal of trees in the Thirsty Creek Appendage IRA is non-commercial fuel treatment and road brushing. This past action reduced some of the fuel loading along the road, but had very limited direct or indirect effects in the IRA. When combining this past action with implementation of any of the action alternatives, taking into account there are no reasonably foreseeable actions that

[77] This prescription is hazard tree removal and the criteria for assessing whether it complies with RARC is different than the other prescriptions; therefore the pre- and post-treatment QMD is not included in the analysis of generally small diameter timber.

are proposed in the IRA, there would be some beneficial cumulative effect to reducing fuels and to creating strategically located fuelbreaks near the Lemolo Lake WUI.

Mt. Bailey IRA

In the Mt. Bailey IRA, non-commercial fuel treatment occurred in 2006 and 2007 with the Diamond Lake Hazardous Fuels Project – Phase II along Road 4795 and the Dellenback Trail. Annual hazard-tree felling and other maintenance activities also occur along the Dellenback Trail. It is reasonable to assume that trail maintenance would continue. The combination of these past projects with implementation of any of the action alternatives of the D-Bug project, plus continued maintenance of the trail, constitutes a minor cumulative effect to vegetation in the Mt. Bailey IRA. However, as both past and current actions reduce the risk of uncharacteristic wildfire effects and removed or continue to remove generally small diameter trees, this effect would be beneficial, as the actions help maintain ecosystem composition and structure, as described in RACR.

Potential Wilderness Areas[78] - Tracked as a Significant Issue

Several members of the public noted concern that management was proposed within Potential Wilderness Areas. They were also concerned that management was proposed in areas that are being proposed as wilderness. Many of these areas did not qualify as Potential Wilderness Areas based on the FSH 1909.12, Chapter 70. The effects of proposed management in those areas are tracked in the following section.

The following indicator quantifies and tracks this issue:

- Acres within the Potential Wilderness Area which would continue to qualify under FSH 1909.12 Chapter 70.

Existing Condition

The Forest Service Land Management Planning Handbook Chapter 70 (FSH 1909.12(70)) describes the criteria for evaluating Potential Wilderness Areas (PWA). Basically, the area must be 5,000 acres or greater or contiguous to an existing wilderness area or potential wilderness area in other Federal ownership and are absent of features that are substantially recognizable and would detract from the wilderness characteristics of the area. The FS Land Management Planning Handbook defines features that could be included in these areas. For this analysis, system roads and areas clearcut harvested were removed. Non-system roads currently exist in these areas but because the Forest Service does not keep an inventory of these roads, they were not delineated for this analysis. Three PWAs were identified, based on GIS mapping, as being potentially affected by actions proposed in this FEIS.

[78] Potential Wilderness Areas may sometimes be identified as potential wilderness areas, or uninventoried roadless areas, are areas of land that were not identified as IRA's during the development of the Umpqua National Forest Land and Resource Management Plan and are not displayed in Appendix C of the LRMP.

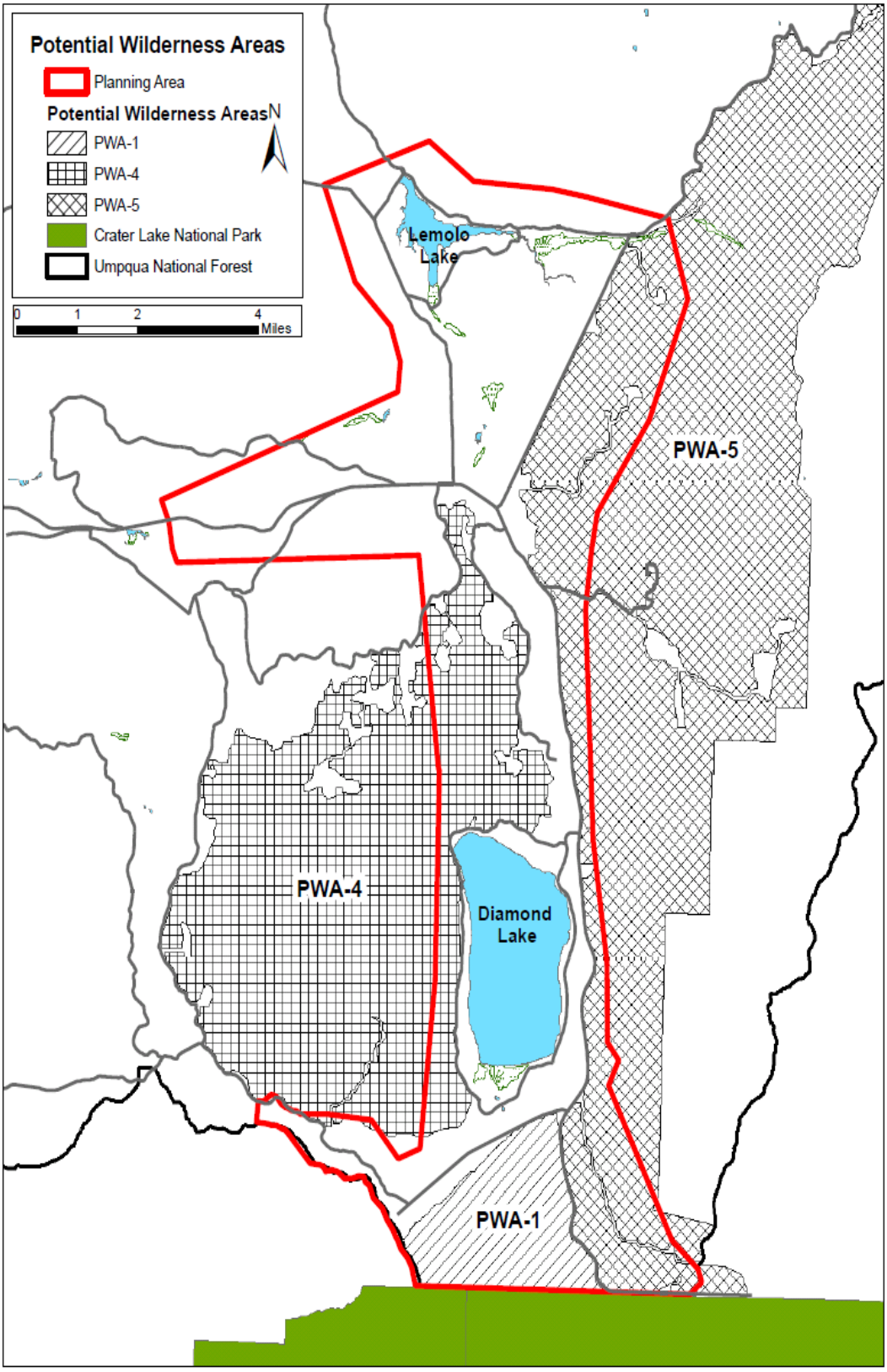

Figure 3-31. Potential Wilderness Areas in the D-Bug Planning Area.

Direct and Indirect Effects

Direct effects are those that would occur immediately following activity at the stand scale, while indirect effects are those that would occur in the future both at the stand and Potential Wilderness Area scale.

Alternative 1 would not affect any PWAs. All opportunities for solitude would remain, all inherent characteristics of the area would be retained, and no impacts from temporary roads would occur. Indirectly, if a fire were to burn through the area, sight distance would increase and the visitor's ability to experience solitude would decrease. Other characteristics important to these areas may be negatively affected by fire. Because there are no direct effects and no past or future actions, no cumulative effects would occur.

The three PWAs are affected differently under each alternative (Table 3-67).

Table 3-66. Affected Acres in Potential Wilderness Areas.

Potential Wilderness Area	Acres on the Umpqua NF	Alternative 2 Acres		Alternative 5 Acres	
		Commercial	Non-Commercial	Commercial	Non-Commercial
PWA – 1	3,307	221	48	217	78
PWA – 4	18,753	167	442	16	379
PWA – 5	35,333	1,048	666	51	3,408
TOTAL	57,393	1,436	1,156	284	3,865

Potential Wilderness Area	Acres on the Umpqua NF	Alternative 2 Acres		Alternative 5 Acres	
		Commercial Treatment	Remaining Area Qualifying as PWA	Commercial Treatment	Remaining Area Qualifying as PWA
PWA – 1	3,307	221	3,086	217	3,090
PWA – 4	18,753	167	18,586	16	18,737
PWA – 5	35,333	1,048	34,285	51	35,282
TOTAL	57,393	1,436	55,957	284	57,109

Effects Common to All Action Alternatives

Noncommercial treatments would generally be substantially unrecognizable to the general forest visitor. These treatments involve cutting small saplings and brush in the undergrowth of the forest. The stumps would be small and disintegrate and covered with forest vegetation in a few years. For this analysis it is assumed that non-commercial treatments would not affect the area from future consideration as potential wilderness. For tracking purposes, the acres of both commercial and noncommercial are included in Table 3-67.

Proposed commercial treatments generally involve thinning from below which removes understory trees that are large enough to be commercially harvested. The stumps and skid roads would remain visible for a longer period. Commercial treatments would result in reducing the area qualified as Potential Wilderness per FSH 1909.12, Chapter 70.

Temporary roads would also remain evident on the landscape for a longer time period. Temporary roads would also result in reducing the area qualified as Potential Wilderness. New temporary roads would be decommissioned, resulting in the roads being less recognizable over time. Some existing unclassified roads would be retained as they currently serve as snowmobile routes or are the old Highway 138, a historical feature.

A description and the effects to individual PWAs are described below.

Table 3-67. Miles of Temporary Roads in Potential Wilderness Areas.

Potential Wilderness Area	New Temporary Roads (miles)		Re-use of Existing Non-system Roads (miles)		Total Temporary Roads Miles	
	Alt 2	Alt 5	Alt 2	Alt 5	Alt 2	Alt 5
1	0	0	0.18	0.19	0.18	0.19
4	0.31	0	0.35	0.26	0.66	0.26
5	6.61	1.67	3.82	3.50	10.43	5.17
TOTALS	6.92	1.67	4.35	3.95	11.27	5.62

PWA-1

PWA-1 consists of 3,307 acres on the Umpqua National Forest. While the area is less than 5,000 acres it is contiguous to areas which meet the potential wilderness criteria in the Crater Lake National Park and Rogue River-Siskiyou National Forest. PWA-1 is border by Highway 230 and Road 760 to the northwest and Highway 138 to the east. Road 760 parallels Highway 230 for approximately 0.3 miles.

Existing non-system roads would be used as temporary roads in this area (Table 3-68). Reuse of these roads will make them more evident, especially in the near future. These temporary roads fall within the treatment units so the acres affected by them are included in the unit acres.

Commercial treatment is on the borders of this PWA and would occur less than 1,200 feet past Road 760 into the interior of PWA-1, and less than 1,000 feet from Highway 138 on the east side. There would be 221 acres in Alternative 2 and 217 acres in Alternative 5 that would be commercially harvested in PWA-1. Essentially this management would remove those acres from consideration as potential wilderness per FSH 1909.12 Chapter 70. Under Alternative 2 there would be 3,086 acres remaining as

potential wilderness while under Alternative 5 there would be 3,090 acres remaining (see Table 3-67).

PWA-4

PWA-4 is 18,753 acres and includes most of Mt. Bailey IRA and areas contiguous to the IRA. The area between the Dellenback Trail, a paved bike path in the IRA and Road 4795, was removed from consideration in this PWA since the paved bike path is recreation improvement that cannot be easily removed. This represents the differences in treatment acres between the Mt. Bailey IRA and PWA-4. Both the IRA and this potential wilderness area have fingers of exclusions from past roads and timber harvest activities. The area is bounded on the west, south, north and northeast by forest system roads that are not heavily traveled. The southwest boundary of this area is the paved bike path which is parallel to Road 4795. This road borders the Diamond Lake Recreation Composite and receives heavy winter OHV use and summer vehicle traffic. There are also likely non-system roads within this PWA that are not taken into account in the area boundaries.

Under Alternative 2 there would be .31 miles of new temporary roads and .35 miles of existing non-system roads that would be used for timber harvest. Under Alternative 5 there would be .26 miles of existing no-system roads used for timber harvest. The temporary roads are within harvest units so the acres affected by them are included in the unit acres.

There would be 167 acres in Alternative 2 and 16 acres in Alternative 5 that would be commercially harvested in PWA-4. Essentially this management would remove those areas from consideration as potential wilderness. Under Alternative 2 there would be 18,586 acres remaining as potential wilderness while under Alternative 5 there would be 18,737 acres remaining (see Table 3-67).

PWA-5

PWA-5 is 35,333 acres and includes the OCRA and Thirsty Creek Appendage IRA along with contiguous areas that are unroaded. Mt. Thielson Wilderness Area is east and contiguous with PWA-5. There are existing non-system roads in this area; some are proposed to be used as temporary roads in this project. Trail 1457, a motorized trail, is in the southeast portion of this potential wilderness area.

Under Alternative 2 there would be 6.61 miles of new temporary roads and 3.82 miles of existing non-system roads that would be used for timber harvest. Under Alternative 5 there would be 1.67 miles of new temporary roads and 3.5 miles of existing non-system roads used for commercial timber harvest. The temporary roads are within the harvest units so the acres affected by them are included in the unit acres. Although all newly constructed temporary roads would be decommissioned, the imprint of these roads would last on the landscape until ground cover is established.

There would be 1,048 acres in Alternative 2 that would be commercially harvest in PWA-5. Units 72 (81 acres) and 73 (691 acres) are of concern to some conservation groups. Essentially this management would remove those areas from consideration as potential wilderness. Under Alternative 2 there would be 34,285 acres remaining as potential wilderness.

Under Alternative 5 there would be 51 acres commercially harvested. There would also be approximately 150 acres of danger tree cutting with the potential for commercial uses along with non-commercial fuel treatment along Highway 138 and Trail 1457. While

some stumps from the danger tree cutting could be evident for a period of time, the danger tree removal wouldn't be substantially recognizable. Any commercial removal would use the motorized trail as a temporary road, but the appearance would not be substantially changed. Therefore, under Alternative 5, it is assumed that the danger tree cutting and non-commercial treatments would not affect the area for potential wilderness consideration. With the 51 acres of commercial treatment there would be 35,282 acres remaining as potential wilderness.

Cumulative Effects

Since the boundaries of PWAs were delineated based on current system roads and timber harvest activities there are no past actions that affect these areas. Currently there are no additional present or reasonably foreseeable actions that would remove any portion of these areas from consideration as a potential wilderness. Therefore, there are no cumulative effects associated with PWAs.

Areas Proposed as Wilderness by Environmental Organizations (APW)

In addition to the areas identified above as meeting Forest Service criteria for Potential Wilderness Areas, there are four areas proposed as wilderness by environmental organizations that could potentially be affected by the D-Bug project. These areas do not meet the Forest Service's criteria as potential wilderness as identified in FSH 1909.12 Chapter 70. Basically, the limiting criteria are: 1) the areas are less than 5,000 acres, 2) the areas are less than 5,000 but they cannot preserved due to physical terrain and natural conditions, 3) the areas less than 5,000 but are not self-contained ecosystems; or 4) the areas are not contiguous to existing wilderness, primitive areas, Administration-endorsed wilderness, or potential wilderness in other Federal ownership.

Umpqua Watersheds, Oregon Wild and Klamath-Siskiyou Wildlands Center state that the proposed treatments in units 72, 73, and 115, which are in areas they have proposed as wilderness areas, could degrade the rare features and potential wilderness characteristics of these areas.

The following indicator quantifies and tracks this issue:

- Acres within affected within areas proposed for wilderness (APW)

The same assumptions are used for areas proposed as wilderness as for potential wilderness areas. Non-commercial treatments would not adversely affect the areas where commercial treatments and temporary roads would have an effect.

Table 3-68. Affected Acres in Areas Proposed as Wilderness (APW) by Environmental Organizations.

Area Proposed as Wilderness	Acres on the Umpqua NF	Alternative 2 Acres		Alternative 5 Acres	
		Commercial	Non-Commercial	Commercial	Non-Commercial
APW-3	2,357	16.9	0	16.9	0
APW-6	2,656	162.3	0	162.3	16.9
APW-7	1,559	258.9	6.8	199.2	21.1

Area Proposed as Wilderness	Acres on the Umpqua NF	Alternative 2 Acres		Alternative 5 Acres	
		Commercial	Non-Commercial	Commercial	Non-Commercial
APW-8	1,765	21.8	18.4	21.8	12.6
TOTAL	8,337	459.9	25.2	400.8	50.6

*This treatment includes danger tree removal. There is the potential for some commercial product but it would be mostly non-commercial.

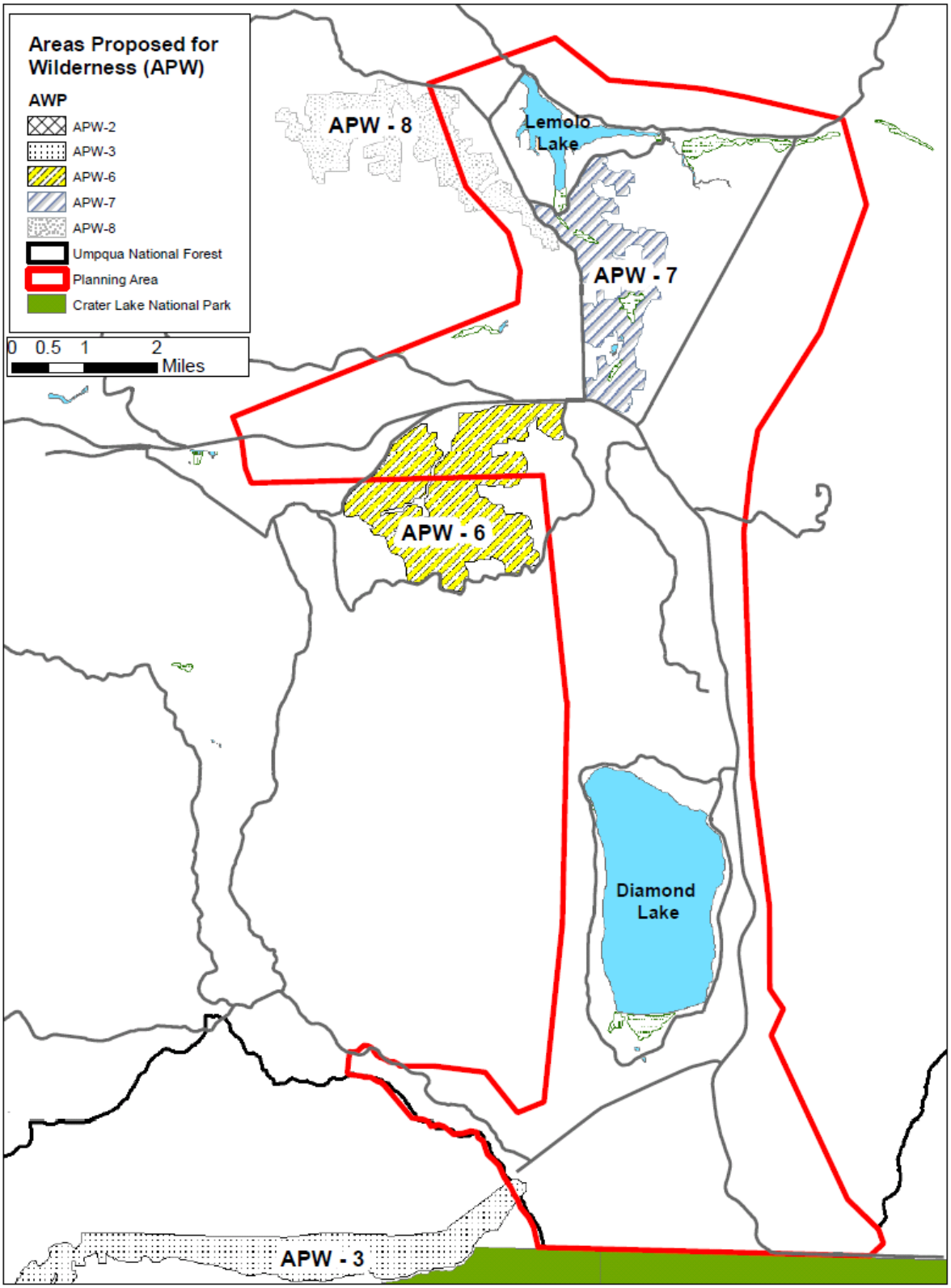

Figure 3-31A. Areas Proposed as Wilderness by Environmental Organizations (APW) in the D-Bug Planning Area.

Table 3-68A. Miles of Temporary Roads in Areas Proposed as Wilderness (APW) by Environmental Groups.

Area Proposed as Wilderness	New Temporary Roads (miles)		Re-use of Existing Non-system Roads (miles)		Total Temporary Roads Miles	
	Alt 2	Alt 5	Alt 2	Alt 5	Alt 2	Alt 5
APW-3	0	0	0	0	0	0
APW-6	1.03	0.84	0	0	1.03	0.84
APW-7	0.79	1.97	0.13	0	0.92	1.97
APW-8	0	0	0.43	0.50	0.43	0.50
TOTALS	6.10	2.81	2.9	0.50	9.00	3.31

APW-3

APW-3 is 2,357 acres that extends out of the planning area and into the Rogue River/Siskiyou National Forest. It is border by Highway 230 and the old Diamond Lake Highway (Road 6530760). Under Alternative 2, 16.9 acres would be commercially harvested. No treatment would occur in Alternative 5. There are no temporary roads associated with either alternative in this area.

APW-6

APW-6 is 2,656 acres and is south of Highway 138. Road 4785-010 extends into an otherwise intact block of forest and breaks up the continuity of the APW. The sand shed also is adjacent to this unroaded area, which is close to the northern part of the Mt. Bailey IRA.

Treatment in this area is adjacent to Highway 138. Under Alternative 2, 162.3 acres in Unit 115 would be commercially harvested. There would be 0.8 miles of new temporary roads constructed.

Under Alternative 5 162.3 acres in Unit 115 would be commercially harvested and 16.9 acres would receive non-commercial fuel treatment. There would be 0.84 miles of new temporary roads constructed in this area.

APW-7

APW-7 is 1,559 acres south of Lemolo Lake, bordered by Highway 138 to the south and between Roads 2610 and 430. The predominant treatment prescription in this area is commercial thinning along roads, extending up to 1,200 feet into the APW.

Under Alternative 2, 258.9 acres would receive commercial treatment and 6.8 acres non-commercial. There would be .79 miles of new temporary roads and .13 miles of non-system roads used as temporary roads.

Under Alternative 5, 199.2 acres would receive commercial treatment and 21.1 acres non-commercial. There would be 1.97 miles of new temporary roads with this alternative.

APW-8

APW-8 is 1,765 acres west of Lemolo Lake. The D-Bug treatments affect only a roadside strip of this area.

Under Alternative 2, 21.8 acres would receive commercial treatment and 18.4 acres non-commercial. There would be 0.43 miles of existing non-system roads that would be used as temporary roads.

Under Alternative 5, 18.4 acres would receive commercial treatment and 12.6 acres would receive non-commercial. There would be 0.50 miles of existing non-system roads that would be used as temporary roads

WILDERNESS

Affected Environment

The Mt. Thielsen Wilderness lies to the east of the planning area and is 'buffered' by the OCRA. The Wilderness is identified in the LRMP as MA4[79] and is to be managed as part of the National System of Wilderness. Portions of the Pacific Crest Trail pass through the wilderness. The Visual Quality Objective (VQO) is preservation. Primary activities are hiking, climbing, fishing, camping, and horseback riding. The most concentrated use occurs around Mt. Thielsen and the Mt. Thielsen trail, with climbing as the main objective. Primary access to the Mt. Thielsen trail is from the trailhead parking area located off Highway 138 in the Diamond Lake area. Diamond Lake Resort also operates guided horse rides into the wilderness using the Howlock (1448) and Thielsen Creek (1449) trails. There are no D-Bug activities proposed in the Wilderness.

Environmental Effects

Because there are no D-Bug activities proposed in the Mt. Thielsen Wilderness, there are no direct or indirect effects. There are no connected or similar actions that would affect the wilderness and there are no reasonably foreseeable actions that would affect the wilderness. Because of the lack of direct and indirect effects, there are no cumulative effects to the Mt. Thielsen Wilderness.

SCENERY MANAGEMENT/VISUAL QUALITY – TRACKED AS A SIGNIFICANT ISSUE

During scoping, an issue was raised by several conservation groups that the proposed activities along Highways 138 and 230 would degrade the scenic drives, and the Visual Quality Objectives[80] (VQOs) of retention and partial retention should be retained instead of amending the VQOs along those routes.

The following indicator quantifies and tracks this issue:

- Acres treated along Highway 138 and 230 that currently have retention or partial retention visual standards that would be moved into a lower visual quality objective level.

[79] The management objective (desired condition) of the Mt. Thielsen Wilderness is to preserve and restore the integrity of the wilderness resource, provide consistent administration by all Forests and Districts involved, maintain and enhance the wilderness resource by managing wilderness under a non-degredation and enhancement policy; and provide a complementary variety of social and managerial settings using the Wilderness Resource Spectrum.

[80] The VQO inventory is divided into three components: the distance zone, the sensitivity level (constituent information), and the variety class (scenic attractiveness). The distance zones are described as FG-foreground, MG-middleground, and BG-background. The sensitivity level (1-highest, 2-average sensitivity, and 3-lowest) rates the concern for scenic quality. The visual inventory also describes the primary and sometimes the secondary place where a specific area can be viewed. This is usually from a prominent point of view or primary use area, or a particular road. Variety class relates to how distinct or common the visual resource is.

Relevant Standards and Guidelines

Visual Standards and Guidelines are listed on pages IV-19 to IV-26 of the LRMP. Specifically for this project, the Umpqua LRMP lists the following standards and guidelines:

- Minimum Level – The minimum acceptable level of visual quality shall be "maximum modification."
- Exceptions/Mitigation – Proposed exceptions to meeting assigned VQOs will be identified through project environmental analysis and amendment procedures described in Forest Plan Chapter Five. Examples of some exceptions are areas where past management practices make it impractical to meet the adopted visual quality objectives (VQO), or areas where catastrophic loss is imminent or has occurred. Visual mitigation measures shall be developed for areas when VQOs are not met so that projected future visual conditions are consistent with the Forest Plan.
- Duration of Visual Impact – the duration objective pertaining to ground disturbance shown in Agriculture Handbook 462 shall be modified to be the same as partial retention. Within Retention and Partial Retention objective areas, duration shall be an evaluation criterion during project environmental analysis. Management techniques shall be explored during the analysis process to attain duration objectives.
- Created Openings – Created openings (timber harvest units) shall be shaped and blended to the extent practicable with the natural terrain. Openings shall be located to achieve the desired combination of multiple use considerations. The maximum percentage of created openings at any one time is based on the VQO objective and distance zone. For retention, this ranges between 5-15% maximum created openings. For partial retention, this ranges between 10-25% maximum created openings. For modification, a maximum of 15-30% of the landscape may be in created openings, while in maximum modification areas, up to 33% of the landscape may be in created openings.
- A harvest unit is considered to be a created opening when the average stand height is less than 20 feet tall in foreground and middle ground distance zones, and less than 4.5 feet tall in background distance zones.
- Activity slash within viewsheds shall be treated commensurate with the VQO. Areas within 500 feet of sensitive routes shall have high priority for treatment. Viewsheds should be treated in a manner that avoids soil color contrast or denudation of the site.

Relevant Watershed Analysis Recommendations

The 2008 Watershed Analysis Iteration and Vegetation Management Plan, and the 2006 Winter Use Guide and Assessment (all incorporated by reference) each recognized that the stability of the scenic resource is currently at risk and recommend vegetative treatments to reduce the hazard of catastrophic wildfire and lower the potential impacts from insect outbreaks.

Existing and Desired Conditions

The Visual Management System is a management tool to recognize the scenic qualities of a specific area. It establishes criteria for identification and classification of the scenic

quality as well as visitor's concern for scenic quality. Each visual quality objective (VQO) represents the degree of alteration from the natural appearing environment. The Umpqua LRMP applies the Visual Management System Inventory as a minimum standard that project proposals should achieve when implemented; this system was developed when the Forest was using regeneration harvest methods as the primary tool for timber harvest. Considerations were not given to the use of commercial thinning or to unnatural changes in the disturbance regimes of the forest when VQOs were assigned to a particular area.

Due to the high level of natural beauty, the high recreation use in the area, and the predominant use of clearcutting as a harvest method at that time, visual quality objectives of retention and partial retention were assigned to the majority of the planning area. Limited activity has occurred in the planning area and the scenic quality around Lemolo and Diamond Lakes has remained very high. The recreating public has been exposed to very limited, small-scale changes to the scenery (primarily recreation related improvements to the area – tables 3-1 and 3-2).

Managing scenery resources has often been attempted by restricting activities from areas of high scenic value. This approach has limited the management opportunities in areas that are highly valued for scenery. In many cases, the hands-off approach in combination with fire exclusion has created conditions that are hazardous to the valued scenery attributes. Forest succession due to fire exclusion has gone unnoticed by most visitors; many visitors perceive the dense forest conditions that are visible from the primary travel routes and trails as being natural, while others are aware of and concerned about fuel build-up and the increasing fire hazard.

Natural forest disturbances are expected, but extensive areas of dead or dying trees (Haider and Hunt 2002, Ribe 1990), such as the destruction of the forest by fire or flooding, are perceived negatively (Daniel 2001; Fanarioutu and Skuras 2004; Gobster 1994, 1995). Timber harvest practices and other activities that create unnatural appearing openings that do not mimic natural patterns lower scenic quality. The perceptions of disturbances are also effected by the viewing distance. Generally, the further from the disturbance, the less negatively it is perceived. The amount of dead woody material is also a predictor of negative scenic ratings for forest scenes (Arthur 1977, Brown and Daniel 1986, Haider 1994, Haider and Hunt 2002).

The visual resource is also described by the USDA's National Forest Scenery Management System (SMS) (Agriculture Handbook Number 701). While the Umpqua National Forest LRMP has not been amended to officially adopt this system, the scenic stability component of the SMS is important to consider in the D-Bug analysis. The D-Bug planning area was assessed in terms of how stable the scenic environment is in its current condition.

Scenic stability is diminishing because the existing scenic character cannot be sustained in light of the mountain pine beetle outbreak and the need to provide safe conditions in the concentrated developed recreation areas. More and more lodgepole pine trees are turning brown and dying as a result of the mountain pine beetle (Figure 30). While this is a natural process, these trees increase the hazard of a high intensity wildfire burning through the area, which would create a scenic landscape that is not desired (as well as putting people at risk).

The uncharacteristically dense stand conditions and the abundance of mature lodgepole pine forest in the area and surrounding landscapes is eroding the ability of the landscape to sustain the existing scenic quality. The quality of the scenery has recently dropped

around Diamond Lake; less so around Lemolo Lake. Within the Diamond Lake Resort area and campgrounds, thousands of dead hazard trees have been felled and removed in the last three years. Many stumps are now obvious and some of the cut stumps are high and not yet masked by vegetative re-growth. Though the pine beetle outbreak has not yet had an impact on the Lemolo area, there are mature stands of lodgepole susceptible to beetle mortality near Lemolo and the uncharacteristically dense mixed conifer and young lodgepole forests are posing hazards in the wildland urban interface that must be addressed in both WUIs.

Figure 3-32. Mountain Pine Beetle Outbreak Along the East Shore of Diamond Lake.

Appendix J of the SMS utilizes two indicators to measure the conditions of and the impacts to scenery resources. The two indicators are Scenic Integrity[81] and Scenic Stability[82]. Scenic integrity is very similar to visual quality, measuring visual impacts to scenery in terms of contrast of color, and distracting elements of unnatural form, line and texture. Scenic stability is a newly defined indicator that is used to measure the stability of scenic attributes given the conditions and stressors that may create potential hazards to the stability or resiliency of the valued scenery attributes.

Scenic stability provides sustainability information based on ecological processes that are necessary to conserve valued scenery for future generations. Sustainability of scenery is primarily based on two aspects of an area: 1) the set of scenery attributes that make up its socially valued scenic character, and 2) the historic range of variability of those attributes, which provides information about how scenery attributes were perpetuated within the ecosystem. The scenic stability analysis first identifies sustainability of individual scenery attributes that make up the valued[83] scenic character, then identifies the sustainability for a landscape's scenic character, through assignment of a scenic stability level.

Scenic stability ratings are from no stability to very high stability. Table 65 displays the scenic stability level in terms of risk (more aptly termed hazard), and stability.

Table 3-69. Scenic Stability Levels.

[81] Scenic Integrity measures the amount of visual disturbance that contrasts with and/or detracts from the natural or socially valued appearance in a landscape.
[82] Scenic Stability is the degree to which the valued scenic character and its scenery attributes can be sustained through time and ecological progression.
[83] Common valued scenery attributes of vegetation include aspen groves, meadows, big tree character and open forest canopies, which are highly influenced by ecosystem changes and imbalances. Other valued scenery attributes include water bodies, landforms and cultural features.

Ecosystem Risk to the Dominant Scenery Attributes	Stability of the Dominant Scenery Attributes	Resulting Scenic Stability Level[84]
LOW RISK TO ALL (includes dominant and major attributes	ALL ATTRIBUTES	VERY HIGH STABILITY
LOW RISK TO ALL	ALL ATTRIBUTES	HIGH STABILITY
HIGH RISK TO FEW	MOST ATTRIBUTES	MODERATE STABILITY
HIGH RISK TO SOME	SOME ATTRIBUTES	LOW STABILITY
HIGH RISK TO MOST	FEW ATTRIBUTES	VERY LOW STABILITY
HIGH RISK TO ALL	NO ATTRIBUTES	NO STABILITY

The D-Bug project area is highly valued for the scenic attractiveness and the recreation opportunities available to the public. Views of the lakes and vistas of Mt. Bailey and Mt. Thielsen make this area very scenic. The contrast of the snowcapped peaks and the coniferous forest make for dynamic scenes. When combined with Diamond Lake in the foreground, the view is very attractive. The dominant scenic attributes are the mountain peaks, the lakes and rivers, and the coniferous forest vegetation.

Ecological Context

The ecological processes that have purported the vegetation are well described in the Diamond Lake and Lemolo Lake Watershed Analyses. As described in the Vegetation section, this area is at an elevation that supports lodgepole pine and some mixed conifer species such as Douglas-fir, ponderosa pine, white fir and Shasta red fir. Fire has played a prominent role in the past, having burned large areas with stand replacement severity. Prior to fire exclusion, fires would create a mosaic of burn severity, from stand replacement to primarily underburns, leaving patches or pockets of unburned trees. Once fire fighting became well-established to protect investments, such as lodges, campgrounds, recreation residences, and other structures, fires were put out as quickly as possible, and the fires were typically reduced to less than 10 acres. At a landscape scale, fire has been virtually excluded, except in nearby Crater Lake National Park, where fire has been applied as a management tool.

The amount of human use in the area increases the potential for human-caused fires, such as a campfire releasing an ember into the adjacent forest vegetation. Lightning is known to strike Mt. Thielsen at a high frequency. Approximately 30% of the fires in this area have been human-caused and 70% caused by lightning. These factors, in combination with the hot dry summers that have occurred during the past 10 to 15 years, leads to a fair conclusion that ignition is quite possible and increasingly so.

[84] VERY HIGH – all dominant and minor scenery attributes of the valued scenic character are present and likely to be sustained; HIGH – All dominant scenery attributes of the valued scenic character are present and are likely to be sustained, but some conditions and stressors present a low risk to the sustainability of dominant scenery attributes; MODERATE – Most attributes present and likely to be sustained, but a few have been lost or are in decline; LOW – Some attributes are present and likely to be sustained, but known conditions and stressors may seriously threatened or have eliminated some attributes; VERY LOW – Most dominant attributes are seriously threatened or absent to do conditions or stressors and are not likely to be sustained and those that remain may be moderately threatened, but are likely to be sustained; NO – All dominant attributes absent or seriously threatened and non are likely to be sustained, except for permanent landforms.

The landscape, from a middleground or background view, is a very lush appearing landscape; thriving vegetation, abundant water and clear blue sky. However, from a foreground view the lodgepole pine stands are often tinged with a brownish red color that is due to the mountain pine beetle infestations that have grown to an epidemic proportion. Forest Service Entomologist Don Goheen has predicted that the mortality rate for this area could be as much as 90% within the next 5 years (Goheen 2008). The planning area is comprised of about 44% lodgepole pine, of which about 8% of those acres are infested and the other 36% are in conditions that invite infestation. Due to fire exclusion, the lodgepole stands have grown to a density that the mountain pine beetle prefers.

There are other signs that cause concern for the stability of the forest stands in the area. The lodgepole pine stands are very densely stocked reducing the trees' ability to develop a thriving appearance of lower branches and full canopy. From a five foot eye level, the lodgepole stands are a nearly continuous mass of poles ranging from 3 to 12 inches in diameter (DBH). Only the smallest trees of less than 3" DBH provide any green needle branches at eye level. The high canopy level is however very dense. The density of these stands has created conditions that are both very welcoming to the mountain pine beetle, and very susceptible to high severity, large stand replacement fire.

These conditions are not localized but wide spread. The project is nearly surrounded by land allocations that have limited management opportunities, and are in a similar condition. The Mt. Bailey inventoried roadless area is adjacent to the west, Crater Lake National Park is adjacent to the south and the Mt. Thielsen Wilderness and the Oregon Cascade Recreation Area is adjacent to the east.

Due to the mountain pine beetle infestation in this area, and the potential for fire ignition and high fire severity conditions, the existing scenic stability is low (Table 65).

In terms of scenic integrity, the D-Bug project area is a landscape of moderate to high scenic integrity (partial retention and retention), where there are few elements that detract from the scenic quality of the area. However, there are areas where stumps and slash are prominent in the foreground views around highly used recreation areas. These stumps detract from the natural appearance and degrade the scenic integrity. Dead and dying lodgepole pine trees are making the forest appear unhealthy to the recreating public.

Desired Condition

Due to the heavy recreational use in this project area, the desired scenic stability level is high (Table 65). The area has a high scenic attractiveness rating as well as high sensitivity level within the Visual Management System. The desired condition is a more sustainable balance between the valued scenery attributes and ecological stressors.

The desired condition of the lodgepole pine stands are a mix of structural stages, providing areas of visual access into the forest stands to view large conifer trees, intermixed with pockets of early seral stage trees that have branches at eye level and below. These conditions are within the historical range of variability and would be occurring in this area if fire exclusion would not have occurred. Mixed conifer stands would provide large tree character and diversity in species, as well as views of the large sized Shasta red fir and pine. The forest floor in the immediate foreground would generally be clear of dead woody material, but pockets of debris would be visible at distances of greater than 300 feet. Stands in and around recreational areas would be open stands that have fewer ladder fuels and an open canopy.

Visual Quality Objectives (VQOs)

Management of the visual resources requires proposed activities to comply with the assigned objective. For D-Bug, they include retention (high scenic integrity), partial retention (moderate scenic integrity), modification (low scenic integrity) or maximum modification (very low scenic integrity). In the areas with the VQO of retention, management activities are not evident to the average forest visitor. In partial retention, management activities are to remain visually subordinate to the characteristic landscape. In areas with a VQO of modification, management activities may visually dominate the landscape; however, roads and visible remnants from logging such as slash and stumps, etc. should remain visually subordinate to the landscape. The maximum modification VQO allows management activities of vegetative and landform alterations to dominate the landscape.

In order to meet the VQO of retention, management activities should not be evident – this would be nearly impossible to achieve under the any of D-Bug commercial or non-commercial treatments, as more than one or two trees may be cut and more than one or two stumps may be evident. Even the VQO of partial retention may be difficult to achieve. In order to protect the WUI, reduce the hazard from the bug-killed trees, and lower the risk that the lodgepole pines in the area would succumb to the mountain pine beetle, trees would have to be removed and fuels would have to be treated. It would be impossible to do these activities and not be visually ”seen” by the average forest visitor. Therefore, in order to do any management activity in the planning area, the D-Bug project proposes to amend the Forest Plan’s VQO’s of retention and partial retention to allow for activities to occur in the planning area.

The majority of the planning area is classified as either retention or partial retention, as are most of the treated areas (both commercial and non-commercial units). Much of the area proposed for treatment can be seen from Highways 138 and/or 230, from the Mt. Bailey IRA, or from the Mt. Thielsen Wilderness Area. Table 66 describes the existing condition of the visual quality objectives found in the planning area; Alternative 1 is represented by the planning area acres.

Table 3-70. Acres of VQO Within the Planning Area and Within the Proposed Treatment Areas of Each Alternative.

Visual Quality Objective	Planning Area Acres (Alternative 1)	Alternative 2 – includes only areas to be treated	Alternative 5 – includes only areas to be treated
Preservation	5	0	0
Retention	15,191	3,320	2,853
Partial Retention	13,028	4,273	3,641
Modification	5,469	767	598
Maximum Modification	8,278	644	661
Totals	41,971	9,004	7,753

highways 138 and 230, both the Lemolo Lake and Diamond Lake recreation composites (all of MA 2), and all roads and trails along or adjacent to these areas are classified as sensitivity level 1 under the Umpqua LRMP, which means that it has the highest

sensitivity for concern over scenic quality; nearly all other roads and routes in the planning area have sensitivity level of 2, which is an average sensitivity.

Direct and Indirect Effects

Direct and indirect effects were analyzed at the planning area scale. Effects to visual quality are determined by considering each alternative in terms of impacts of treatments to the natural appearance of the area.

Alternative 1 would have no direct effect to the visual quality of the area because no ground disturbing activities would occur. Indirectly, however, Alternative 1 does not respond to the scenic instability of the area. With no action, existing trends and conditions would continue, including the mountain pine beetle infestation. As more lodgepole succumb to mountain pine beetles, their needles would turn brown; if mortality occurs as predicted, up to 90% of the lodgepole pine may die within a few years, creating a landscape of brown trees. As disclosed in the fire/fuels section, these areas are susceptible to stand replacement fire, which would visually alter the area for decades, until new seedlings grew to a height sufficient to become the prominent feature in the viewshed (versus the blackened snags). This would affect scenic stability at a landscape scale that has reduced stability to low, and if not treated, is very likely to reduce the stability level even further to very low. Without intervention, the scenery is expected to decline over time until vegetation reestablishes over the next several decades.

Effects to scenic stability are determined by considering each action alternative in terms of treatments and their effect on the existing condition. For example, in a dense forest salvaging dead trees and thinning the trees and canopy reduces the fuel load and directly improves the resiliency of the stand to fire. . As the stands move to a more fire resilient condition, the scenic stability is improved.

The direct effects of this project to the scenic stability are minimal at a landscape scale. There are not enough acres proposed to be treated to make any measurable difference to stability of the scenic attributes across the landscape. The project is not designed to fully eliminate the threat of further beetle infestations or fire, but acts to reduce the fire hazard where people congregate. Considering the treatment proposals from a foreground perspective, the scenic stability would be improved in the foreground areas. The campgrounds, lodges and recreation residences are all places where people experience the foreground scenery in a very connected manner, being within the forest canopy rather than just viewing the scenery from a distance. These foreground attributes create a large part of the recreational experience. Therefore, scenic stability will be address at two differing scales: foreground and landscape.

Effects Common to All Alternatives

Treatments[85] are proposed primarily in foreground areas around the perimeter of the Diamond Lake and Lemolo Lake recreation areas, private recreation residences, and along Highways 138 and 230, Lemolo Lake Road, Windigo Pass Road, and Thirsty Creek Road. In general, the duration of the impact would last approximately 3 to 10 years, depending on the site, the type of slash treatment, and how rapid ground vegetation responds in the area. Units would be designed to blend with the landscape and avoid harsh edges as much as possible.

[85] For unit by unit affects to scenic integrity and visual quality objective, please see the Visuals/Scenery Specialist Report in the Project File.

Burning would have the potential to directly and indirectly impact scenery, especially if the burn were 'hot' and consumed more slash or trees than planned; underburning is limited and not expected to result in major changes to the visual quality of the area. Mastication would have the potential to directly and indirectly impact scenery, especially in the foreground view of the campgrounds and recreation residences. The treatment produces light-colored chips that would be visible from these locations. However, the effects from slash, pile burns, and mastication would fade after 1 to 3 years, as vegetation grows and the burned area is no longer visible. Areas in retention would be prioritized for pile burning to maintain scenery in the area.

In response to the issue raised during scoping, for the action alternatives, there are about 114 acres within 150 feet of Highway 230 where treatments would be most visible. Within this area, about 10 acres would move from Retention to Partial Retention, while 70 acres would move from Retention to Modification. About 29 acres would move from Partial Retention to Modification. About 5 acres would remain as Partial Retention after treatment.

Along Highway 138, there are about 564 acres within 150 feet of the highway that would be most visible after treatment. Within this area, about 210 acres would move from Retention to Partial Retention, while 194 acres would move from Retention to Modification. About 135 acres would move from Partial Retention to Modification. About 24 acres would remain as Partial Retention after treatment. As vegetation grows on the forest floor, the visual impacts from the treatments would become less obvious and the area would return to its pre-treatment VQO.

To meet the Retention VQO, the stumps of harvested trees would be cut to a 6 inch to 8 inch height within 50 feet of Highways 138 and 230 and FS Roads 4795 and 2610, and within the Broken Arrow and Thielsen View Campgrounds. To meet the Retention VQO, there would be a 50-foot no-cut buffer uphill of the Dellenback trail in Units 82 and 86, and the stumps of harvested trees would be cut to a 6 inch to 8 inch height within 50 feet of the Dellenback Trail in the other units the trail traverses (units 2, 3, 4, 8, 12, 17, 19, 33, 36, 37, 89, 90, 91). Hazard trees that need to be felled in the above areas may need to be cut to a taller height for safety reasons. As funding is available, these stumps would be cut flat with the bark side of the stump to the road or trail. The stumps would be cut as low to the ground as safety allows, ideally flush cut but not to exceed 6 to 8 inches in height. These actions will lessen the visual impacts of the harvest treatments.

Table 3-71. Effects to Visuals/Scenery by Treatment Type by Alternative.

Treatment Type	Primary Effects (Beneficial/Adverse)	Resulting VQO for action alternatives	Alt 1	Alt 2	Alt 5
Overstory removal retaining understory trees Prescription 1	Beneficial – Reduces fuel loads near where people congregate. Adverse – Stumps may be visible and slash piles not immediately treated, detracting from the scenic quality.	Modification in Foreground No change to Background	0	59	0
Thinning Uninfested Lodgepole Pine (retaining ~50 TPA)	Beneficial – Reduces hazard/risk of further beetle infestation; reduces appearance of dead and dying	Partial Retention in Middleground	0	4,685	3,633

Treatment Type	Primary Effects (Beneficial/Adverse)	Resulting VQO for action alternatives	Alt 1	Alt 2	Alt 5
and thinning low merchantability stands and salvaging dead and dying lodgepole pine (retaining 50-200 TPA) Prescriptions 2-4	trees; limits effects of infestation in foreground, improving scenic stability. Opens vistas to large diameter trees in middleground in areas of lodgepole and mixed conifer. Creates conditions to manage wildfire as a ground fire instead of crown fire. Adverse – Stumps may be visible and slash piles not immediately treated would detract from the scenic quality. Chips resulting from mastication treatment in the short-term (Prescription 3 only).	Modification in Foreground No Change to Background			
Non-commercial treatments Prescriptions 5-8	Beneficial – Reduces fuel loads along evacuation routes and opens vistas to large diameter trees in middleground. Adverse – Stumps may be visible and slash piles not immediately treated would detract from the scenic quality. Chips resulting from mastication treatment in the short-term (Prescription 6 only).	Partial Retention in Middleground Modification to Partial Retention in Foreground No Change to Background	0	2,026	2,068
Mixed Conifer Thinning (retaining 50-200 TPA) Prescriptions 9 - 13	Benefits scenic stability by focusing retention on fire resilient species and opens vistas to large diameter trees in middleground. Reduces canopy densities and fuel loads, creating a more fire and disease resilient stand. Adverse – Stumps may be visible and slash piles not immediately treated would detract from the scenic quality.	Partial Retention in Middleground Modification to Partial Retention in Foreground, depending on TPA retained No Change to Background	0	2,247	2,040

None of the connected or similar actions would have any lasting effects on the visual resources. Short term impacts include equipment visible in and along roads, yarders or other logging machinery visible on roads and near or within recreation sites. By

amending the Forest Plan, all Standards and Guidelines would be met for visual quality objectives in the short term. In the long term, non-commercial methods may be used to maintain the fuelbreak, thus maintaining an open forest condition and desired scenic view.

Cumulative Effects

The scale at which cumulative effects are analyzed is the planning area. All past regeneration harvest was considered (9,972 acres in the planning area). The Forest Silviculturist estimated that areas that were regeneration harvested after 1985 may not have reached 20 feet in height, depending on the forest type and whether or not the unit was pre-commercially thinned. As a result, this analysis uses 1980 as the cut-off date in order to conservatively estimate the affects to visual quality.

Of the 9,972 acres that were regeneration harvested (clearcut, shelterwood, or final removal) in the planning area, about 6,876 acres were harvested after 1980. Under the existing condition, there are 474 acres harvested after 1980 that are in retention; this is 3% of the 15,191 acres assigned to retention in the planning area and is below the 5%-15% of the area allowed in openings under S&Gs (USDA, 1990). There are 2,220 acres harvested after 1980 that are in partial retention; this is less than 17% percent of the 13,028 acres of partial retention in the planning area and is within the 10%-25% of the area allowed to be in openings under S&Gs. For the modification VQO, there are currently 1,196 acres that were harvested after 1980 or 21% of the 5,469 acres of modification in the planning area, which is within the 15%-30% allowed for openings under S&Gs. Finally, for maximum modification, there are 2,186 acres that were harvested after 1980, or 26% of the 8,278 acres of maximum modification ground, which is below the 33% allowed for openings, thus meeting S&Gs that address openings.

When adding the acres proposed to be treated, only those treatments that retain fewer than 50 trees per acre would be considered as openings from a visuals standpoint. The silvicultural prescriptions for commercial thinning in lodgepole pine and mixed conifer stands would retain enough trees that these units would not contribute to the maximum acreage of allowable openings. The lodgepole pine overstory removal prescription of retaining 20 trees per acre (silvicultural prescription 1 in Alternative 2) would be considered a regeneration harvest and would therefore contribute to the openings. Only these units would potentially contribute to cumulative effects.

Alternative 2 would add 44 acres as openings in retention acres, bringing the total openings under retention to 518 acres, or 3.4 percent; this is still below the acreage allowed for openings. Under partial retention, 15 acres would be considered as openings, increasing the total to 2,235 acres, or 17 percent; this is still below the acreage allowed for openings under the Standards and Guidelines in the LRMP.

Alternative 5 would add zero acres as openings under retention, as no units occur in prescription 1, meaning that this alternative would not contribute to a cumulative effect within the retention Visual Quality Objective.

The no action alternative has no cumulative effect on visuals, because it does not directly alter the landscape; however, should a stand replacement severity wildfire occur and burn a large acreage, the visual quality would potentially be degraded. As described above, Alternative 5 would not contribute to a cumulative effect, as no treatment acres are proposed that would add to the openings. Alternative 2 adds 49 acres to an open condition by implementing prescription 1. However, given the current condition, these acreage changes are minor and constitute less than one percent

change in VQOs from the existing condition. There would be no contribution to harvest unit openings from connected or similar actions.

When considering past timber sales as stated above, present activities, and the relatively few reasonably foreseeable activities (Table 14) in the planning area that would have the potential to affect visual quality, and by amending the Forest Plan to allow for treatments to occur in Retention and Partial Retention, no cumulative effects to the visual quality are anticipated to occur with the action alternatives.

NATIONAL FOREST MANAGEMENT ACT DETERMINATION OF SIGNIFICANCE – TRACKED AS A SIGNIFICANT ISSUE

The Responsible Official will make a determination of significance of the proposed amendments to the Forest Plan in the Record of Decision. Forest Service Manual 1926.51 outlines the requirements that determine whether a proposed change to the LRMP is significant or not, based on National Forest Management Act requirements. A discussion of each of the proposed amendments (see Chapter 2) under the action alternatives and the requirements of NFMA appear below. Alternative 1 would not amend the plan and is not discussed further.

Amendment 1: Amending the VQO objectives of Retention and Partial Retention along highways 138 and 230.

Amendment 2: Amending Management Area 1 and its associated prescriptions to allow for limited timber harvest in and adjacent to the Diamond Lake WUI.

Amendment 3: Amending Management Area 2 and its associated prescriptions to allow for timber harvest units greater than ½ acre in size and commercial and personal use firewood cutting.

Forest Service Manual 1926.51 states four scenarios from which non-significant LRMP changes may result.

1. Actions that do not significantly alter the multiple-use goals and objectives for long-term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further on-site analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long-term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

All proposed changes are for the purposes of this project only and do not significantly alter long-term LRMP multiple-use goals and objectives. Amendment 1 modifies VQOs along highways 138 and 230 and areas surrounding Diamond Lake for this project to effectuate treatments that meet the purpose and need. Amendment 2 changes prescriptions in MA-1 for this project to allow timber harvest to reduce the potential for mountain pine beetle infestation and high-severity fire within a WUI. Amendment 3 changes prescriptions in MA-2 for this project to allow for timber harvest in units greater than one-half acre in size in order to implement effective treatments that meet the purpose and need. All proposed changes are based on analysis of on-site conditions, as detailed in Chapter 3 of this FEIS. Any change to LRMP standards or guidelines,

specifically in the case of VQOs, is minor because of the size of the area affected and temporal nature of the project. Because of the specific and limited nature of these changes to the LRMP, these amendments are are not significant.

Specifically Required Disclosures

CULTURAL RESOURCES

The affected environment for cultural resources falls within the areas of proposed ground-disturbing activities (timber harvest, fuels treatment, road construction, reconstruction, and decommissioning, subsoiling, landing construction, etc.).

Cultural resource surveys occurred based on pre-field analysis for the D-Bug project area. Depending upon the location of planned activities, these surveys took the form of inventory surveys with monitoring or impact area surveys. All the surveys were in fulfillment with the Inventory Strategy approved by the Oregon State Historic Preservation Office. A report documenting the surveys will be submitted to the State Historic Preservation Office as required under the Programmatic Agreement between Region 6 of the Forest Service, the Advisory Council of Historic Preservation, and the Oregon State Historic Preservation Office.

Prehistoric and historic resources were located during cultural surveys for the D-Bug project. Some sites and resources are not considered substantial due to their lack of integrity or 'significance', as defined under the National Historic Preservation Act. All potentially National-Register-eligible cultural resources have been protected by modifying treatments in areas with cultural resources, by establishing mitigation measures to use during project implementation, and/or by buffering the locations that may occur near proposed activities. Archaeological testing of several sites is planned to determine the sites' extent and a determination of eligibility to the National Register of Historic Places. Consultation has been completed with the tribes concerning the archaeological testing. If further mitigation is required prior to the undertaking, this will be completed in consultation with the State Historic Preservation Office (SHPO) and the tribes.

Direct, Indirect, and Cumulative Effects

The potential exists for unidentified cultural resources in the D-Bug project area. Mitigation measures described in Chapter 2 would protect undiscovered cultural resources, lowering the potential for effects to these resources. Overall, proposed ground disturbing activities would have little potential to affect cultural resources. Standard contract provisions would provide for protection of cultural resources discovered during project implementation. The action alternatives may reduce the potential of damage to historic properties due to the reduced risk of high-intensity fire occurrence. Alternative 1 would have no direct effects on any cultural resources. Indirectly, a wildfire may have the potential to burn or damage existing cultural resources, especially if the fire was of high intensity.

The Umpqua National Forest has sent a cover letter with the quarterly copies of the Schedule of Proposed Action (SOPA) to each of the tribes. Each quarter, the cover letter highlights new projects and projects that may be of interest to the tribes. D-Bug was identified as a new project when the project was first initiated. The Confederated Tribes of the Grand Ronde, Confederated Tribes of the Siletz, and the Cow Creek Band of Umpqua Tribe of Indians were contacted by Debra Barner, Heritage Program Manager for the Forest. The Forest also utilized phone calls, letters, and opportunities

to participate in public tours and public meetings, as well as meetings at tribal offices to interact with the tribes. Under the treaties with the tribes, no trust resources or reserved treaty rights are given for the lands managed by the Umpqua National Forest. Therefore, no effects to trust resources or reserved treaty rights would occur with any of the alternatives.

Potential effects from ongoing activities would not create cumulative effects on cultural resources with the additional activity associated with any of the action alternatives. Based on the results of the cultural resource surveys, review and mitigation of known resources, mitigation of undiscovered sites, and consultation with tribes, there would be no indirect or cumulative effects on the heritage resources as the result of implementing the D-Bug project. Direct effects will be mitigated in consultation with the tribes and SHPO.

AIR QUALITY

Standards for ambient air quality[86] are set by the Environmental Protection Agency (EPA) and are designed to protect human health and welfare. Air quality can be impacted by the presence of particulate matter and other pollutants produced by both prescribed burning and wildfire[87]. Although smoke from wildfire is considered a natural event by the EPA's Natural Events Policy (air quality standards do not apply), smoke generated from prescribed burning must meet federal and state air-quality standards set forth in the Clean Air Act (CAA, Section 160). All activities associated with this project will be implemented to meet standards in the CAA.

The Forest Service is required to file a burn plan with Oregon Department of Environmental Quality (ODEQ) and would comply with its strict standards for air quality. ODEQ would not provide approval for burning when atmospheric conditions exist that may result in an inversion or other atmospheric conditions that would cause air-quality violations. ODEQ strictly regulates burning; as such, there is very little likelihood that the effects to air quality from any action alternative would exceed air-quality standards, even when combined with other burning and pollution sources.

Regional Haze Rule was designed by the EPA to call on states to establish goals for improving visibility in mandatory Class I areas and to develop long-term strategies for reducing emissions of air pollutants that cause visibility impairment to these areas. At this time, Oregon does not yet have a State Implementation Strategy (SIS) to deal with regional haze or visibility impairment, and no standards currently exist. However, the importance of visibility in these areas, such as Crater Lake National Park, is recognized and burn prescriptions will be designed to minimize potential for smoke intrusion in these areas.

Because prescribed burning is not a stationary source of pollutants, and because no burning associated with this project is within a non-attainment area, Prevention of Significant Deterioration, and the conformity provisions (see Glossary) of the CAA are not applicable.

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[86] Ambient air quality is defined under the Clean Air Act of 1963 as the air quality outside of industrial site boundaries.

[87] Although prescribed burning affects air quality in ways similar to wildfire, it offers some advantages over wildfire. Prescribed burning plans are developed and implemented to minimize impacts on the airshed by the consideration of atmospheric conditions, season of burn (e.g., burning is restricted between July 1 to September 15 under the Oregon Visibility Protection Plan), fuel and duff moisture, diurnal wind shifts, ignition techniques and rapid mop-up.

Other air-quality impacts that may occur related to prescribed burning include: temporary and localized loss of aesthetic qualities due to visibility reduction, reduced visibility on highways and roads causing potential safety issues, health problems for sensitive people (i.e., asthma), and human discomfort. These impacts may occur at pollutant levels that are within air-quality standards. Smoke impacts to safety, human health or visibility that occur within air-quality standards are termed “nuisance smoke”.

The closest smoke-sensitive receptors[88] are Oakridge, Roseburg, Cottage Grove, and are no closer than 35 miles from the project area. The closest Class I airsheds (see Glossary) are Diamond Peak Wilderness (about ten miles to the north) and Crater Lake National Park (adjacent to the project area on the south). Although Mt. Thielsen Wilderness, located directly to the east, is not a designated Class I Airshed, the importance of air quality in this area is also recognized in this report.

UNAVOIDABLE ADVERSE IMPACTS

Implementation of an action alternative may result in potential adverse environmental effects that may not be mitigated or avoided. Field reconnaissance and interdisciplinary analysis helped eliminate or mitigate many potential impacts. All Forest Plan standards and guidelines, Best Management Practices, project design features, and other mitigation measures and management requirements (found in Chapter 2) lessen potential effects. The specific effects associated with project activities were discussed throughout this chapter.

The potential still exists for adverse impacts, even with mitigation and application of standards and guidelines and BMPs. As disclosed, disturbance to some wildlife species may occur; recreationists would have limited access to some recreation sites, both dispersed and developed, during harvest operations. These impacts vary in duration and intensity. Most of these effects are predicted to be short-term (during harvest operations). Standards and Guidelines for Visual Quality Objectives have been amended where the effects of the treatments are unavoidable in the foreground areas; without the amendment, the project cannot proceed. All other effects would be within acceptable parameters. In addition, some monitoring is prescribed to ensure that effects are within limits and that mitigation measures and BMPs are successful.

IRREVERSIBLE/IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitments are those that cannot be regained, such as the quarrying and use of rock from a former rock-outcrop. Irretrievable commitments are those that are lost for a period of time such as the loss of timber productivity in the construction of a temporary road. Once the road is obliterated following log haul, timber production can be resumed. The timber production loss is irretrievable, but the action is not irreversible because timber production can resume.

Alternative 1 would result in irreversible losses of the economic value of beetle-killed timber. The mountain pine beetle infestation is predicted to progress over the next several years, potentially killing up to 90 percent of the largest lodgepole in infested stands (Goheen, 2008). Once dead, the wood rapidly decays and become difficult to sell, especially in a depressed timber market. As such, the commercial value of that

[88] Smoke-Sensitive Receptors are areas designated by the State Board of Forestry, in consultation with the Department of Environmental Quality, that are provided the highest level of protection under the smoke management plan because of its past history of smoke incidents, density of population, or other special legal statuses.

timber would be lost or highly compromised. Under the action alternatives, irreversible economic losses can also be expected, because even with preventative treatments, lodgepole pine trees will die from the infestation. However, assuming that an action alternative is implemented in a timely manner and that the infestation progresses relatively slowly, fewer economic losses can be expected compared to Alternative 1. This is especially true of Alternative 2, which treats more of the lodgepole pine than Alternative 5. The Economics section in this chapter describes these conditions in more detail.

The implementation of alternatives 2 and 5 would result in the irretrievable effect of temporarily foreclosing the possible option of designating certain areas as wilderness areas. The assessment of the effects of the alternatives on potential wilderness characteristics and future designation concluded that harvest operations would preclude several areas from being considered as wilderness, due to the visibility of stumps and the footprints left from temporary roads and their subsequent decommissioning. However, these impacts would subside, making this impact irretrievable, but not irreversible.

Similarly, recreational experiences associated with summer and fall hiking and biking would be irretrievably lost under the action alternatives because some trails would be closed to use while logging and hauling in the vicinity would occur. This short-term loss is seasonal and expected to only last for the length of the season of operation. The Recreation section of this chapter describes these conditions in more detail.

All the action alternatives would result in an irretrievable loss of scenic values along highways 138 and 230 and in the vicinity of several trails where tree stumps and bare soil would be evident for a number of years. Over time however, these losses would diminish as understory vegetation growth progresses. The Scenic Quality section of this chapter describes these conditions in more detail.

SHORT TERM IMPACTS VS. LONG TERM PRODUCTIVITY

NEPA requires consideration of the relationship between short-term uses of the human environment and the maintenance and enhancement of long-term productivity (40 CFR 1502.16). It is the intent of this project to continue to manage resources so that they are available for future generations. The harvest of trees and fuels treatments associated with this project is considered a short-term use of a renewable resource. The use of the resource is considered renewable, because the harvested area would maintain vegetation, both in the understory and overstory. No impairment to the productivity of the land to continue growing trees is projected to occur as a result of implementing this project.

The soils section of this document describes actions that would be taken in order to help maintain long-term site productivity. Mitigation and project design features that would help retain effective ground cover and subsoiling some of the skid trails would help maintain the long-term productivity of the project.

UNIQUE HABITATS

Unique habitats are discussed under the terrestrial section of this Chapter. No further information will be added here.

WETLANDS AND FLOODPLAINS

Floodplains are associated with perennial streams and vary from only a few feet to much larger areas depending on the size of the stream and the topography of the streambanks and surrounding area. The environmental effects of all project activities within any floodplain are consistent with the Standards and Guidelines for the Umpqua National Forest LRMP and have been evaluated and declared in the LRMP Final EIS (March 1990). Since the activities in this project follow those Standards and Guidelines, this activity will not be declared separately for this sale.

Impacts to wetlands are disclosed in the aquatics section of this chapter and will not be discussed further.

PRIME FARMLANDS, RANGELANDS, FORESTLANDS, AND PARKLANDS

No prime farmlands, rangelands, forestlands or parklands exist within the area. Therefore, no direct, indirect or cumulative effects would occur.

POTENTIAL OR UNUSUAL EXPENDITURES OF ENERGY

The action alternatives would require expenditures of fuel for workers to access the D-Bug project for use of power equipment and to utilize the logging systems. Alternative 1 would require no expenditure of fuel. No other direct, indirect, or cumulative effects are expected to occur with any of the action alternatives.

CONFLICTS WITH PLANS, POLICIES, OR OTHER JURISDICTIONS

Implementation of any of the alternatives would not conflict with the plans or policies of other jurisdictions, including the tribes. This project would not conflict with any other policies, regulations, or laws, including the Clean Water Act, Endangered Species Act, and the National Historic Preservation Act. Effects to air quality and compliance with the Clean Air Act are described in this section. This project is outside of the Mt. Thielsen Wilderness, thus creating no conflicts.

CONSUMERS, CIVIL RIGHTS, MINORITY GROUPS, AND WOMEN

Contracting procedures would ensure that projects made available to contractors through this project would be advertised and awarded in a manner that gives proper consideration to minority- and women-owned business groups. Because of this consideration, there would be no direct, indirect, or cumulative effects to consumers, civil rights, or minority groups with implementation of any of the alternatives.

ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton signed Executive Order 12898. This order directs Federal agencies to address environmental justice by identifying and disclosing the effects of the proposed activities on minority and low-income populations. The effects of the proposed alternatives on the economic conditions of the State and county are disclosed in the Economics section of this document.

According to U.S. Census data for Douglas County, 5.6 percent of the population is a minority. The same data indicates the poverty level in Douglas County is 14.2 percent, versus 13.5 percent statewide. As of June, 2010, unemployment is 14.3 percent in Douglas County, versus 10.5 percent statewide. The project occurs more than 80 miles away from any large population centers (Roseburg or Medford) that would be directly affected by the project. The Wildland-Urban Interface communities of Diamond Lake

and Lemolo Lake are directly within the project area and would be directly affected by short-term trail and recreation site closures, as well as noise and impacts to scenery. Noise and operating impacts are mitigated by limiting operations, both seasonally and during daylight hours. Both resorts at Diamond Lake and Lemolo Lake may see a beneficial impact as workers use the stores, restaurants, or lodge facilities.

The community of Toketee lies less than ten air miles to the east; the Toketee Ranger Station is located in that community, along with housing for Forest Service and Pacificorp families. The community of Dry Creek, which is about 20 miles to the west, has a small store that could see an increase in business during logging and non-commercial operations. Both Toketee and Dry Creek may potentially be affected by an increase in log truck traffic, as would the recreating public. The communities of Idleyld Park and Glide, which lie about 50 miles to the west, may also see an increases in business and traffic. Cumulatively, the continued operation of the Wapiti, Tugboat, and Lobo sales may add to increases in traffic moving east to west and vice-versa, particularly when combined with the D-Bug project. In addition, the proposed North Umpqua Highway Project would reconstruct portions of Highway 138 from milepost 52.8 to milepost 67.2, which is on the western edge of the planning area, further causing traffic congestion during the summer months. Overall, none of these increases would be comparable to the logging in the area in the late 1980s. No other adverse direct, indirect, or cumulative effects would occur.

Where there is concentrated and dispersed recreation, the effects to those recreating in the area would be greatest. These areas will be closed during operations to protect people from logging and non-commercial activities. Minority groups or low-income groups that use these areas may be impacted during logging operations by the increase in log truck traffic, an increase in noise, and a diminished capacity for dispersed camping. These groups may choose to recreate elsewhere. Adverse impacts to these groups would end when logging and other connected actions are completed. Overall, none of the action alternatives imposes any other additional hardships on minority or low-income communities. Therefore, there would be no direct, indirect, or cumulative effects to environmental justice with any alternative. The no action alternative has no direct, indirect or cumulative effects on environmental justice, as no actions would be taken that would deter people from using the area.

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CHAPTER 4

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Miles Barkhurst	Umpqua National Forest, Supervisor's Office, Civil Engineer / Forest Road Manager. BSME, Environmental Geosciences Minor, Oregon State University, 1997. Twenty-five years Forest Service experience in transportation planning, road design and construction, road-related watershed restoration, and transportation system management.
Debra Barner	Umpqua National Forest, Supervisor's Office Forest Archaeologist. M.S. Anthropology, History, and History of Science 1982. Ten years private archaeological contracting and fourteen years with the Forest Service.
Josh Chapman	Umpqua National Forest, Supervisor's Office, Wildlife Biologist, B.S. Wildlife, Humboldt State University, 2004; B.A. English Literature, University of Victoria, British Columbia, 1998. 10 years of wildlife and natural resources related field work experience for the National Park Service, U.S. Geological Survey, and Forest Service. Currently working as the Wildlife Biologist for the Forest Planning Team.
Joel Detlef	Umpqua National Forest, Cottage Grove Ranger District, Forester/Logging Systems. B.S. Forestry, Humboldt State University, 2004; A.S. Landscape Horticulture and Arboriculture, San Francisco; 6 years US Marine Corps. 4 years experience on presale/timber marking crew.
Gabe Dumm	Umpqua National Forest, Supervisor's Office, Fire Ecologist. MS Forest Resources, University of Idaho,2003; BS Conservation Social Sciences, University of Idaho (1998); A.A. Wilderness Management, Vermilion Community College, 1996. About 10 years of experience in wildfire suppression/prescribed burning, structural fire fighting (live-in career experience and training program, volunteer), wildland fire effects research, and resource (fuels) planning. Currently serving as Forest Fuels Planner and Fire Ecologist.

Barbara Fontaine	Umpqua National Forest, Timber Planning Team Fisheries Biologist. M.S. Fisheries Biology, Oregon State University, 1988; B.S. Wildlife Management. Humboldt State University, 1979. Twenty -six years of Forest Service experience in timber sale planning, fish and wildlife inventories, and habitat restoration. Also currently serving as the project coordinator for the Timber Planning Team.
Richard Helliwell	Umpqua National Forest, Supervisor's Office, Forest Botanist. B.A. Anthropology, University of Maryland, 1979; B.S. Biology, Southern Oregon State College, 1985. Botanist, Warm Springs Indian Reservation, 1985-1989; Botanist, Bear Springs Ranger District, Mt. Hood National Forest, 1989-1991; Botanist, Big Summit Ranger District, Ochoco National Forest, 1991-1995. Forest Botanist, Umpqua National Forest, 1995-present. Survey & Manage Bryophyte-Lichen Lead, Northwest Forest Plan Area, detail to PNW Regional Office, 2001-2004.
Steve Hofford	Umpqua National Forest, Supervisor's Office, Hydrologist. B.S. Watershed Science - Hydrology, Colorado State University, 1978; A.A.S. Electrical Instrumentation, Williamsport Area Community College, 1967. Over thirty years of experience in water resources with the Forest Service, Bureau of Land Management, and U. S. Geological Survey. Currently serving as Hydrologist on the Forest Planning Team.
Don Morrison	Umpqua National Forest, Supervisor's Office, Timber Sale Planning Team Forester. B.A. Botany, Humboldt State University, 1979; Certified Silviculturist, 2002 to present. Over thirty years of experience in forest inventory, soil science, silviculture, and landscape planning.
Steve Nelson	Umpqua National Forest, Supervisor's Office, Contracting Officer/Economic Analysis. B.S. Forestry, minor in Business Management, Humboldt State University, 1980. Forest Engineering Institute, Oregon State University, 1985. Twenty-seven years Forest Service experience in NEPA, Timber, Engineering, and Transportation Planning. Currently serving as Contracting Officer and Assistant Timber Staff Officer for the Umpqua National Forest.
Greg Orton	Umpqua National Forest, Supervisor's Office, Soil Scientist. B.S. Soil Science, California Polytechnic State University, San Luis Obispo, 1991. A.S. Forest and Parks Recreation Management, Kings River Community College Forest Resources, 1978. Nineteen years experience in Timber Planning. Thirty-two years of experience in forestry, recreation, and management.
Brad Paul	U.S. Forest Service, Pacific Northwest Regional Office, Appeals and NEPA Specialist; J.D. Environmental/Land Use Law, University of Missouri-Kansas City; B.A. Communications, University of Missouria-Columbia. Four years of experience in recreation, planning, appeals and litigation.

Stephanie Wessell	U.S. Forest Service, Umpqua National Forest, Supervisor's Office, Timber Planning Team Forester. M.S. Wildlife Science/Forestry, Oregon State University, 2005; B.S. Wildlife Science/Botany, Oregon State University, 2001; B.S. Political Science, University of Oregon, 1997. Over thirteen years of Federal experience in silviculture, botany, wildlife, and planning.

The following people also helped in preparation of this project:

Rick Abbott	Zone Silviculturist
Jim Archuleta	Soil Scientist
Barnes & Associates	Transportation Planning Assistance and Silviculture assistance
Bryan Benz	Botanist/Field Reconnaissance
Jeff Bohler	District Wildlife Biologist
Larry Broeker	Forest Geologist
Joel Detlef	Logging Systems Input
Derek Ibarguen	Zone Recreation Manager
Greg Lesch	Products and Planning Staff
Gary Loffler	Landscape Architect
Donna Mattson	Landscape Architect
John Ouimet	Former District Ranger
Angie Snyder	Cultural Resource Technician
Pat Williams	Logging Systems Input

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CHAPTER 5

LIST OF PARTICIPANTS AND PUBLIC INVOLVEMENT

Public Involvement Process

Initial contacts with the public for the D-Bug project began in August of 2007, when the IDT started field reconnaissance to develop a proposed action. At that time, the need to collaborate was identified. Numerous contacts were made with interested individuals, homeowners, special use permittees, conservation groups, industry representatives, and other agencies over a 6 month period of time, with the goal of collaborating on the development of the proposed action. This collaboration also included newspaper articles, an advertised public meeting at the Douglas County library and a follow-up field trip. The feedback received during the development of the proposed action is summarized in notes, conversation records, and in a 'pre-scoping summary' document. The project was also listed in the October 2007 Schedule of Proposed Actions (SOPA), which let interested people know the project was in development.

Formal scoping began in January of 2008, when a scoping packet was sent to over 350 individuals and groups (Table 68), including maps and details of the proposed action. People were invited to document their concerns regarding the proposal. In addition, a Notice of Intent to prepare an Environmental Impact Statement was published in the January 22, 2008 Federal Register, and a front-page story describing the details of the proposed action was published on February 8, 2008 in The Roseburg New Review.

The regulatory agency (US Fish and Wildlife Service) charged with overseeing the Endangered Species Act, was consulted extensively throughout the planning process. Consultation with this agency will be finalized before the Record of Decision is signed.

The Tribal governments (Cow Creek Band of Umpqua Indians, Confederated Tribe of the Grand Ronde Indians, and the Confederated Tribe of the Siletz Indians) have been sent a letter describing the project, with a request for further information. To date, no responses have been received. The Tribes were also consulted under the National Historic Preservation Act.

During the scoping period, letters, face-to-face discussions, e-mails, and phone calls regarding the D-Bug Hazard Reduction Timber Sale Project Proposed Action were received from 37 individuals or groups. The Project Record contains a detailed scoping summary of all comments received during scoping.

The public comment period for the D-Bug project DEIS began on March 14, 2009, with publication of the Notice of Availability in the Federal Register and closed on April 27, 2009. Requests for extension of the comment period prompted the Responsible Official to extend the comment period until June 8, 2009, totaling 87 days for public comment. The public was asked to comment on Alternative 4 as described in the Chapter 2. A field trip to the planning area was held on June 4, 2009, to take additional comments and give people the opportunity to visit the planning area with members of the Interdisciplinary Team.

The Forest received 428 timely comment letters, emails or phone calls. An additional 634 comments, primarily in the form of emails, were received after the close of the extended comment period. The vast majority of these comments resemble the timely

comments received and are on file (electronically) at the Umpqua National Forest Supervisor's Office. Table 5-1 displays the names and organization of those who commented, the type of comment received, and the date the comment was received.

In response to the comments received from the DEIS, the Forest prepared a "working alternative" that was shared via public collaboration meetings on March 18-19, 2010, in Roseburg. After those meetings, the working alternative was refined to become what is now Alternative 5. Input received via this collaborative meeting is not considered a comment sufficient to establish standing to object under the regulations at 36 CFR 218.7.

TRIBES THAT WERE CONSULTED

Cow Creek Band of Umpqua Tribe of Indians

Confederated Tribe of Grand Ronde of Indians

Confederated Tribe of Siletz Indians

INDIVIDUALS, GROUPS, AND AGENCIES INVOLVED IN THE PLANNING PROCESS

An extensive mail list was developed for the D-Bug project. The following list was used to inform the public of the opportunity for early involvement, public meetings, field trips and the start of the formal scoping process (Table 5-1).

Table 5-1. Individuals/groups who received outreach and scoping information.

Participant		Affiliation
		Representative Susan Morgan
		Congressman Peter DeFazio
		McReynolds Family 2002 Trust
		Bruce Stanley Construction
		Sun Studs
		North Umpqua Business Association
		Umpqua Watersheds
Kenneth Adams		Diamond Lake Homeowner
		Klamath-Siskiyou Wildland Center
		Douglas County Library
		Douglas County Commissioners
		Rocky Mountain Elk Foundation
		Sullivan & Company Inc.
		Columbia Helicopter Inc.
Betty & Don	Adams	
Frank	Adams	
Richard Browne	and Lisa Bailey	Diamond Lake Homeowner
James	Anderson	Cross Country Riders
Butch	Anderson	
Jerry	Anderson	

Participant		Affiliation
Darrol	Anderson	
John	Armes	Edelweiss Ski Club
Beth	Ayer	PNW 4-Wheel Drive Association
Buck and Linda	Baker	Diamond Lake Homeowner
Tim	Ballard	
Larry	Barlow	
Rick	Barnes	Barnes Forestry Consultants
Diane	Barr	
Richard	Barrett	
Bob	Bastian	Rocky Mountain Elk Foundation
Rayma	Bateman	Diamond Lake Homeowner
Dick	Bauer	
Brad	Bebeau	
Paul	Beck	Herbert Lumber
Bruce	Benson	Diamond Lake Homeowner
Fred	Bertsche	Oregon Hunters Association
Julie	Bonney	Diamond Lake Homeowner
Kent	Bonney	Diamond Lake Homeowner
Mike	Bormuth	
Becky	Bosley	Diamond Lake Homeowner
Terry	Bounds	
Milford	Bowers	
Gene	Bowling	Rogue Snowmobilers
Mark	Boyer	
Wayne & Susan	Brace	Diamond Lake Homeowner
Ruben	Brenhaug	
Mac	Brock,	Crater Lake National Park, Chief of Resources
Nancy	Bruce-Ceccanese	
Tom	Bryant	
Rodney	Burgardner	
Gary and Barbara	Burke	Diamond Lake Homeowner
Robert	Burns, Jr.	Diamond Lake Homeowner
Robert	Burson	
Robert	Butler	Diamond Lake Homeowner
Steve	Callaway	
Douglas and Gayle	Carl	Diamond Lake Homeowner
Ken	Carloni	
Steve	Carter	Northwest Hardwoods (DTO)
Patrick and Carol	Cavanaugh	Diamond Lake Homeowner
Scott	Center	US Fish & Wildlife

Participant		Affiliation
Jim	Chapman	Diamond Lake Homeowner
Jerry	Cochran	
Kathy and Michael	Collier	Diamond Lake Homeowner
Chris	Conroy	Congressman Peter Defazio's Roseburg Office
Brian	Cowan	
Gordon	Culbertson	Swanson Group -Manufacturing, L.L.C.
Bruce	Curtis	
George	Daley	
Leon Douglas	Dense	Diamond Lake Homeowner
Arnold	Depner	Diamond Lake Homeowner
Diana	Donovan	
Larry	Doyle	Diamond Lake Homeowner
Robert	Dunn	Diamond Lake Homeowner
Gary	Dunn	
Francis	Eatherington	Umpqua Watersheds, Inc.
Ronnie	Egger	
Chuck	Ehlers	Diamond Lake Homeowner
Wes & Bev	Ellis	
Dave	Erickson	
Mike	Eshleman	
Wayne	Estes	
Samuel	Fagone Sr	
Patricia	Fagone-Colfax	Diamond Lake Homeowner
Matt	Fairchild	
Joseph	Federico	UFA
Joe	Ferguson	Steamboaters
Forrest	Fleischman	Forest Service Employees for Environmental Ethics
Brian	Fletcher	
Tom	Foote	
Jeanne & George	Forrest	
John & Lynn	Forsyth	Diamond Lake Homeowner
Swede	French	Rocky Mountain Elk Foundation
Randy	Garrison	
Jeff	Gillette	
Javier	Goirigolzarri	Resource Management Services
Dr. Augustine	Gombart	Diamond Lake Homeowner
Allen	Goodwin	Diamond Lake Homeowner
Sarah	Grafenstein	
Janice	Green	Recreational Fishing Alliance
Gerald	Griffeth	Diamond Lake Homeowner

Participant		Affiliation
Bill	Griffin	
Larry & Darelyn	Griffin	Diamond Lake Homeowner
Fred & Helen	Gross	Diamond Lake Homeowner
Steve & Sandra	Gross-Hunt	Diamond Lake Homeowner
Rich	Grost	PacifiCorp
Jake	Groves	American Forest Resource Council
Larry & Roberta	Hall	Diamond Lake Homeowner
Bob	Hall	BLM - Public Affairs
Don	Hamann	
Tom	Hanke	
Don	Harmon	
Robin	Hartmann	North Umpqua Foundation
Don	Harwick	Swanson Group -Manufacturing, L.L.C.
Tom	Hatfield	Farm Bureau
Emmett	Havemann	
Doug	Heiken	Oregon WILD
Bert & Anne	Henderson	Diamond Lake Homeowner
Ken	Hendrick	
Scott	Henselman	Diamond Lake Homeowner
Paul	Herberling	Oregon Department Of Environmental Quality
Leonard	Herzstein	
Paul	Hess	
Redge	Heth	
Bill	Hicky	
Cari	Hinesly	Pacific Sled Dog & Skijor Association
Sandra	Hislop	Diamond Lake Homeowner
Robert	Hoedel	Diamond Lake Homeowner
Bob	Hoehne	
Bruce	Hoevet	
Dan	Hoffman	
Lewis & Elizabeth	Hogan	Diamond Lake Homeowner
Chris & Hugh	Hohe	
Janet	Holland	
Dave & Denyse	Horsburgh	Diamond Lake Homeowner
M	Houde	
Steve	Houde	
Ben	Hoyle	
Ralph	Huffman	Diamond Lake Homeowner
Donald	Isakson	
Matt	Jackson	

Participant		Affiliation
David	Jackson	
Gunnar	Johnson	
Stanley & Gina	Johnson	Diamond Lake Homeowner
Ray	Jones	Roseburg Forest Products
Dale	Josh	
Ken	Joslen	c/o Cheryl Hibbs, Diamond Lake Homeowner
Bob	Kamph	
Sharon	Karr	Diamond Lake Homeowner
Phil & Jo	Kaser	Diamond Lake Homeowner
Paul	Kay	"Ursa"
Scott	Keep	Seneca Sawmill Co
Jerry	Kerk	DR Johnson Lumber
Linda	Kesling	
Roger	King	
Ray	Kinney	SWCD
Bob	Kinyon	Partnership for the Umpqua Rivers
Chad	Kirstein	
Steve	Koch	Diamond Lake Resort
Karl	Konecny	North Umpqua Foundation
Bernie & Ruby	Kosola	Diamond Lake Homeowner
Art	Kramert	
Garry P.	Krause	
Dick	Kreger	
Berdine	Krenek	Diamond Lake Homeowner
Teresa	Kubo	EPA Region 10 - NEPA Review Unit
Dick	Kyker	Diamond Lake Homeowner
Klaus	Labuhn	Diamond Lake Homeowner
Tom	Laden	Grants Pass Nordic Club
Cecil	Lake	
Scott & Dianna	Lamb	Lemolo Lake Resort
Stan	Larson	Diamond Lake Homeowner
Josh	Laughlin	Cascadia Wildlands Project
Joe	Laurance	Douglas County Commissioner
Donald & Marlene	Lawless	Diamond Lake Homeowner
Larry	Layton	Umpqua Regional Council of Governments
William & Carol	Leaverton	Diamond Lake RV Park
Charles & Judith	Leipold	Diamond Lake Homeowner
John & Penny	Lind	
Richard	Little	Diamond Lake Homeowner
Bill	Logan	
Jim	Long	

Participant		Affiliation
David & Laura	Loomis	Diamond Lake Homeowner
David B.	Lowry	Diamond Lake Homeowner
Tod	Lum	Oregon Department of Fish and Wildlife
Mike	Lund	
Chuck	Lundy, Superintendent	Crater Lake National Park
Cinthia	Maples	Diamond Lake Homeowner
Chris	Marchand	
Suzanne	Marchant	
Roy	Marshall	
Frank	Massingale	
Jeremiah	Mattos	
Charlotte	Mattson-Payne	Diamond Lake Homeowner
Russ	McCurdy	Weyerhaeuser Pole Facility
James	McMeen	
Tom	McReynolds	Diamond Lake Homeowner
Stephen	McReynolds	
Pat	Mehlhoff	Beardsley Cabin Trust, Diamond Lake Homeowner
G.	Meiling	
Suzanne	Merchant	Diamond Lake Homeowner
Chris	Mercier	Confederated Tribes of the Grande Ronde
N. T.	Merrill	
Gerald	Meyer	Douglas County Health Depart.
Dick	Meyer	
Ross	Mickey	Northwest Forestry Association
Sharon Karr and	Mike Macon	Diamond Lake Homeowner
Mary	Miller	Diamond Lake Homeowner
Rick	Minear	
Robert	Minear	Diamond Lake Homeowner
Marv & Libby	Mizell	
Bob	Moffett	
Rick	Moffitt	
Frank & Jeanie	Moore	
Sam	Moore	
Sam	Moore	
Tom & Nancy	Moore	
Bill	Moore	Seneca Timber Company
Lyle	Morrison	
Dick & Vella	Munn	Diamond Lake Homeowner
Ken	Nagao	

Participant		Affiliation
Evelyn	Nores	
Bob	Olds	Diamond Lake Homeowner
Norman	Olson	Diamond Lake Homeowner
Michael	O'Mara	
Stephan & Bethany	Overhoff	Diamond Lake Homeowner
Ed	Padilla	
Tim	Palm	
Ed	Parker	
John	Passmore	
Dan	Patterson	
Jack	Patterson	
Ray	Patterson	
John	Paulson	
Alan	Paulson	
Donald & Sally	Pearce	Diamond Lake Homeowner
Adam	Pearson	The News-Review
Harold	Pedergen	
Everett	Peterson	
Charles C.	Peterson	Diamond Lake Homeowner
Stan	Petrowski	
Rick & Diane	Phillips	
Mike	Piehl	
Delores	Pigsley	Confederated Tribes of the Siletz
Culley	Polehn	Southern Oregon Nordic Club
Elaine	Porter	
John	Punches	OSU Extension Service
Bob & Jan	Purkeypile	Diamond Lake Homeowner
Bob	Ragon	DTO
Brad	Reed	Crater Lake National Park
Betty	Rice	Diamond Lake Homeowner
Bill	Roady	Diamond Lake Homeowner
James & Woodra	Roberts	Diamond Lake Homeowner
Sharon	Roberts	
Ross & Suzanne	Roberts	Diamond Lake Homeowner
Rick	Rockholt	Diamond Lake Resort
Steve & Kristi	Roe	Diamond Lake Homeowner
Steven	Rondeau	Dir Natural Res.- Cow Creek Band of Umpqua Indians
Tom	Rondeau	

Participant		Affiliation
Cindy	Rooney	Oregon Hunters Association
Don	Rooper	Interfor Pacific
George	Roth	
Erich and Alice	Rother	Diamond Lake Homeowner
Tina	Roy	
Rolf E.	Ruf	
Sue	Rummer	
B.	Sachau	
Steve	Sand	
Buck	Sarves	
Kenneth	Scgeudegger	Diamond Lake Homeowner
Doug & Tina	Schattenkerk	
Edward	Schattenkerk	
Kenneth & Elvera	Scheidegger	
Gary	Schroeder	C & D Lumber
Sue	Scott	
Richard	Secord, Jr.	
Richard	Secord, Sr.	
Rick & Jenny	Seidemann	
Suma	Shaazmunda	
Sue	Shaffer	Cow Creek Band of Umpqua Indians
Doug & Tina	Shattenkerk	Diamond Lake Homeowner
Dave	Sheman	
Glenn	Shirek	
Gary & Peggy	Shontz	Diamond Lake Homeowner
Ron & Rachel	Shubin	Diamond Lake Homeowner
Philip	Simon	
Cory	Sipher	
Anna	Slemmer	
Wendell	Smith	Diamond Lake Homeowner
Sean	Smith	Starfire Lumber Co.
Lee & Hazeldean	Smith	c/o Brenda Riggs - Diamond Lake Homeowner
Maryjane	Snockers	
Jack	Snyder	Diamond Lake Homeowner
Rick	Sohn	Lone Rock Timber
Phil	Southern	
Stephen	Speer	Diamond Lake Homeowner
Larry	Spielbusch	
Charles	Spooner	Steamboaters

Participant		Affiliation
Tom	Staley	
James	Stancliff	
Patrick	Starnes	
Karl & Rosan	Staubach	Diamond Lake Homeowner
Phil	Stenbeck	Douglas County Planning Department
Nancy	Stern	
Rachel	Stevenson	Diamond Lake Homeowner
Bruce	Stewart	Bohemia Mine Owner Assn.
Joe	Strahl	
John & Ann	Studer	Diamond Lake Homeowner
Joel & Kathleen	Sullivan	Diamond Lake Homeowner
Christina	Swanson	Diamond Lake Homeowner
James	Talburt	
Barbara	Taylor	
Kenneth & Nancy	Tedder	Diamond Lake Homeowner
Connie	Thomas	Diamond Lake Homeowner
James & Mary	Thompson	Diamond Lake Homeowner
Dan	Thomsen	PacifiCorp
Robert	Thornton	Diamond Lake Homeowner
Bernadette	Tobar	
Peter	Tronquet	
Craig	Tuss	US Fish & Wildlife
Paul	Utz	
Olis & Jean	Van Meter	
David	VanDermark	
Eileen	Vaughn	Diamond Lake Homeowner
Stan & Kathy	Vejtasa	Umpqua Valley Audubon Society
Leonard	Vollard	
Jeff	Waddington	
Susan	Waddle	
Rick	Waddle	
Dave	Wagner	
Diana	Wales	Umpqua Valley Audubon Society
Malinda	Walls	
Frank	Walter	
Cindy	Walters	
Charles	Wamack	
Jonathan	Warren	Diamond Lake Homeowner
Joe & Jackie	Watson	Diamond Lake Homeowner
Joe	Watson	Diamond Lake Homeowner

Participant		Affiliation
Viven	Weaver	
Avann	Weber	
Katie	Weidman	
Jim	Wells	Umpqua Fishermen
Francis	Welty	
Rick	Werner	
LaVerne R.	West	
Clifford	Wheeler	Diamond Lake Homeowner
Don	Whitaker	Don Whitaker Logging & Hauling
MaryAnn	Wilcox	
Dennis	Williams	Paradise Northwest
Carey	Williams	Southern Oregon Fly Fishers
Don	Wilson	Oregon Hunters Association
Levi & Kendra	Wilson	
Amy	Wilson	Southwest Oregon RC&D
William	Wood	Alla Mage Ski Club
Norman	Woods	
Donna	Woolley	Diamond Lake Homeowner
Fred	Worsley	
Ken	Wostenberg	
Ron	Yockim	
John	Yoder	
Curtis & Susan	Young	Diamond Lake Homeowner
Albert	Young	
Marion	Young	

AGENCIES NOTIFIED OF THE AVAILABILITY OF THE FEIS

The following Federal and State agencies were notified of the availability of the FEIS at the beginning of the public comment period (Tables 5-2).

Table 5-2. Federal and State Agencies Notified

Federal Agencies Notified
Advisory Council on Historic Preservation
USDA, APHIS PPD/EAD
USDA, Natural Resource Conservation Serv.
National Marine Fisheries Service
U.S. Army Corps of Engineers - NW Division
U.S. Environmental Protection Agency

State Agencies
Department of Fish and Wildlife
Oregon Parks and Recreation Department
Water Resources Department
Division of State Lands
Department of Geology and Mineral Industries
Department of Environmental Quality

USDA, National Agricultural Library
U.S. Environmental Protection Agency, R-10
U.S. Department of Interior
Northwest Power Planning Council
U.S. Coast Guard
Federal Aviation Administration
Federal Highway Administration
U.S. Department of Energy

Department of Land Conservation and Development
Economic and Community Development
Department of Administrative Services
Oregon Department of Forestry
Governor's Natural Resources Office

INDIVIDUALS AND GROUPS NOTIFIED OF THE AVAILABILITY OF THE DEIS/FEIS

The following individuals were notified by mail regarding the availability of the DEIS at the beginning of the public comment period (Tables 5-3).

Table 5-3. Individuals and Groups Notified of the DEIS and/or Sent Copies of the DEIS.

Name	Organization		Name	Organization
Kenneth Adams Trust	Diamond Lake Summer Homeowner		Elgan Amidon	Diamond Lake Summer Homeowner
Richard Brown and Lisa Bailey	Diamond Lake Summer Homeowner		Darrol Anderson	
Buck and Linda Baker	Diamond Lake Summer Homeowner		Tim Ballard	
Richard Barrett			Bob Bastian	Rocky Mt. Elk Foundation
Rayma Bateman	Diamond Lake Summer Homeowner		Bruce Benson	Diamond Lake Summer Homeowner
Julie Bonney	Diamond Lake Summer Homeowner		Kent Bonney	Diamond Lake Summer Homeowner
Becky Bosley	Diamond Lake Summer Homeowner		Terry Bounds	
Mark Boyer			Wayne and Susan Brace	Diamond Lake Summer Homeowner
Mack Brock	National Park Service, Crater Lake NP		Gary and Barbara Burke	Diamond Lake Summer Homeowner
Robert Burns, Jr.	Diamond Lake Summer Homeowner		Robert Butler	Diamond Lake Summer Homeowner
Douglas and Gayle Carl	Diamond Lake Summer Homeowner		Patrick and Carol Cavanaugh	Diamond Lake Summer Homeowner
Jim Chapman	Diamond Lake Summer Homeowner		Pat Colfax	
Michael and	Diamond Lake Summer		Steve Denney	Oregon Dept of Fish

Name	Organization		Name	Organization
Kathy Collier	Homeowner			and Wildlife
Leon Douglas Dense	Diamond Lake Summer Homeowner		Arnold Depner	Diamond Lake Summer Homeowner
Larry Doyle	Diamond Lake Summer Homeowner		Roger Doyle	
Robert Dunn	Diamond Lake Summer Homeowner		Francis Eatherington	Umpqua Watersheds, Inc.
Ronnie Egger			Chuck Ehlers	Diamond Lake Summer Homeowner
Wes and Bev Ellis			Samuel Fagone, Sr.	
Patricia Fagone-Colfax	Diamond Lake Summer Homeowner		Joe Ferguson	Steamboaters
John and Lynn Forsyth	Diamond Lake Summer Homeowner		Doug and Marry Ann Glover	
Javier Goirigolzarri	Resource Management, Services, L.L.C.		Dr. Augustine Gombart	Diamond Lake Summer Homeowner
Allen Goodwin	Diamond Lake Summer Homeowner		Janice Green	Recreational Fishing Alliance
Gerald Griffeth	Diamond Lake Summer Homeowner		Larry and Darelyn Griffin	Diamond Lake Summer Homeowner
Fred and Helen Gross	Diamond Lake Summer Homeowner		Steve and Sandra Gross-Hunt	Diamond Lake Summer Homeowner
Jacob Groves	American Forest Resource Council		Larry and Roberta Hall	Diamond Lake Summer Homeowner
Don Hamann, Inc.			Don Hardwick	Swanson Group Manufacturing, L.L.C.
Doug Heiken	Oregon Wild		Bert and Anne Henderson	Diamond Lake Summer Homeowner
Ken Hendrick			Scott Henselman	Diamond Lake Summer Homeowner
Cari Hinesly	Pacific Sled Dog and Skijor Association		Sandra Hislop	Diamond Lake Summer Homeowner
Robert and Joan Hoedel	Diamond Lake Summer Homeowner		Lewis and Elizabeth Hogan	Diamond Lake Summer Homeowner
Hugh Hohe			Dave and Denyse Horsburgh	Diamond Lake Summer Homeowner
Ralph Huffman	Diamond Lake Summer Homeowner		Stanley and Gina Johnson	Diamond Lake Summer Homeowner
Sharon Karr	Diamond Lake Summer		Phil and Jo	Diamond Lake Summer

Name	Organization		Name	Organization
	Homeowner		Kaser	Homeowner
Linda Kesling			Steve Koch	Diamond Lake Resort
Karl Konecny	The North Umpqua Foundation		Bernie and Ruby Kosola	Diamond Lake Summer Homeowner
Jeri Krenek	Diamond Lake Summer Homeowner		Dick Kyker	Diamond Lake Summer Homeowner
Klaus Labuhn	Diamond Lake Summer Homeowner		Scott and Diana Lamb	Lemolo Lake Resort
Stan Larson	Diamond Lake Summer Homeowner		Josh Laughlin	Cascadia Wildlands Project
Joe Laurence	Douglas County Commissioner		Donald and Marlene Lawless	Diamond Lake Summer Homeowner
William and Carol Leaverton	Diamond Lake RV Park		Charles and Judith Leipold	Diamond Lake Summer Homeowner
John and Penny Lind			Richard Little	Diamond Lake Summer Homeowner
Jim Long			Dave and Laura Loomis	Diamond Lake Summer Homeowner
David B. Lowry	Diamond Lake Summer Homeowner		Cinthia Maples	Diamond Lake Summer Homeowner
Stan Martindale	Swanson Group Manufacturing, L.L.C.		Charlotte Mattson-Payne	Diamond Lake Summer Homeowner
Tom and Barbara McReynolds	Diamond Lake Summer Homeowner		Pat Mehlhoff	Beardsley Cabin Trust, Diamond Lake Summer Homeowner
G. Meiling			Suzanne Merchant	Diamond Lake Summer Homeowner
N.T. Merrill			Gerald Meyer	Douglas County Health Department.
Mark and Karen Mihaljevich			Mike Macon	Diamond Lake Summer Homeowner
Dennis and Mary Miller	Diamond Lake Summer Homeowner		Rick Minear	
Robert and Zelna Minear	Diamond Lake Summer Homeowner		Frank and Jeanie Moore	
Susan Morgan	State Representative		Dick and Vella Munn	Diamond Lake Summer Homeowner
Bob Olds	Diamond Lake Summer Homeowner		Norman Olson	Diamond Lake Summer Homeowner
Michael O'Mara			Stephan and Bethany Overhoff	Diamond Lake Summer Homeowner

Name	Organization		Name	Organization
Dan Patterson			John Patterson	
Donald and Sally Pearce	Diamond Lake Summer Homeowner		Machya Pecoraro	
Charles C. Peterson	Diamond Lake Summer Homeowner		Stanley Petrowski	
Bob and Jan Purkeypile	Diamond Lake Summer Homeowner		Bob Ragon	Douglas Timber Operators
Betty Rice and Guy Kennerly	Diamond Lake Summer Homeowner		William Roady	Diamond Lake Summer Homeowner
Ross and Suzanne Roberts	Diamond Lake Summer Homeowner		James and Woodra Roberts	Diamond Lake Summer Homeowner
Rick Rockholt	Diamond Lake Resort		Steve and Kristi Roe	Diamond Lake Summer Homeowner
Steven Rondeau	Cow Creek Band of Umpqua Tribe of Indians		George Roth	
Erich and Alice Rother	Diamond Lake Summer Homeowner		Kenneth Scgeudegger	Diamond Lake Summer Homeowner
Doug and Tina Schattenkerk	Diamond Lake Summer Homeowner		Gary Schroeder	C&D Lumber
Gary Shontz	Diamond Lake Summer Homeowner		Ron and Rachel Shubin	Diamond Lake Summer Homeowner
Wendell Smith	Diamond Lake Summer Homeowner		Jack Snyder	Diamond Lake Summer Homeowner
Sephen Speer	Diamond Lake Summer Homeowner		Charles Spooner	Steamboaters
Tom Stalye			Bruce Stanley	Bruce Stanley Construction
Karl and Rosan Staubach	Diamond Lake Summer Homeowner		Rachel Stevenson	Diamond Lake Summer Homeowner
John Studer	Diamond Lake Summer Homeowner		Michael Sullivan	Sullivan & Company, Inc.
Joel and Kathleen Sullivan	Diamond Lake Summer Homeowner		Christina Swanson	Diamond Lake Summer Homeowner
Ron Swenson			Kenneth and Nancy Tedder	Diamond Lake Summer Homeowner
Connie Thomas	Diamond Lake Summer Homeowner		James and mary Thompson	Diamond Lake Summer Homeowner
Robert Thorton	Diamond Lake Summer Homeowner		Stan and Kathy Vejtasa	Umpqua Valley Audubon Society
Jonathan Warren	Diamond Lake Summer Homeowner		Joe Watson	Diamond Lake Summer Homeowner
Joe and Jackie	Diamond Lake Summer		Viven Weaver	

Name	Organization		Name	Organization
Watson	Homeowner			
Clifford Wheeler	Diamond Lake Summer Homeowner		Donna Wooley	Diamond Lake Summer Homeowner
Ron Yockim	Attorney at Law		Curtis and Susan Young	Diamond Lake Summer Homeowner
	The North Umpqua Foundation			US Fish and Wildlife Service

REFERENCES CITED

Agee, J.K. 1993. Fire Ecology of Pacific Northwest Forests. Island Press. Washington, D.C.

Agee, J,K., B. Bahro, M.A. Finney, P.N. Omi, D.S. Sapsis, C.N. Skinner, J.W. Van Wagtendonk, and C.P. Weatherspoon, 2000. Use of shaded fuelbreaks in landscape fire management. Forest Ecology and Management: 127(55-66).

Agee, J.K., and C.N. Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management :211(83-97).

Ager, A.A., Finney, M.A., Kerns, B.K., and Maffei, H. 2007. Modeling wildfire risk to northern spotted owl (*Strix occidentalis caurina*) habitat in central Oregon. For. Ecol. Mgt. 246:45-56.

Altman, B. 1999. Conservation Strategy for Landbirds in Coniferous Forests of Western Oregon and Washington. Prepared for the Oregon-Washington Partners in Flight. http://www.orwapif.org/pdf/western_forest.pdf

Altman, B. 2000. Conservation Strategy for Landbirds of the East Slope of the Cascade Mountains in Oregon and Washington. Prepared for the Oregon-Washington Partners in Flight. http://www.orwapif.org/pdf/east_slope.pdf

Amaranthus, M.P., D. Page-Dumroese, A. Harvey, E. Cazares and L.F. Bednar. 1996. Soil compaction and organic matter affect conifer seedling nonmycorrhizal root tip abundance and diversity. Research Paper PNW-RP-494. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 12 p.

Amiro BD, MacPherson JI, Desjardins RL. 1999. BOREAS flight measurements of forest-fire effects on carbon dioxide and energy fluxes. Agricultural and Forest Meteorology 96:199-208

Amman, G.D. and J.A. Logan. 1998. Silvicultural control of mountain pine beetle: Prescriptions and the influence of microclimate. American Entomologist 44(3): 166-177

Aney, W., and Loomis, J. 2009. Boze Incident, Umpqua National Forest, Tiller Ranger District, Long Term Implimentation Plan. September 21. 42 p.

Arnett, E.B., R.J. Anderson, C. Sokol, F.B. Isaacs, R.G. Anthony, and W.P. Erickson. 2001. Relationships between nesting bald eagles and selective logging in south-central Oregon. Wildlife Society Bulletin 29(3):795-803.

Arno, S.F. 2000. Fire regimes in western forest ecosystems. Pp. 97-120 in USDA Forest Service, Rocky Mountain Research Station, General Technical Report 42, vol. 2, Fort Collins, Colorado.

Arno, S.F., Allison-Bunnell, S. 2002. Flames in our Forest – Disaster or Renewal?. Island Press. Washington D.C.

Arora, D. 1986. Mushrooms demystified. Ten Speed Press, Berkeley, California

Arthur, Louise M. 1977. Predicting scenic beauty of forest environments: some empirical tests. Forest Science. 23: 151-160.

Aubry, K.B. and C.M. Raley. 2002. The Pileated Woodpecker as a keystone habitat modifier in the Pacific Northwest. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181.

Aubry, K.B. and C.M. Raley. 2006. Ecological characteristics of Fishers (*Martes pennanti*) in Southern Oregon Cascade Range. USDA Forest Service, Pacific Northwest Research Station, Olympia Forestry Sciences Laboratory, Olympia, WA, USA.

Aubry, K.B, and J.C. Lewis. 2003. Extirpation and reintroduction of fishers (*Martes pennanti*) in Oregon: implications for their conservation in the pacific states. Biological Conservation 114:79-90.

Aubry, K.B., K.S. Mckelvey and J.P. Copeland. 2007. Distribution and Broadscale Habitat Relations of the Wolverine in the Contiguous United States. Journal of Wildlife Management 71(7):2147-2158.

Audubon Society. 2007a. The 2007 Audubon Watchlist: Yellow Rail (*Coturnicops noveboracensis*). http://web1.audubon.org/science/species/watchlist/profile.php?speciesCode=yelrai

Audubon Society. 2007b. The 2007 Audubon Watchlist, Black Swift (*Cypseloides niger*) http://audubon2.org/watchlist/viewSpecies.jsp?id=38

Audubon Society. 2007c. The 2007 Audubon Watchlist, Lewis Woodpecker (*Melanerpes lewis*). http://web1.audubon.org/science/species/watchlist/profile.php?speciesCode=lewwoo

Audubon Society. 2007d. The 2007 Audubon Watchlist, White-headed Woodpecker (*Picoides albolarvatus*). http://audubon2.org/watchlist/viewSpecies.jsp?id=211

Attiwill, P.M. 1994. The disturbance of forest ecosystems : The ecological basis for conservative management. Forest Ecology and Management 63 : 247-300.

Barrett, S. et al, 2004. California mixed conifer reference conditions (PNVG code: MCON). Fire Regime Condition Class Interagency Handbook. Biophysical settings description – west. http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1885&mode=2&in_hi_userid=2&cached=true

Bate, L.J., E.O. Garton, and M.J. Wisdom. 2002. Sampling Methods for Snags and Large Trees Important to Wildlife. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181. http://gis.fs.fed.us/psw/publications/documents/gtr-181/059_BateSnag.pdf

Beschta, Robert L., James R. Boyle, Carol C. Chambers, Wayne P. Gibson, Stanley V. Gregory, Jeffery Grizzel, Joan C. Hagar, Judy L. Li, William C. McComb, Tye W. Parzybok, Maryanne L. Reiter, George H. Taylor, and James E. Warila. 1995. Cumulative effects of forest practices in Oregon: literature and synthesis. Prepared for Oregon Department of Forestry, Salem, OR.

Biswell, Brian, M. Blow, R. Breckel, L. Finley and J. Lint. 2002. Survey protocol for the red tree vole. Version 2.1, Revision, October 2002. http://www.blm.gov/or/plans/surveyandmanage/SP/RedTreeVole/200210/RTV%20protocol%20revision-V.2.1-final.pdf

Black, S.H. 2005. Logging to Control Insects: The science and myths behind managing forest insect “pests”: A synthesis of independently reviewed research. The Xerces Soc. For Invertebrate Conservation, Portland Oregon. 82 pages.

Black, S.H. and L. Lauvray. 2005. Fact Sheet for the Johnson's Hairstreak (*Callophrys johnsoni*). September 28, 2005. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/20050906- fact-sheet-johnsons-hairstreak.doc

Board on Atmospheric Science and Climate. 2010. Advancing the science of climate change. The National Academy of Science, Nat'l Academies Press, Washington, D.C. 2001

Bradbury, S.M., R.M. Danielson and S. Visser. 1998. Ectomycorrhizas of regenerating stands of lodgepole pine (*Pinus contorta*). Canadian Journal of Botany 76: 218-227

British Columbia Forest Practices Board, 2007. Lodgepole pine stand structure 25 years after mountain pine beetle attack. Report FPB/SR/32, January, 2007.

Blackburn, Lori. 2007. Lodgepole Suitability and Forest Plan Amendment. Unpublished Memo by the Umpqua NF Silviculturist.

Blackburn, Lori. 2008. Lodgepole Pine – Suggested Stocking Levels. Unpublished Memo by the Umpqua NF Silviculturist.

Board on Atmospheric Science and Climate. 2010. Advancing the science of climate change. The National Academy of Science, Nat'l Academies Press, Washington, D.C. 2001.

Bolander, Peter, ed. 1999. Dust palliative selection and application guide. Project Report 9977-1207-SDTDC. , San Dimas, CA: USDA, Forest Service, San Dimas Technology and Development Center. 20p.

British Columbia Forest Practices Board. 2007. Lodgepole pine stand structure 25 years after mountain pine beetle attack. Report FPB/SR/32, January, 2007.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. BioScience 54(7): 677-688

Brady, Nyle C. 1990. The nature and properties of soils. 11th Edition; pp 499-501.

Bosch, J. M., and J. D. Hewlett. 1982. A review of catchment experiments to determine the effect of vegetation changes on water yield and evapotranspiration. J. Hydrol. 55:3-23.

Brown, Darrell, Richard G. Hallman, Charles R. Lee, John G. Skogerboe, Kurt Eskew, Richard A. Price, Norwood R. Page, Michael Clar, Robert Kort, Homer Hopins. 1986. Non-native stabilization practices in reclamation and vegetation restoration of problem soils in disturbed lands. 270 pages. Pollution Technology Review No. 137. Noyes Data Corp. Ridge Park, NJ.

Brown, George W. 1972. The Alsea watershed study. School of Forestry, Oregon State University; Corvallis, OR. Reprinted from Vol. XXXII, Pacific Logging Congress 1972 Loggers Handbook.

Brown, George W., Arnold R. Gahler, and Richard B. Marston. 1973. Nutrient losses after clear-cut logging and slash burning in the Oregon coast range. Water Resources Research, October 1973; American Geophysical Union.

Brown, T.C. and T.C. Daniel 1986. Context effects in perceived environmental quality assessment: scene selection and landscape quality ratings. Journal of Environmental Psychology. 7(3): 233-250.

Brown, T.J., Hall, B.L. and Westerling, A.L. 2004. The impact of twenty-first century climate change on wildland fire danger in the western United States: an application perspective. Climate Change. 62: 365-388.

Buchanan, J.B.,R. J. Gutiérrez, R.G. Anthony, T. Cullinan, L.V. Diller, E.D. Forsman, A.B. Franklin. 2007. A synopsis of suggested approaches to address potential competitive interactions between Barred Owls (*Strix varia*) and Spotted Owls (*S. occidentalis*). Biological Invasions 9:679–69.

Bull, E.L. 1987. Ecology of the Pileated Woodpecker in Northeastern Oregon. Journal of Wildlife Management, 51(2):472-481.

Bull, E.L., and A.K. Blumton. 1999. Effect of Fuels Reduction on American Martens and Their Prey. USDA Forest Service, Pacific Northwest Research Station, Research Note PNW- RN-539.

Bull, E.L., and T.W. Heater. 2001. Survival, causes of mortality, and reproduction in the American Marten in northeastern Oregon. Northwestern Naturalist 82:1-6.

Bull, E.L., Heater T.W. and J.F. Shepard. 2005. Habitat Selection by the American Marten in Northeastern Oregon. Northwest Science 79(1)37-43.

Burke, T.E. 1998. Conservation Assessment for *Deroceras hesperium*, Evening fieldslug. Revised by N. Duncan 2005. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning- docs/20050900-moll-evening-fieldslug.doc

Buskirk, S.W. and L.F. Ruggiero. 1994. American Marten. *In* Ruggiero, Leonard F.; Aubry, Keith B.; Buskirk, Steven W.; Lyon, L. Jack; Zielinski, William J., tech. eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. Gen. Tech. Rep. RM-254. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Buskirk, S. and W.J. Zielinski. 1997. Marten. In Harris, John E., and Chester V. Ogan, Eds. 1997. Mesocarnivores of Northern California: Biology, Management, and Survey Techniques, Workshop Manual. August 12-15, 1997, Humboldt State Univ., Arcata, CA. The Wildlife Society, California North Coast Chapter, Arcata, CA. 127 p.

Buskirk, S. and W.J. Zielinski. 1999. Small and mid-sized carnivores *In* Zabel, C.J. and R.G. Anthony, Eds, Mammal Community Dynamics Management and Conservation in the Coniferous Forests of Western North America. Cambridge University Press, Cambridge, MA.

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

Carroll, C. 2007. Interacting Effects of Climate Change, Landscape Conversion, and Harvest on Carnivore Populations at the Range Margin: Marten and Lynx in the Northern Appalachians. Conservation Biology 21(4):1092–1104.

Carroll, C., J. R. Dunk and A. Moilanen. 2010. Optimizing resiliency of reserve networks to climate change: multispecies conservation planning in the Pacific Northwest, USA. Global Change Biology 16:891-904.

Castellano, M.A., J.E. Smith, T. O'Dell, E. Cázares, and S. Nugent. 1999. Handbook to strategy 1 fungal taxa from the Northwest Forest Plan. Gen. Tech. Rep. PNW-GTR-476. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 195 p.

Castellano, M.A., E. Cázares, B. Fondrick, and T. Dreisbach. 2003. Handbook to additional fungal species of special concern in the Northwest Forest Plan. Gen. Tech. Rep. PNW-GTR-572. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 144 p.

Chapin, T.G., D.J. Harrison, and D.D. Katnik. 1998. Influence of Landscape Pattern on Habitat Use by American Marten in an Industrial Forest. Conservation Biology 12(6)1327–1337.

Christner, Jere. 1981. Changes in peak streamflows from managed areas of the Willamette National Forest. USDA Forest Service, Pacific Northwest Region, Willamette National Forest. Forest Report. 28p.

Clark, T.W., E. Anderson, C. Douglas and M. Strickland. 1987. *Martes americana*. Mammalian Species, 289:1-8.

Clarkson, D.A. and L.S. Mills. 1994. Hypogeous sporocarps in forest remnants and clearcuts in Southwest Oregon. Northwest Science 68(4): 259-265

Cole, W. W., Cahill, D. B., and G. D. Lessard, 1983. Harvesting strategies for management of mountain pine beetle infestations in Lodgepole pine: preliminary evaluation, East Long Creek Demonstration Area, Shoshone National Forest, Wyoming. RP-INT-318. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 11pp.

Collins, B.M., Stephens, S.L., Moghaddas, J.J., and Battles, J. 2010. Challenges and approaches in planning fuel treatments across fire-excluded forested landscapes. Journal of Forestry. Jan/Feb.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, VA. 75 pp.

Conway, C. J., and C. P. Nadeau. 2005. Development and field testing of survey methods for a continental marsh bird monitoring program in North America. Wildlife Research Report # 2005-11. USGS Arizona Cooperative Fish and Wildlife Research Unit, Tucson, Arizona. http://www.fws.gov/birds/waterbirds/monitoring/conway_and_nadeau_SSP_marsh_bird_final_report.pdf

Copeland, J.P., J.M. Peek, C.R. Groves, W.E. Melquist, K.S. McKelvey, G.W. McDaniel, C.D. Long, and C.E. Harris. 2007. Seasonal Habitat Associations of the Wolverine in Central Idaho. Journal of Wildlife Management 71(7):2201–2212.

Corace, R.G., N.W. Lapinski, and S.J. Sjogren. 2001. Conservation Assessment for Black-backed Woodpecker (Picoides arcticus). USDA Forest Service, Eastern Region. http://www.fs.fed.us/r1/clearwater/terra_org/wildlife_07/sensitive_species/black_backed_woodpecker/conservation_assessment.pdf

Council on Environmental Quality. 2005. Memo from CEQ on cumulative effects guidance. June 2005.

Courtney, S.P, J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J.Gutiérrez, J.M. Marzluff and L. Sztukowski. 2004. Scientific evaluation of the Status of the Northern Spotted Owl. Sustainable Ecosystems Institute Portland, Oregon.

Covert-Bratland, K.A., W.M. Block and T.C. Theimer. 2006. Hairy Woodpecker Winter Ecology in Ponderosa Pine Forests Representing Different Ages Since Wildfire. Journal of Wildlife Management 70(5):1379–1392.

Creel, S. J.E. Fox, A. Hardy, J. Sands, B. Garrott and R.O. Peterson. 2002. Snowmobile Activity and Glucocorticoid Stress Responses in Wolves and Elk. Conservation Biology 16(3):809-814.

Cullings, K.W., D.R. Vogler, V.T. Parker and S.K. Finley. 2000. Ectomychorrhizal specificity patterns in a mixed *Pinus contorta* and *Picea engelmannii* forest in Yellowstone National Park. Applied and Environmental Microbiology 66(11): 4988-499

Curry, T., N. Greenwald and A. Garty. 2008. Petition to list 32 mollusk species from freshwater and terrestrial ecosystems of the northwestern United States as Threatened or Endangered under the Endangered Species Act. Submitted to the Secretary of the Interior D. Kempthorne on March 13, 2008. http://www.biologicaldiversity.org/campaigns/Pacific_Northwest_mollusks/pdfs/PNW_mollusk_petition.pdf

Cushman, K.A., and C.A. Pearl. 2007. A Conservation Assessment for the Oregon Spotted Frog (*Rana pretiosa*). USDA Forest Service Region 6 and USDI Bureau of Land Management, Oregon and Washington. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/ca-ha-rapr-2007-03-27.doc

Dahms, W.G. Gross and Net Yield Tables for Lodgepole Pine. 1964. Research Paper PNW-8

Daniel, T.C. 2001 Aesthetic preference and ecological sustainability.In: Sheppard, S.R.J.; Harshaw,H.W., eds. Forests and landscapes: linking ecology, sustainability, and aesthetics. NewYork, NY: CABI Publishing, in association with The International Union of Forestry Research Organizations: 15-29.

Davis, R. and J. Chapman. 2007. D-Bug Timber Sale, Diamond Lake Ranger District, Carnivore Track Plate Survey Results. Unpublished, available at the Umpqua NF Supervisor's Office.

Davis, R. and J. Chapman. 2008. Habitat suitability map for the pine marten (*Martes americana*) in the Oregon Cascades. GIS raster file, available at the Umpqua NF Supervisors Office.

Davis, R. and J. Lint. 2005. Chapter 3: Habitat Status and Trend. *In* Lint, Joseph, tech. coord. 2005. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. Gen. Tech. Rep. PNW-GTR-648. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 176 p.

Davis, Randy L., Christopher W. Swanston. 2010. Wildland forest soil carbon management. USDA Forest Service. WO

Dixon, G.E., comp. 2010. *Essential FVS: A User's Guide to the Forest Vegetation Simulator*. USDA Forest Service, Forest Management Service Center. Fort Collins, CO. 240pp.

Douglas County. 2004. Douglas County Community Wildfire Plans. Accessed on 05/25/2010. http://www.co.douglas.or.us/planning/wildfire_plans/

Dudley, J.G. 2005. Home Range Size And Foraging Habitat Of Black-backed Woodpeckers. Masters Thesis, Boise State University, 76 pp.

Dugger, K.M., F. Wagner, R.G. Anthony, and G.S. Olson. 2005. The relationship between habitat characteristics and demographic performance of northern spotted owls in southern Oregon. The Condor 107:863-878.

Duncan, N. 2008. Species Account for *Gliabates oregonius* (salamander slug). http://web.or.blm.gov/mollusks/

Duncan, N. 2008. Species Fact Sheet for *Pristinicola hemphilli* (pristine springsnail).

Duncan, N., T. Burke, S. Dowlan, and P. Hohenlohe. 2003. Survey protocol for survey and manage terrestrial mollusk species from the Northwest Forest Plan. Version 3.0. http://www.blm.gov/or/plans/surveyandmanage/SP/Mollusks/terrestrial/Mollusk%20document.pdf

Duran, Lara. 2009. Effects of prescribed burning on mycorrhizal fungi in Crater Lake National Park. Manager's Viewpoint. Timothy swedberg@nifc.blm.gov.

Elliot, William J. 2005. Watershed analysis for fuel management operations, Draft chapter In general tech. report on the environmental consequences toolkit for applied wildland fire research in support of project level fuels planning. USDA-FS, Rocky Mtn. Res. Sta., Moscow, ID.

Edmonds, R.L., D. Blinkley, M.C. Feller, P. Sollins, A. Abee, and D.D. Myrold. 1989. Nutrient cycling: effects on productivity of Northwest forests. pp 17-35 In Perry, D. A., R. Meurisse, B. Thomas, R. Miller, J. Boyle, J. Means, C. R. Perry, and R. F. Powers, eds. Maintaining the long-term productivity of Pacific Northwest forest ecosystems. Timber Press, Portland, OR.

Edmonds, R.L. 1991. Organic matter decomposition in Western United States forests. Washington State Univ. Moscow ID.

Exeter, R.L., L. Norvell and E. Cazares. 2006. Ramaria of the Pacific Northwestern United States. USDI BLM/OR/WA/PT-06/050-1792, Salem, OR 157 p.

Fanarioutu and Skuras. 2004. In: Social Science to Improve Fuels Management: A Synthesis of Research on Aesthetics and Fuels Management.

Farris, K.L, M.J. Huss and S. Zack. 2004. The Role of Foraging Woodpeckers in the Decomposition of Ponderosa Pine Snags. The Condor, Vol:106(1)50-59.

FEMAT 1993. Forest Ecosystem Management: an ecological, economic and social assessment. Report of the Forest Ecosystem Management Team.

Fettig, C.J., K.D. Klepzig, R.F. Billings, A.S. Munson, T.E. Nebeker, J.F. Negron, J.T. Nowak. 2007. Forest Ecology and Management, 238: 24-53.

FGDC (Federal Geographic Data Committee). 2004. Federal standards for delineation of hydrologic unit boundaries; Version 2.0. http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/

Filip, G.M., C.L. Schmidt, D.W. Scott, and S.A. Fitzgerald. 2007. Understanding and defining mortality in western conifer forests. Western Journal of Applied Forestry 22: 105-115.

Fimrite, D. 2008. It's true: wolverine is thriving near Tahoe. San Francisco Chronicle, March 25, 2008.

Finney, M.A. 2001. Design of regular landscape fuel treatment patterns for modifying fire growth and behavior. Forest Science. 47(2):219-228.

Finney, M.A., and Cohen, J.D. 2003. Expectation and evaluation of fuel management objectives. USDA Forest Service proceedings. RMRS-P-29, Missoula, Montana. p. 353-366.

Finney, M.A., S. Brittain, and R. Seli. 2004. FlamMap Version 2.0

Finney, M.A., Seli, R.C., McHugh, C.W., Ager, A.A. Bahro, B. and Agee, J.K. 2007. Simulation of long-term landscape-level fuel treatment effects on large wildfires. Int. J. Wildland Fire. 16:712-727.

Fire Regime Condition Class (FRCC) website. Accessed on July 7, 2008. http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1885&mode=2&in_hi_userid=2&cached=true

Fire Science Brief. 2009. The forest, the fire and fungi: studying the effects of prescribed burning on mycorrhizal fungi in Crater Lake National Park. Feb. 2009 Issue 38. www.firescience.gov

Fix, D. 1990. Birds of Diamond Lake. Compiled on September 27, 1990, unpublished.

Flannigan, M.D., Stocks, B.J., and Wotton, B.M. 2000. Climate change and forest fires. The Science of the Total Environment. 262: 221-229.

Forman, R.T.T., D. Sperling, J.A. Bissonette, A.P. Clevenger, C.D. Cutshall, V.H. Dale, L. Fahric, R. France, C.R. Goldman, K. Heanue, J.A. Jones, F.J. Swanson, T. Turrentine, and T.C. Winter. 2003. Road Ecology: Science and Solutions. Island Press, Washington D.C.

Fowler, W.B., J.D. Helvey, and E.N. Felix. 1987. Hydrologic and climatic changes in three small watersheds after timber harvest. Res. Pap. PNW-RP-379. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 13 p.

Gaines, W.L., P.H. Singleton, and R.C. Ross. 2003. Assessing the Cumulative Effects of Linear Recreation Routes on Wildlife Habitats on the Okanogan and Wenatchee National Forests. Pacific Northwest Research Station, General Technical Report, PNW-GTR-586.

Gary, H. L., 1978. The vertical distribution of needles and branchwood in thinned and unthinned 80-year-old Lodgepole pine. Northwest Science, 52(4), pp 303-309.

Gauthier, Gilles. 1993. Bufflehead (*Bucephala albeola*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/067doi:bna.67

Gebert, Krista M., and Charles E. Keegan III, Sue Willits, Al Chase, April 2002. Utilization of Oregon's Timber Harvest and Associated Direct Economic Effects, 1998. Pacific Northwest Research Station General Technical Report PNW-GTR-532.

Glista, D.J., T.L. Devault and J.A. Dewoody. 2007. Vertebrate Road Mortality Predominantly Impacts Amphibians. Herpetelogical Conservation and Biology 3(1)77-87.

Gobster P.H. 1995). The aesthetic experience of sustainable forest ecosystems. In: Covington, W.Wallace; Debano, Leonard F., tech. coord. Sustainable ecological systems: implementingan ecological approach to land management;1993 July 12-15; Flagstaff, AZ. Gen.Tech. Rep. RM-247. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 246-255.

Goggans, R., R.D. Dixon, and L. C. Seminara. 1989. Habitat Use by Three-toed and Black-backed Woodpeckers, Deschutes National Forest, Oregon. Oregon Departmetn of Fish and Wildlife and USDA Deschutes National Forest, Nongame Project Number 87-3-02.

Goheen, Don and Dave Bridgewater, 2007. Forest Service entomologists, field trip to the D-bug project, personal communications.

Goheen, Don, 2008. Mountain pine beetle epidemic on the Diamond Lake Ranger District, Umpqua National Forest. Unpublished report. Available online at: http://www.fs.fed.us/r6/umpqua/projects/projectdocs/d-bug-ts/det-mt-pine-beetle-epidemic-diamond-lake-rd.pdf

Gonzalez-Benecke CA, Martin TA, Cropper Jr WP, Bracho R. Forest management effects on in situ and ex situ slash pine forest carbon balance. Forest Ecology and Management In Press, Corrected Proof

Gomez, D.M., R.G. Anthony and J.M. Trappe. 2003. The influence of thinning on production of hypogeous fungus sporocarps in Douglas-fir forests in the Northern Oregon Coast Range. Northwest Science 77(4): 308-319

Gowan, D. and T.E. Burke. 1999. Conservation Assessment for *Pristiloma arcticum crateris,* Crater Lake Tightcoil. Revised by N. Duncan 2004. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning- docs/20050713-moll-crater-lake-tightcoil.doc

Graham, R.T., A.E. Harvey, T.B. Jain, and J.R. Tonn. 1999. The effects of thinning and similar stand treatments on fire behavior in western forests. USDA For. Serv. Gen. Tech. Rpt. GTR-463.

Graham, R.T., S.M. McCaffrey, and T.B. Jain. 2004. Science basis for changing forest structure to modify wildfire behavior and severity. USDA For. Serv. Gen. Tech. Rpt. GTR-120.

Graham, R.T., Jain, T.B., and Loseke, M. 2009. Fuel treatments, fire suppression, and their interactions with wildfire and its effects. USDA RMRS-GTR-229. 36p

Haider Wolfgang. 1994.The aesthetics of white pine and red pine forests. The Forestry Chronicle. 70(4): 402-410.

Haider, W. and L. Hunt 2002). Visual aesthetic quality of northern Ontario's forested shorelines. Environmental Management. 29(3): 324-334 (as cited in): Social Science to Improve Fuels Management: A Synthesis of Research on Aesthetics and Fuels Management. 2005. Ryan, Robert L. editor, Gen. Tech. Rep. NC-261. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 58 p.

Hamer, T. E., E. D. Forsman, and E. M. Glenn. 2009. Home range attributes and habitat selection of barred owls and spotted owls in an area of sympatry. The Condor 109:750-768.

Hardy, Colin C.; Ottmar, Roger D.; Peterson, Janice L; Core, John E.; Seamon, Paula; [Editors] 2001. Smoke management guide for prescribed and wildland fire: 2001 edition PMS 420-2. NFES 1279. Boise, ID: National Wildfire Coordination Group. 226 p

Hargis, C.D., J.A. Bissonette, and D.L. Turner. 1999. The influence of forest fragmentation and landscape pattern on American Martens. Journal of Applied Ecology 36:157-172.

Harr, R.D., 1979. Effects of timber harvest on streamflow in the rain-dominated portion of the Pacific Northwest, in Proceedings of a Workshop on Scheduling timber Harvest for Hydrologic Concerns, USDA, Forest Service, Portland, OR. 45p.

Harr, R.D., and R.L. Fredriksen,1988. Water quality after logging small watersheds within the Bull Run Watershed, Oregon. Water Resources Bulletin 24:1103-1111.

Harrod, R.J., and S. Reichard. 2001. Fire and invasive species within the temperate and boreal coniferous forests of western North America. Pages 95-101 *in* K.E.M. Galley and T.P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: The First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11, Tall Timbers Research Station, Tallahassee, FL.

Hart, Stephen C., and Mary K. Firestone. 1991. Forest floor soil interactions in the internal nitrogen cycle of an old-growth forest. Biogeochemistry 12: 103-127, 1991.

Hatten, Jeff, Darlene Zabowski, George Scherer, Elizabeth Dolan. 2005. A comparison of soil properties after contemporary wildfire and fire suppression. For. Eco. & Mgt. 220 (2005) 227-241.

Healey, S.P., W.B. Cohen, T.A. Spies, M. Moeur, D. Pflugmacher, M.G. Whitley and M. Lefsky. 2008. The Relative Impact of Harvest and Fire upon Landscape-Level Dynamics of Older Forests: Lessons from the Northwest Forest Plan. Ecosystems (2008) 11: 1106–1119

Helliwell, R. 2008. Forest Botanist for the Umpqua National Forest. Personal communication.

Hessburg, P.F., J.K. Agee, and J.F. Franklin. 2005. Dry forests and wildland fires of the inland Northwest USA: contrasting the landscape ecology of the pre-settlement and modern eras. For. Ecol. Mgt. 211: 117-139.

Hicke, J.A., and J.C. Jenkins. 2008. Mapping lodgepole pine stand structure susceptibility to mountain pine beetle attack across the western United States. Forest Ecology and Management 255: 1536-1547.

Hickman, James C. 1976. Non-Forest Vegetation of the Central Western Cascade Mountains of Oregon. Northwest Science 50:145-55

Hirzel, A.H., G. Le Laya, V. Helfera, C. Randina, and A. Guisana. 2006. Evaluating the ability of habitat suitability models to predict species presences. Ecological Modeling 199:142-152.

Hurteau, Matthew and Malcolm North. 2009. Fuel treatment effects on tree-based forest carbon storage and emissions under modeled wildfire scenarios. Front Ecol Environ 2009; 7(8): 409-414, doi:101890/080049.

IMPLAN Professional, Version 2.0, June, 2000. Social Accounting and Impact Analysis Software. Minnesota IMPLAN Group, Stillwater, MN

Ingebritsen. S.E., R.H. Mariner, and D.R. Sherrod. 1994. Hydrothermal systems of the Cascade Range, north-central Oregon: U.S. Geological Survey Professional Paper 1044-L, 86 p.

Innes JLaDLP. 2001. Procedings introduction: managing forests in a greenhouse world - context and challenges.: Dept. of For. Res. Mgt., University of British columbia, For. Sci. Centre, #2045-2424 Main Mall, Vancouver, B.C., Canada V6T 1Z4

IPCC 2007. Summary for policymakers. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, P. Dave, L.A. Meyer (eds)], Cambridge Univ. Press, UK and New York, USA.

Jefferson, A., G. Grant, and T. Rose. 2006. Influence of volcanic history on groundwater patterns on the west slope of the Oregon High Cascades, Water Resources Research, 42, W12411, doi:10.1029/2005Wr004812.

Jones, J.A., and G.E. Grant. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. Water Resource Research. 32(4): pgs 959-974.

Jones, L.C. and M.G. Raphael. 1991. Ecology and management of marten in fragmented habitats of the Pacific Northwest. Progress Report: Fiscal Year 1991. Pacific Northwest Research Station, Olympia, WA.

Jones, M.D., D.M. Durall and J.W.G. Cairney. 2003. Ectomycorrhizal fungal communities in young forest stands regenerating after clearcut logging. New Phytologist 157: 399-422.

Kays, R.W. and D.E. Wilson. 2002. Mammals of North America. Princeton University Press: Princeton, NJ. 240 Pp.

Kaufmann M.R., G.H. Aplet, M. Babler, W.L. Baker, B. Bentz, M. Harrington, B.C. Hawkes, L. Stroh Huckaby, M.J. Jenkins, D.M. Kashian, R.E. Keane, D. Kulakowski, C. McHugh, J. Negron, J. Popp, W.H. Romme, T. Schoennagel, W. Shepperd, F.W. Smith, E. Kennedy Sutherland, D. Tinker, and T.T. Veblen. 2008. The status of our scientific understanding of lodgepole pine and mountain pine beetles – a focus on forest ecology and fire behavior. The Nature Conservancy, Arlington, VA. GFI technical report 2008-2.]

Keane, B, E Reinhardt, J. Brown, and L. Gangi. First order fire effects model, (FOFEM) Gen. Tech. Report. INT-GTR-344 USDA, FS--Intermountain Research Station.

Keane, R.E., R.A. Parsons, and P.F. Hessburg. 2002. Estimating historical range and variation of landscape patch dynamics: limitations of the simulation approach. Ecological Modeling 151: 29-49.

Keane, R.E., P.F. Hessburg, P.B. Landres, and F.J. Swanson. 2009. The use of historical range of variability (HRV) in landscape management. Forest Ecology and Management 258: 1025-1037.

Keeley, J.E. 2001. Fire and invasive species in Mediterranean-climate ecosystems of California. Pages 81-94 *in* K.E.M. Galley and T.P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: The First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11, Tall Timbers Research Station, Tallahassee, FL.

Keinarth, D.A.. 2004. Fringed Myotis (*Myotis thysanodes*): A Technical Conservation Assessment. USDA Forest Service, Rocky Mountain Region. Available: http://www.fs.fed.us/r2/projects/scp/assessments/fringedmyotis.pdf

Kelley, R., S. Dowlan, N. Duncan, and T. Burke. 1999. Field guide to Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan. Bureau of Land Management, Oregon State Office.

Kerwin, A.E. and R. Huff. 2007. Conservation Assessment for the Mardon Skipper (*Polities mardon*). Version 1.0. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/ca-iile-poma-2007-05-16.doc.

Kimmins, J.P. March 1977. Evaluation of the consequences for future tree productivity of the loss of nutrients in whole-tree harvesting. Forest Ecol. Manage., 1: 169-183.

Kolbe, J.A., J.R. Squires, D.H. Pletscher, and L.F. Ruggiero. 2007. The Effect of Snowmobile Trails on Coyote Movements Within Lynx Home Ranges. Journal of Wildlife Management 71(5):1409-1418.

Körner, C., and D. Basler. 2010. Phenology under global warming. Science 327: 1461-1462.

Kozak RaCG. 2000. Life cycle analysis: a wood products perspective.: Dept. of Wood Sci. Univ. of British Columbia, #2900-2424 Main Mall, Vancouver, B.C., Canada V6T 1W5

Kurz, W.A., C.C. Dymond, G. Stinson, G.J. Rampley, E.T. Neilson, A.L. Carroll, T. Ebata, and L. Safranyik. 2008. Mountain pine beetle and forest carbon feedback to climate change. Nature 452: 987-990.

Lal, R. 2005. Forest soils and carbon sequestration. For. Eco. & Mgt. 220 (2005) 242-258.

Landres, P.B., P. Morgan, and F.J. Swanson. 1999. Overview of the use of natural variability concepts in managing ecological systems. Ecological Applications 9: 1179-1188.

Landscape Ecology, Modeling, Mapping and Analysis (LEMMA). 2010. GNN mapping of existing vegetation for Northwest Forest Plan Effectiveness Monitoring. Modeling region 224, Oregon and California Cascades. http://www.fsl.orst.edu/lemma/main.php?project=common&id=mr&model_region=224&ref=nwfp, last accessed 5 May 2010.

Larkin, J.L., J.J. Cox, M.W. Wichrowski, M.R. Dzialak, and D.S. Maehr, 2004. Influences on release-site fidelity of translocated elk. Restoration Ecology 12:97-105.

Layton Environmental Engineering, LLC. 2007. Air emission estimates for wood waste conversion. 1900 Crestwood Blvd., Suite 114, Birminingham, Alabama 35210.Lindo, Zoë and Suzanne Visser. 2003. Microbial biomass, nitrogen and phosphorus mineralization,

and mesofauna in boreal conifer and deciduous forest floors following partial and clear-cut harvesting. Can. J. For. Res. Vol. 33, pp 1610-1620.

Levad, R. 2007. The Coolest Bird: A Natural History of the Black Swift and Those Who Have Pursued It. Unpublished.

Lenihan, J.M., R. Drapek, D. Bachelet and R.P. Neilson. 2003. Climate change effects on vegetation distribution, carbon, and fire in California. Ecological Applications 13(6)1667-1681.

Lippke B. 2006. Environmental performance improvement in residential construction: the impact of products, biofuels, and processes., ed. L Edmonds, pp. 58-63. Forest Products Journal: CORRIM, Forest Products Society

Littell, J.S., D. McKenzie, D.L. Peterson, A.L. Westerling. 2009. Climate and wildfire area burned in western U.S. ecoprovinces, 1916–2003. Ecological Applications 2009 19:4, 1003-1021

Loehle, C. 2004. Applying landscape principles to fire hazard reduction. Forest Ecology and Management. 198: 261-267.

Lowther, P.E. and C.T. Collins. 2002. Black Swift (*Cypseloides niger*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/676

Luoma, D.L., J.L. Eberhart, R. Molina and M.P. Amaranthus. 2004. Response of ectomycorrhizal fungus sporocarp production to varying levels and patterns of green-tree retention. Forest Ecology and Management 202: 337-354.

Luoma, D.L., C.A. Stockdale, R. Molina and J.L. Eberhart. 2006. The spatial influence of *Pseudotsuga menziesii* retention trees on ectomycorrhiza diversity. Can. J. For. 36; 2561-2573.

Lynch, H.J. Renkin, R.A., Crabtree, R.L. and Moorcroft, P.R. 2006. The influence of previous mountain pine beetle (Dendroctonus ponderosae) activity on the 1988 Yellowstone fires. Ecosystems. 2006(9): 1318-1327.

MacDonald, L. H., A. W. Smart, and R.C. Wissmar. 1991. Monitoring Guidelines to evaluate effects of Forestry activities on streams in the Pacific Northwest and Alaska. EPA/910/9-91-001. Region 10 USEPA, Seattle WA. 166p.

Manriquez, Ana C. 2002. Carbon sequestration in the Pacific Northwest: a model. College of Forest Resource. Univ. of WA.

Marcot, Bruce G. February 2003. Ecosystem processes related to wood decay. USDA Forest Service & USDI Fish and Wildlife Service. PNW. http://www.notes.fs.fed.us/pnw/DecAID/DecAID.nsf

Marshall, D.B., M.G. Hunter, and A.L. Contreras, Eds. 2003. Birds of Oregon: A General Reference. Oregon State University Press, Corvallis, OR. 768 Pp.

Martinson, E.J., and Omi, P.N. 2003. Performance of fuel treatments subjected to wildfires. USDA RMRS-P-29.

McDade, M. H., F. J. Swanson, W. A. Mckee, J. F. Franklin, and J. Van Sickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Canadian Journal of Forest Research 20: 326-330.

McKenzie, D., Gedalof, Z., Peterson, D. and Mote, P. 2004. Climatic change, wildfire, and conservation. Conservation Biology. 18(4): 890-902.

Mellen, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2006. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.0. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon. http://wwwnotes.fs.fed.us:81/pnw/DecAID/DecAID.nsf

Mellen-McLean, K, B.G. Marcot, J.L. Ohmann, K. Waddell, S.A. Livingston, E.A. Willhite, B.B. Hostetler, C. Ogden, and T. Dreisbach. 2009. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.1. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon. http://www.fs.fed.us/r6/nr/wildlife/decaid/index.shtml

Merriam K.E., J.E. Keeley and J.L. Beyers. 2006. Fuelbreaks affect nonnative species abundance in Californian plant communities. Ecological Applications 16(2): 515-527

Meurisse, Robert T., Wayne A. Robbie, Jerry Niehoff, Gary Ford. 1989. Dominant soil forming processes and properties in Western-Montane forest types and landscapes – some implications for productivity and management. Washington State University. http://forest.moscowfsl.wsu.edu/smp/solo/documents/GTRs/INT_280/Meurisse_INT-280.php

Miles EL. 2001. Beyond the Kyoto/Marrakech Protocol: options and strategies.: School of Marine Affairs and Climate Impacts Group, JISAO, Univ. of Wash., Seattle WA 98195

Monleon, Vicente J., Kermit Cormack, Jr., and Johanna D. Landsberg. 1997. Short- and long–term effects of prescribed underburning on nitrogen availability in ponderosa pine stands in central Oregon. Can. J. For. Res. Vol. 27, No 3, pp 369-378, 2003; NRC Research Press Web site. http://pubs.nrc-cnrc.gc.ca/rp-ps/issueDetail.jsp?jcode=cjfr&lang=eng&vol=27&is=3.

Morrison, D. 2008. Personal communication with Don Morrison, Umpqua NF Planning Team Forester, regarding time required for lodgepole to grow to breast height in the southern portion of the planning area. July 11, 2008.

Mote P. 2001. How and why is Northwest climate changing? : JISAO/SMA Climate Impacts Group, Box 35435, Univ. of Wash. 98195

Murphy, M. L., and K. V. Koski. 1989. Input and depletion of woody debris in Alaska streams and implications for streamside management. North American Journal of Fisheries Management 9: 427-436.

Nedeau, E., A. K. Smith, and J. Stone. 2000. Freshwater Muscles of the Pacific Northwest. 45 pages.

North, Malcolm, Matthew Hurteau, and James Innes. 2009. Fire suppression and fuels treatment effects on mixed-conifer carbon stocks and emissions. Ecological Applications, 19(6) 2009, pp. 1385-1396. Ecological Society of America.

ODF 2007. Log Price Information, Regions 2 & 3 – Coos (Coos, Curry, Douglas Counties & Roseburg Market). Oregon Department of Forestry. Available at: http://egov.oregon.gov/ODF/STATE_FORESTS/TIMBER_SALES/

OED 2002. Oregon Employment Department. Regional Profile Industry Employment in Region 6, Brian T. Rooney, 2002.

O'Laughlin, J., and P.S. Cook. 2003. Inventory-based forest health indicators. J. For. 101: 11-17.

Oliver, C.D. and B.C. Larson, 1996. Forest Stand Dynamics. Updated edition. McGraw-Hill, Inc. New York. 544pp.

OLMIS. Oregon Labor Market Information System. Oregon Employment Department. www.olmis.org Summary Covered Employment and Payroll Report, Douglas County, 2002.

OMB A-94. Office of Management and Budget Circular No. A-94. October 29, 1992, revised 1999. Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.

O'Neill, Robert V.; Hunsaker, Carolyn T.; Jones, K. Bruce; Ritters, Kurt H.; Wickham, James D.; Schwartz, Paul M.; Goodman, Iris A.; Jackson, Barbara L.; Baillargeon, William S. 1997. Monitoring environmental quality at the landscape scale BioScience 47(8): 513-519.

Opler, Paul A., Harry Pavulaan, Ray E. Stanford, Michael Pogue, coordinators. 2006. Butterflies and Moths of North America. Bozeman, MT: NBII Mountain Prairie Information Node. http://www.butterfliesandmoths.org/

Oregon Department of Environmental Quality (ODEQ). 2002. North Umpqua hydroelectric project (FERC No. 1927); evaluation report and findings; Federal Clean Water Act Section 401; Application for Water Quality Certification.

Oregon Department of Environmental Quality (ODEQ). 2003. Designated beneficial uses – Umpqua Basin. Oregon Administrated Rules 340-41-0320, Table 320A. http://www.deq.state.or.us/wq/rules/div041/dbutables/table320a.pdf

Oregon Department of Environmental Quality (ODEQ). 2006. Umpqua basin total maximum daily load (TMDL) and water quality management plan (WQMP). Medford, Oregon. http://www.deq.state.or.us/wq/tmdls/umpqua.htm.

Oregon Department of Human Services and Department of Environmental Quality. 2004. Source water assessment report; summary of analysis. Diamond Lake Lodge/Resort, Diamond Lake, Oregon, Douglas County. PWS #4192104.

Oregon Department of Human Services. Personal Communications. 2008. Regarding drinking water protection.

Orton, Greg. 2007. Unpublished road restoration monitoring records for the Little Rock Creek watershed road restoration. Umpqua National Forest.

Pacala S, Socolow R. 2004. Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies. Science 305:968-72

Pacific Northwest (PNW) Research Notes. 2009. Looking Out For The Pileated Woodpecker. Pacific Northwest Research Station, Issue 109.

Page, W.G. and M.J. Jenkins. 2007. Mountain pine beetle-induced changes to selected lodgepole pine fuel complexes within the Intermountain Region. Forest Science, 53(4) 507-518.

Palma, C.D., Cui, W., Martell, D.L., Robak, D., and Weintraub, A. 2007. Assessing the impact of stand-level harvest in the flammability of forest landscapes. International Journal of Wildland Fire. 16: 584-592.

Parker, T.J., Clancy, K.M., and Mathiasen, R.L. 2006. Interactions among fire, insects and pathogens I coniferous forests of the interior western United States and Canada. Ag. and For. Ent. 2006(8), 167-189.

Pearson, Robert R. and K.B. Livezey. 2003. Distribution, numbers, and site characteristics of spotted owls and barred owls in the Cascade Mountains of Washington. J. Raptor Res. 37(4):265-275.

Perkins, J.W. 1938. Reminiscences of Southern Oregon pioneers, a personal interview of George A. Bonebreake (unpublished)

Peterson, D., M. Finny, C. Skinner, M. Kaufmann, M. Johnson, W. Sheppard, M. Harrington, R. Keane, D. McKenzie, E. Reinhardt, and K. Ryan. 2004. Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity. USDA, Rocky Mountain Research Station. GTR-120. 43 pages.

Peterson, D.L., M.C. Johnson, J.K. Agee, T.B. Jain, D. McKenzie and E.D. Reinhardt. 2005. Forest structure and fire hazard in dry forests of the Western United States. Gen. Tech. Rep. PNW-GTR-628. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 p.

Piaggio, A, and R. Sherwin. 2005. Species Account for *Corynorhinus townsendii*, Townsend's big-eared Bat. Western Bat Working Group. http://wbwg.org/species_accounts/vespertilonidae/coto.pdf

Pohl, K., 2003. Lodgepole pine – subalpine (Calif.) reference conditions (PNVG code: LPSC). Fire Regime Condition Class Interagency Handbook. Biophysical settings description – west. http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1885&mode=2&in_hi_userid=2&cached=true

Powell R.A., S.W. Buskirk, and W.J. Zielinski. 2003. Fisher and Marten in Feldhamer, G.A., B.C. Thompson and J.A. Chapman editors. 2003. Wild Mammals of North America. Johns Hopkins University Press, Baltimore, MD.

Powell, D.C., V.A. Rockwell, J.A. Townsley, J. Booser, S.P. Bulkin, T.H. Martin, B. Obedzinski, F. Zensen. 2001. Forest density management. Recent history and trends for the Pacific Northwest Region. USDA, PNW Region R6-NR-TM-TP-05-01.

Powell, R.A., S.W. Buskirk, and W.J. Zielinski. 2003. Fisher and Marten *in* Feldhamer, G.A., B.C. Thompson and J.A. Chapman editors. 2003. Wild Mammals of North America. Johns Hopkins University Press, Baltimore, MD.

Preisler, H.K., and R.G. Mitchell. 1993. Colonization pattern of the mountain pine beetle in thinned and unthinned lodgepole pine stands. Forest Science 39: 528-545.

Preisler, H.K., A.A. Ager and M.J. Wisdom. 2006. Statistical methods for analyzing responses of wildlife to human disturbance. Journal of Applied Ecology 43:164-172.

Prescott, C. E. 2002. The influence of the forest canopy on nutrient cycling. Tree Physiology 22:1193-1200.

Prescott, C. E., D. Hope Graeme, and L. L. Blevins. 2003. Effects of gap size on litter decomposition and soil nitrate concentrations in a high-elevation spruce-fir forest. Can. J. For. Res. Vol. 33, pp 2210-2220, 2003.

Quincy Library Group. 1997. The QLG Fuelbreak Strategy (white paper). http://www.qlg.org/pub/agree/fbstra.htm

Quincy Library Group. 1997. The QLG Fuelbreak Strategy. Paper adopted at the QLG meeting of 1/30/97. 13 p.

Quintana-Coyer, D.L., R.P. Gerhardt, M.D. Broyles, J.A. Dillon, C.A. Friesen, S.A. Godwin and S.D. Kamrath. 2004. Survey protocol for the great gray owl within the range of the Northwest Forest Plan (v 3.0). 46p.

Rainer, M. 1983. Winter habitat use and responses to snow cover of fisher (*Martes pennanti*) and marten (*Martes americana*) in southeastern Manitoba. Canadian Journal of Zoology 61: 25-34.

Reeves, G.H., L.E. Benda, K.M. Burnett, P.A. Bisson, and J.R. Sedell. 1995. A disturbance based ecosystem approach to maintaining and restoring freshwater habitats of evolutionary significant units of anadromous salmonids in the Pacific Northwest pages 334-349 In: Evolution and the Aquatic Ecosystem; defining unique units in population conservation. American Fisheries Society Symposium 17, Bethesda MD

Reinhardt, E.D., R.E. Keane, and J.K. Brown. 1997. First Order Fire Effects Model, FOFEM 4.0 User's Guide. Gen. Tech. Rep. IMT-GTR-344. USDA Forest Service, Rocky Mountain Research Station.

Reinhardt, E. and N.L. Crookston (Technical Editors). 2003. The Fire and Fuels Extension to the Forest Vegetation Simulator. Gen. Tech. Rep. RMRS-GTR-116. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 209 p.

Ribe, R.G. 1990. A general model for understanding the perception of scenic beauty of northern hardwood forests. Landscape Journal v. 9(2) 86-101

Rigolot, E. 2002. Fuel Break assessment with an expert appraisement approach. Forest fire research and wildland fire safety: Proceedings of IV International Conference on Forest Fire Research 2002 Wildland Fire Safety Summit, Luso, Coimbra, Portugal, 18-23 November 2002

Romme, W. H., D. H. Knight and J. B. Yavitt, 1986. Mountain pine beetle outbreaks in the Rocky Mountains – regulators of primary productivity. American Naturalist 127:484-494.

Rooney, T.P. 2005. The Michigan Botanist 44: 78-182.

Rose, C. L., B. G. Marcot, T. K. Mellen, J. L. Ohmann, K. L. Waddell, D. L. Lindley, and B. Schreiber. 2001. Decaying wood in Pacific Northwest forests: concepts and tools for habitat management. Pp. 580-623 in: D. H. Johnson and T. A. O'Neil, ed. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis OR. http://www.nwhi.org/inc/data/GISdata/docs/WHROW/chapter24.pdf

Rosenberg, D.K., K.A. Swindle, and R.G. Anthony. 2003. Influence of prey abundance on northern spotted owl reproductive success in western Oregon. Can. J. Zool. 81: 1715–1725.

Rowland, M.M., M.J. Wisdom, B.K. Johnson, and M.A. Penninger. 2004. Effects of Roads on Elk: Implications for Management in Forested Ecosystems. Transactions of the Sixty-ninth North American Wildlife and Natural Resources Conference, J. Rahm ed. Wildlife Management Institute, Washington D.C.

Ruggiero, L.F., K.S. McKelvey, K.B. Aubry, J.P. Copeland, D.H. Pletscher, and M.G. Hornocker. 2007. Wolverine Conservation and Management. Journal of Wildlife Management 71(7):2145–2146.

Ryan et al. 2010. A synthesis of the science on forests and carbon for U.S. forests. Ecology, No. 13 (spring 2010).

Safford, H.D., Schmidt, D.A., and Carlson, C.H. 2009. Effects of fuel treatments on fire severity in an area of wildland-urban interface, Angora Fire, Lake Tahoe Basin, California. Forest Ecology and Managment

Sandberg, David V.; Ottmar, Roger D.; Peterson, Janice L.; Core, John. 2002. Wildland fire on ecosystems: effects of fire on air. Gen. Tech. Rep. RMRS-GTR-42-vol. 5. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 79 p.

Sauer, J. R., J. E. Hines, and J. Fallon. 2006. The North American Breeding Bird Survey, DRAFT Results and Analysis 1966 - 2005. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD, USA. http://www.mbr-pwrc.usgs.gov/bbs/.

Scheuering, E. 2006. Fact Sheet for the Coronis Fritillary (*Speyeria coronis coronis*). January 10, 2006. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/sfs-iile-speyeria-coronis-coronis.doc

Schowalter, T.D. 2006. Insect Ecology: An Ecosystem Approach. 2nd ed. Academic Press, San Diego, CA. 483 pp.

Schwartz, M.W., L.R. Iverson, A.M. Prasad, S.N. Matthews and R.J. O'connor. 2006. Predicting Extinctions As A Result Of Climate Change. Ecology, 87(7): 1611–1615.

Schwendeman, T. 1981. Dust control study - Gallatin National Forest. USDA Forest Service, Region 1.

Shaw, D.C., P.T. Oester, and G.M. Filip. 2009. *Managing Insects and Diseases of Oregon Conifers*. Oregon State University, Corvallis, OR. 98 pp.

Sherrod, D. R. 1991. Geologic map of a part of the Cascade Range between latitudes 43°–44°, central Oregon, U.S. Geological Survey, Misc. Invest. Ser., I-1891.

Shlisky, A., 2003. California red fir reference conditions (PNVG code: RFCA). Fire Regime Condition Class Interagency Handbook. Biophysical settings description – west. http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1885&mode=2&in_hi_userid=2&cached=true

Six J. 2002. Stabilization mechanisms of soil organic matter: implications for c-saturation of soils., ed. RT Contant, EA Paul, K Paustian, pp. 155-76. Plant and Soil

Singleton, P. H., J. F. Lehmkuhl, W. L. Gaines, and S. A. Graham. 2010. Barred Owl Space Use and Habitat Selection in the Eastern Cascades, Washington. Journal of Wildlife Management 74:285-294.

Skinner, C.N. 2007. Silviculture and Forest Management Under a Rapidly Changing Climate. In: Powers, Robert F., tech. editor. Restoring fire-adapted ecosystems: proceedings of the 2005 national silviculture workshop. Gen. Tech. Rep. PSW-GTR-203,

Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture: p. 21-32

Snyder, S. A. 1991. *Martes americana*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/.

Sollins, P., C.C. Grier, F.M. McCorison, K. Cromack, Jr., R. Fogel, and R.L. Fredriksen, 1980. The internal element cycles of an old-growth Douglas-fir ecosystem in Western Oregon. Ecological Monographs 50:261-285.

Sollins, P. and F.M. McCorison, 1981. Nitrogen and carbon solution chemistry of an old growth coniferous forest watershed before and after cutting. Water Resources Research 17:1409-1418.

Spies, T.A., J.D. Miller, J.B. Buchanan, J.F. Lehmkuhl, J.F. Franklin, S.P. Healey, P.F. Hessburg, H.D. Safford,W.B. Cohen, R.S.H. Kennedy, E.E. Knapp, J.K. Agee and M. Moeur. 2010. Underestimating Risks to the Northern Spotted Owl in Fire-Prone Forests: Response to Hanson et al. Conservation Biology Vol:24(1): 330–333.

Stark, J.M. and S.C. Hart, 1999. Effects of disturbance on microbial activity and N-cycling in forest and shrubland ecosystems, in Proceedings, Pacific Northwest forest and rangeland soil organism symposium; 1998 March 17-19; Corvallis, OR. Gen. Tech. Rep. PNW.

Stedman, Stephen J. 2000. Horned Grebe (*Podiceps auritus*), The Birds of North America online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/505

Stein, Amy L., Climate Change Under NEPA: Avoiding Cursory Consideration of Greenhouse Gases (February 14, 2010). University of Colorado Law Review, Vol. 81, 2010. Available at SSRN: http://ssrn.com/abstract=1444166.

Stephens, S.L., Moghaddas, J.J., Edminster, C., Fiedler, C.E., Haase, S., Harrington, M., Keeley, J.E., Knapp, E.E., McIver, J.D. Metlen, K., and Skinner, C.N. 2009. Fire treatmen effects on vegetation structure, fuels, and potential fire severity in western U.S. forests. Ecological Applications. 19(2), 305-320.

Stewart CE. 2007. Soil Carbon saturation: concept, evidence and evaluation., ed. K Paustian, RT Conant, AF Plante, J Six, pp. 19-31. Biochemistry: Springer Science+Business Media B.V.

Stone, T. 2007a. Species Fact Sheet for the Black Swift (*Cypseloides niger*). August 31, 2007. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/sfs-vert-bi-Cypseloides-niger- 2007-08-31.doc

Stone, T. 2007b. Species Fact Sheet for the Harlequin Duck (*Histrionicus histrionicus*). September 14, 2007. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/sfs-vert-bi-Histrionicus-histrionicus-2007-09-14.doc

Stone, T. 2007c. Species Fact Sheet for the California Wolverine (*Gulo gulo luteus*). September 26, 2007. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/sfs-vert-ma-Gulo-gulo-luteus-2007-09-27.doc

Stohlgren, T.J., D. Binkley, G.W. Chong, M.A. Kalkhan, L.D. Schell, K.A. Bull, Y. Otsuki, G. Newman, M. Bashkin and Y. Son. 1999. Exotic species invade hot spots of native plant diversity. Ecological Monographs 69(1): 25-46

Stohlgren, T.J., G.W. Chong, L.D. Schell, K.A. Rimar, Y. Otsuki, M. Lee, M.A. Kalkhan and C.A Villa. 2002. Assessing vulnerability to invasive nonnative plant species at multiple spatial scales. Environmental Management 29(4): 566-577

Storck, P., T. Kern, and S. Bolton. 1999. Measurement of differences in Snow accumulation, melt, and micrometeorology due to forest harvesting. Northwest Science 73:87-101.

Stout, Bonnie E. and Gary L. Nuechterlein. 1999. Red-necked Grebe (*Podiceps grisegena*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/465doi:10.2173/bna.465

Strittholt, J.R., and D.A. Dellasala. 2001. Importance of Roadless Areas in Biodiversity Conservation in Forested Ecosystems: Case Study of the Klamath-Siskiyou Ecoregion of the United States. Conservation Biology 15(6):1742-1754.

Strom, B.A. and Fule, P.Z. 2007. Pre-wildfire fuel treatments affect long-term ponderosa pine forest dynamics. International Journal of Wildland Fire. 16: 128-138.

Stuart, J.D., J.K. Agee, and R.I. Gara 1998. Lodgepole pine regeneration in an old, self sustaining forest in south central Oregon. Canadian Journal For. Resources Vol 19 (1096-1104).

Tague C. 2008. Deep groundwater mediates streamflow response to climate change in the Oregon Cascades., ed. G Grant, M Farrell, J Choate, A Jefferson, pp. 189-210. Climate Change: Springer Science + Buiseness Media B.V.

Taylor, S.W. and Carroll, A.L. 2003. Disturbance, forest age, and mountain pine beetle outbreak dynamics in BC: a historical perspective. Proceedings of Mountain Pine Beetle Symposium: Challenges and Solutions. Oct 30-31, 2003, Kelowna, B.C. pp. 41-51.

Taylor, S.W., Carroll, A.L., Alfaro, R.I., and Safranyik, L. 2006. Forest, climate and mountain pine beetle outbreak dynamics in western Canada. *In*: Forest, Climate, and Mountain Pine Beetle Outbreak Dynamics in Western Canada. Natural Resources Canada, B.C. pp. 67 – 94.

Thomas, J. W., E. D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. A conservation strategy for the Northern spotted owl. Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl, Portland, OR. 427pp.

Thomas, R.B., and W.F. Megahan, 1998. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon: A second opinion. Water Resources Research 34(12): 3393-3403. (April 1, b).

Tiedemann, Arthur R., James O. Kelmmedson, Evelyn L. Bull. 2000. Solution of forest health problems with prescribed fire: are forest productivity and wildlife at risk? Forest Ecology and Management 127 (2000) 1-18. Elsevier Science B.V.

Tobalske, Bret W. 1997. Lewis's Woodpecker (*Melanerpes lewis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/284doi:10.2173/bna.284

Trappe, M.J. 2008. Effects of disturbance modes on mycorrhizal fungus communities at Crater Lake National Park. PhD dissertation. Oregon State University, Corvallis, OR. 218 p.

Trochta, D. 1999. Effects of Winter Recreation on Mid-Sized Carnivores (Wolverine, Fisher, Marten, Lynx, Bobcat, Red fox, and Weasel). In Olliff, T., K. Legg, and B. Kaeding, editors. 1999. Effects of winter recreation on wildlife of the Greater Yellowstone Area: a literature review and assessment. Report to the Greater Yellowstone Coordinating Committee. Yellowstone National Park, Wyoming. 315 pages.

Turner, M.G. 1989. Landscape ecology: The effect of pattern on process. Annual Review of Ecology and Systematics 20: 171-197.

Turner, M.G., Romme, W.H., and Gardner, R.H. 1999. Prefire heterogeneity, fire severity, and early postfire plant reestablishment in subalpine forests of Yellowstone National Park, Wyoming. Int. J. of Wildland Fire. 9(1): 21-36.

Umpqua Valley Audubon Society. 2006. Survey Results from the Diamond Lake Ranger District, 1996-2006. Data compiled by M. Jones, report by B. Ryan and S. Vecchio.

United Nations Intergovernmental Panel on Climate Change (IPCC). 2007, Climate change 2007: Synthesis report, summary for policymakers.

U.S. Environmental Protection Agency. 1978. Report on Diamond Lake, Douglas County, Oregon, EPA Region X. Working Paper No. 828. 7 pp. + appendices.

USDA Forest Service. 1976. Soil Resource Inventory.

USDA Forest Service. Pacific Northwest Region. 1984. Forester's Field Handbook

USDA, Forest Service. 1988. General Water Quality Best Management Practices Handbook for the Pacific Northwest Region.

USDA, Forest Service. 1990. Umpqua National Forest Land and Resource Management Plan and FEIS. Pacific Northwest Region. Umpqua National Forest, Roseburg, OR.

USDA, Forest Service. 1990. Forest Service Manual 2600 - FSM 2600 - Wildlife, Fish And Sensitive Plant Habitat Management. http://www.fs.fed.us/cgi-bin/Directives/get_dirs/fsm?2600

USDA, Forest Service. 1992. Long-Range Planning for Developed Sites in the Pacific Northwest: The Context of Hazard Tree Management. FPM-TP039-92. USDA Forest Service, R6, Pacific Northwest Region. Portland, OR. 120 pp.

USDA, Forest Service, Pacific Northwest Region. 1993. A first Approximation of Ecosystem Health.

USDA Forest Service, Pacific Northwest Region. 1996. Field Guide to the Forested Plant Associations of Southwestern Oregon. R6-NR-ECOL-TP-17-96.

USDA, Forest Service. San Dimas Technology and Development Center. Dust Palliative Selection and Application Guide.

USDA, Forest Service. 2000. USDA Forest Service Landbird Strategic Plan. 24 Pp. http://www.fs.fed.us/biology/resources/pubs/wildlife/landbird.pdf

USDA, Forest Service. 2001. Special Areas; Roadless Area Conservation; Final Rule. Federal Register Vol.66(9):3244-3273.

USDA, Forest Service. 2003a. Technical and Development Program. Cut-to-length system: A tool for Land Managers. San Dimas, CA. CD-ROM.

USDA, Forest Service. 2003. Umpqua National Forest Roads Analysis Report: Forest Scale.

USDA, Forest Service. 2004. Regional Forester's sensitive plant list. Pacific Northwest Region, July, Portland, Oregon.

USDA, Forest Service. 2005a. Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants, Final Environmental Impact Statement, Record of Decision. R6-NR-FHP-PR-02-05. Portland, Oregon

USDA, Forest Service. 2005b. Off-Highway Vehicle Recreation in the United States, Regions and States: A National Report from the National Survey on Recreation and the Environment (NSRE), June, 2005. Prepared by the U.S. Forest Service's National OHV Policy & Implementation Teams, Cordell, H.K., C.J. Betz, G. Green and M. Owens authors. www.fs.fed.us/recreation/programs/ohv/OHV_final_report.pdf.

USDA, Forest Service. 2008. Forest Service strategic framework for responding to climate change. Version 1.0. 21 pp.

USDA Forest Service. 2009. Climate Change Considerations in Project Level NEPA Analysis January 13, 2009 WO memo.

USDA, Forest Service, 2010a. Water, climate change, and forests: Watershed stewardship for a changing climate. PNW-GTR-812. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 75 pp.

USDA, Forest Service. 2010b. Responding to climate change: Draft integrated strategy for landscape conservation for the Pacific Northwest Region. USDA Forest Service Region 6 and the Pacific Northwest Research Station. Version1.2. May 2010. 16 pp.

USDA, Umpqua National Forest. 1996. Upper Clearwater Watershed Analysis, Diamond Lake Ranger District, Idleyld Park, OR.

USDA, Umpqua National Forest. 1998. Diamond Lake/Lemolo Lake Watershed Analysis, Diamond Lake Ranger District, Idleyld Park, OR.

USDA, Umpqua National Forest. 2004. Diamond Lake Restoration Project Final Environmental Impact Statement. S. Chambers Team Leader.

USDA, Umpqua National Forest. 2008. Vegetation management plan for the unroaded recreation area west of Diamond Lake (management area 1) and the Diamond Lake and Lemolo Lake recreation composite areas (management area 2) plus watershed analysis iteration updating recommendations made in the 1998 Diamond Lake / Lemolo Lake watershed analysis. Umpqua National Forest. Unpublished.

USDA/USDI. 1994. 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. http://www.reo.gov/library/reports/newroda.pdf. Includes Appendix J2 – Results of Additional Species Analysis.

USDA/USDI. 1999. Field Guide to Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan. Contributors: Kelley, R., S. Dowlan, N. Duncan, and T. Burke.
http://www.blm.gov/or/plans/surveyandmanage/Field_Guide/Terrestrial_Mollusk/Terrestrial_Guide.pdf

USDA /USDI. 2001. Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. Portland, Oregon. 2 vols.

USDA/USDI. 2005. Northwest Forest Plan Temperature TMDL Implementation Strategy. Evaluation of the Northwest Forest Plan Aquatic Conservation Strategy and Associated tools to achieve and maintain stream temperature water quality standards.

USDA/USDI. 2008. *Field Guide for Danger Tree Identification and Response*. R6-NR-FP-PR-01-08. 64 pp.

USDA/USDI. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy. http://fsweb.wo.fs.fed.us/fire/fam/firepolicy/policy.pdf

USDI, Bureau of Land Management. 1999. Field Guide to Survey and Manage Terrestrial Mollusk Species from the Northwest Forest Plan. Contributors: Kelley, R., S. Dowlan, N. Duncan, and T. Burke. June of 1999. http://www.blm.gov/or/plans/surveyandmanage/Field_Guide/Terrestrial_Mollusk/Terrestrial_Guide.pdf

USDI. U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Fisheries Service. 2000. Habitat Conservation Planning Handbook. http://www.fws.gov/endangered/hcp/hcpbook.htm

USDI. U.S. Fish and Wildlife Service. 1978. Determination of Certain Populations of Bald Eagles as Endangered or Threatened. February 14, 1978. Federal Register: Vol:43, No:31:6230-6233.

USDI. U.S. Fish and Wildlife Service. 1989. The northern spotted owl; a status review supplement. US Fish and Wildlife Service, Region 1, Portland, OR.

USDI. U.S. Fish and Wildlife Service. 1992. Endangered and Threatened Wildlife and Plants; Determination of Critical Habitat for the Northern Spotted Owl. January 15, 1992. Federal Register: Vol: 57, No:10:1796-1797.

USDI. U.S. Fish and Wildlife Service. 2004a. Species Assessment and Listing Priority Assignment Form for the Mardon Skipper (*Polities mardon*). http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/20040719-mardon-skipper.pdf

USDI. U.S. Fish and Wildlife Service. 2004b. Species Assessment and Listing Priority Form for *Martes pennanti*, Fisher. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/20040816-fisher.pdf

USDI. U.S. Fish and Wildlife Service. 2007a. National Bald Eagle Management Guidelines. http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf

USDI. U.S. Fish and Wildlife Service. 2007b. Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife; Final Rule; Endangered and Threatened Wildlife and Plants; Draft Post–Delisting and Monitoring Plan for the Bald Eagle (*Haliaeetus leucocephalus*) and Proposed Information Collection; Notice. July 9, 2007. Federal Register: Vol:72, No: 130:37346-37372.

USDI. U.S. 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. 2007. Methodology for estimating the number of northern spotted owls affected by proposed federal actions. Oregon Fish and Wildlife Office, Fish and Wildlife Service, Portland, OR.

USDI US Geological Survey. 2007. The National Map LANDFIRE: LANDFIRE Rapid Assessment Fire Regimes layer. US Department of Interior, US Geological Survey. http://www.landfire.gov/, last accessed 5 May 2010.

Van Wagtendonk, J.W. 1996. Use of a deterministic fire growth model to test fuel treatments. Sierra Nevada Ecosystem Project: Final report to Congress, vol. II. Davis, University of California, Centers for Water and Wildland Resources.

Vanderwel, M.C., J.R. Malcolm, and S.C. Mills. 2007. A Meta-Analysis of Bird Responses to Uniform Partial Harvesting across North America. Conservation Biology 21(5):1230–1240.

Van Lanen, N.J.. 2010. Out with the old and in with the new? Investigating competition between barred owls (*Strix varia*) and Northern spotted owls (*Strix occidentalis caurina*) in Northwestern California with a playback experiment. Unpublished Thesis, March 24, 2010, Colorado State University, Fort Collins, CO. 133 pp.

Waldo, J.B.. 1880. Diaries and Letters from the High Cascades. Unpublished. –.

Wasser, S.K., K. Bevis, G. King, and E. Hanson. 1997. Noninvasive Physiological Measures of Disturbance in the Northern Spotted Owl. Conservation Biology, 11(4):1019–1022.

Weasma, T.R. 1998. Conservation Assessment for *Helminthoglypta hertlieni*, Oregon Shoulderband. Reconfigured by N. Duncan, 2004. http://www.fs.fed.us/r6/sfpnw/issssp/documents/planning-docs/20050713-moll-oregon-shoulderband.doc

Weasma, T.R. and N. Duncan. 2005. Conservation Assessment for *Monadenia (Shastelix) chaceana*, Chace Sideband.

Weatherspoon C.P., and C.N. Skinner. 1996. Landscape-level strategies for forest fuel management. Sierra Nevada Ecosystem Project: Final report to Congress, Vol II, Assessment and Scientific basis for management options. UC Davis Centers for water and wildland resources.

Weir, R.D. and A.S. Harestad. 2003. Scale-Dependent Habitat Selectivity by Fishers in South-Central British Columbia. The Journal of Wildlife Management, 67(1)73-82.

Weller, T.J. 2005. Western Bat Working Group, Species Account for *Myotis thysanodes*, Fringed Myotis. http://wbwg.org/species_accounts/vespertilonidae/myth.pdf

Wessell, S.J. 2010. Productivity estimates for the Lodgepole Pine-Mountain Hemlock/Depauperate (PICO-TSME/DEP) Plant Association. Filed in Project Record.

Westerling A. L., H. G. Hidalgo, D. R. Cayan and T. W. Swetnam. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. Science 313:940-943.

Whitehead, R. J. and G. L. Russo, 2005. “Beetle-proofed” Lodgepole pine stands in interior British Columbia have less damage from mountain pine beetle. Report BC-X-

402. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC, 17pp.

Wildland Fire Leadership Council (WFLC), 2008. Healthy Forests and Rangelands; Success Stories. http://www.forestsandrangelands.gov/success/index.cfm

Zabel, C.J, K. McKelvey, and J.P. Ward. 1995. Influence of primary prey on home-range size and habitat-use patterns of northern spotted owls (*Strix occidentalis caurina*). Canadian Journal of Zoology 73: 433-439.

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ACRONYMS, GLOSSARY OF TERMS, AND INDEX

Acronyms

ACS	Aquatic Conservation Strategy
BBWO	Black-Backed Woodpecker
BE	Biological Evaluation
BLM	Bureau of Land Management
BMP	Best Management Practice
BS	Bachelor of Science Degree
BTU	British Thermal Unit (measure of heat)
CAA	Clean Air Act
CE	Categorical Exclusion
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHU	Critical Habitat Unit (for the Northern Spotted Owl)
CI	Crowning Index
CO_2eq	Carbon Dioxide warming equivalents
CWD	Coarse Woody Debris
CWPP	Community Wildfire Protection Plan
dbh	[Tree] Diameter at Breast Height
DEIS	Draft Environmental Impact Statement
DEQ	Department of Environmental Quality
DO	Dissolved Oxygen (in water)
EGC	Effective Ground Cover
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FEMAT	Forest Ecosystem Management Assessment Team
FOFEM	First Order Fire Effects Model
FS	Forest Service
FVS	Forest Vegetation Simulator
FY	Fiscal Year
GIS	Geographic Information System

GP	Grapple pile
GSE	Ground Skidding Equipment
HFRA	Healthy Forest Restoration Act
HE	Habitat Effectiveness (a measure used to quantify habitat for big game)
HP	Handpile
HRP	Hydrologic Recovery Percentage
HUC	Hydrological Unit Code
IDT	Interdisciplinary Team
IRA	Inventoried Roadless Area
LRMP	1990 Umpqua National Forest Land and Resource Management Plan
LSR	Late Successional Reserve
MA	Management Area
MOCA	Managed Owl Conservation Areas
MBF	Thousand Board Feet
MEC	Mechanical Logging
ML	(Road) Maintenance Level
NEPA	National Environmental Policy Act of 1969
NF	National Forest
NFMA	National Forest Management Act of 1976
NFP	Northwest Forest Plan
NOI	Notice of Intent
NRF	Nesting, Roosting, and Foraging Habitat
NSOOM	Northern Spotted Owl Occupancy Map
OCRA	Oregon Cascades Recreation Area
ODEQ	Oregon Department Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OHV	Off Highway Vehicle
ONHP	Oregon Natural Heritage Program
OSHA	Oregon Safety and Health Administration
PA	Proposed Action
PCT	Precommercial Thinning
pH	power of Hydrogen
RMO	Road Management Objectives
ROD	Record of Decision (for the Northwest Forest Plan)

ROS	Recreational Opportunity Spectrum
RVD	Recreational Visitor Day
S&G	Standards and Guidelines (from Forest Plans)
SMS	Scenery Management System
SKY	Skyline
TI	Torching Index
TPA	Trees Per Acre
TMDL	Total Maximum Daily Load
UB	Underburn
UNF	Umpqua National Forest
USFWS	US Fish and Wildlife Service
USDA	United States Department of Agriculture
USDI	United States Department of Interior
WMU	Wildlife Management Unit
USFS	United States Forest Service
VQO	Visual Quality Objective
WA	Watershed Analysis
WEPP	Water Erosion Prediction Program
WUI	Wildland-Urban Interface
VLSB	Volcanic Legacy Scenic Byway

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Glossary

A

Activity center: A term used in northern spotted owl management to denote regular use of an area by owls. It may be a nest site, repeated presence of pairs, or territorial behavior by individuals.

Activity fuels: Fuels generated by management activity (slash).

Administratively withdrawn: Areas removed from the suitable timber base through agency direction and land management plans.

Airshed: A geographic area delineated using similar atmospheric characteristics.

Air Pollutant: Any substance in the air that could, if in high enough concentration, harm humans, animals, vegetation, or material. Air pollutants may include almost any natural or artificial matter capable of being airborne in the form of solid particles, liquid droplets, gases, or a combination of these.

Air Quality: The composition of air with respect to quantities of pollution therein; used most frequently in connection with “standards” of maximum acceptable pollutant concentrations.

Administratively withdrawn: Areas removed from the suitable timber base through agency direction and land management plans.

Allelopathic: Refers to plants that naturally have pesticide characteristics with abilities to keep other plants from growing near them.

Alluvial: Material deposited by creeks and rivers, including gravel, sand, silt and clay.

Ameliorate: To improve or become more satisfactory.

Anadromous: Those species of fish that mature in the ocean and migrate into fresh water rivers and streams to spawn (e.g., salmon and steelhead).

Analysis Area: Areas that are described in the EIS where appropriate to define the area of potential impact at the appropriate scale. These scales are not always the same between resource areas and may be a portion of the Study Area, or a larger scale that extends beyond the Study Area; examples include hydrology (sub-watersheds), wildlife (habitat blocks), or social-economic areas (where people are), etc.

Animal damage: Physical damage to forest tree seed, seedlings, and young trees through seed foraging, browsing, cutting, rubbing, or trampling, by mammals and birds.

Anthropogenic: Of, relating to, or resulting from the influence of humans on nature.

Aquatic habitat: Habitat that occurs in free water.

Aquifer: A geologic formation or structure that transmits water in sufficient quantity to supply the needs for a water development; usually saturated sands, gravel, fractures, pumice, or cavernous and vesicular rock.

Aspect: The direction a slope faces with respect to the cardinal compass points.

B

Bark slippage: When trees are susceptible to damage because of sap flow and accelerated growth in the spring of the year, which makes bark easily damaged and or removed from the bole of the tree.

Bedrock: Solid rock underlying soils.

Best Management Practices (BMPs): Management practices developed by the Forest Service designed to protect, maintain, or improve water quality by preventative rather than corrective means. Developed in compliance with the Clean water Act and coordinated with the United States Environmental Protection Agency and the State of Oregon.

Biological control: Deployment of host specific organisms to eliminate or control noxious weeds.

Biological diversity: The variety of life forms and processes, including a complexity of species, communities, gene pools, and ecological functions.

Biological Evaluation (BE): An evaluation of the effects on Threatened, Endangered, or Sensitive plant or wildlife species required by the Forest Service for the Proposed Action and each alternative.

Biological Opinion (BO): The document resulting from formal consultation that states the opinion of the US Fish and Wildlife Service or National Marine Fisheries Service as to whether or not a Federal action is likely to jeopardize the continued existence of listed species.

Blowdown: Trees felled by high winds (see windthrow).

Bryophytes: Plants of the phylum Bryophyta, including mosses, liverworts and hornworts, characterized by the lack of true roots, stems and leaves.

Bucked: To cut a length of log with a chainsaw.

C

Canopy closure: The degree to which the canopy blocks sunlight or obscures the sky.

Carbon Dioxide warming equivalents: The warming effect of CO_2 is assigned a value of 1, and the warming effects of other gases are calculated as multiples of this value in order to assess effects of the project on global warming.

Cavity nester: Wildlife species, most frequently birds, that require cavities (holes) in trees for nesting and reproduction.

Class I area: A CAA classification that protects the air quality in national parks greater than 6,000 acres and Wilderness areas greater than 5,000 acres that existed on August 7, 1977.

Classified roads: A road constructed or maintained for long-term use. May include public, private, or forest system roads. May include roads that are maintained to remain open year-round or roads that are closed.

Clearcut harvest: A timber harvest method in which all trees are removed in a single entry from a designated area, with the exception of retention trees or snags. The objective is to create an even-aged stand.

Climax vegetation: The final vegetative community which emerges after a series of successive vegetation stages and perpetuates itself indefinitely unless disturbed by outside forces.

Coarse fragments: Rock or mineral particles greater than 2.0 mm in diameter. Gravel is rock less than 7.6 cm (3 in), cobbles are diameters 7.6 to 25 cm (3 to 10 in), stones are 25 to 61 cm (10 to 24 in), and boulders are greater than 61 cm (24 in).

Coarse woody debris: Standing dead trees and large down woody material.

Co-dominant trees: Trees with crowns forming the general level of the main canopy in even-aged stands or, in uneven aged stands, the main canopy of the tree's immediate neighbors, receiving full light from above and comparatively little from the sides.

Cohort: A distinct aggregation of trees originating from a single natural event or regeneration activity, or a grouping of trees (e.g., 10-year age class) as used in inventory or management.

Commercial thinning: The harvest of generally merchantable trees from a stand usually to encourage growth of the remaining leave trees (see density management).

Commodity value: The economic value of outputs from the forest that are commercially sold to private operators.

Compaction (soil): An increase in bulk density and a decrease in soil porosity resulting from applied loads, vibration, or pressure.

Conformity Provisions: Provisions in the Clean Air Act (Section 176(c)) that prohibit federal agencies from taking any action within a non-attainment area that causes or contributes to a new violation in standards of, increases the frequency or severity of an existing violation, or delays the timely attainment of a standard as defined in the area plan.

Congressionally Reserved areas: Areas that require Congressional enactment for their establishment, such as Wilderness Areas and the Oregon Cascades Recreation Area.

Connectivity: A measure of the extent to which conditions among late-successional forest areas or within stream and river systems that provide habitat for important ecological functions such as species breeding, feeding, and dispersal of young.

Contiguous habitat: Habitat suitable to support the life needs of species that is distributed continuously or nearly continuously across an area of the landscape.

Core area: An area of late successional habitat surrounding a nesting area.

Cost efficiency: The usefulness of specified inputs (costs) to produce specified outputs (benefits). In measuring cost efficiency, some outputs including environmental, economic, or social impacts, are not assigned monetary values but are achieved at specified levels in the least costly manner. Cost efficiency is usually measured using present net value, although use of benefit-cost ratios and rates-of-return may be appropriate.

Cost: The negative (adverse) effects. Costs may be monetary, social, physical or environmental in nature.

Critical habitat: Under the Endangered Species Act, critical habitat is defined as (1) the specific areas within the geographic area occupied by a Federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection; and (2)

specific areas outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species.

Crown: The upper part of a tree or other woody plant that makes up the branches and the foliage.

Crowning Index (CI): The 20' wind speed necessary to result in a crown fire once it has started. CI is a function of canopy bulk density, slope, and fuel moisture content (a higher CI number indicates lower hazard).

Flame length - The length of a flame from the top of the fuels being consumed. A good benchmark is to keep flame lengths below 4 feet under hot and dry conditions,

Cultural (heritage) resource: Any definite location of past human activity identifiable through field survey, historical documentation, or oral evidence. This includes archaeological sites, structures, or places, and places of traditional cultural or religious importance to specified groups whether or not represented by physical remains.

Cumulative effects: Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions.

D

Decommissioning: To permanently terminate the function of a road and mitigate any adverse impacts to forest resources. May include blocking the entrance, assuring natural or artificial re-vegetation, removal of drainage structures, and re-establishing natural drainage patterns; and for system roads, removal from the Forest road inventory.

Density management: Cutting (and removal) of trees for the primary purpose of widening their spacing so that growth of remaining leave trees can be accelerated.

Developed recreation: A site or area developed with permanent facilities designed to accommodate recreation users.

Discount factor: A factor applied to future monetary costs and benefits to convert them to ‘present value’, thus reflecting society’s time preference for money. A four percent discount factor is required for Federal projects.

Dispersal habitat: Habitat that allows safe movement of young or displaced animals in search of a new territory. For spotted owls, dispersal habitat is mature to old-growth forest that has a closed canopy.

Dispersed recreation: Outdoor recreation in which visitors are diffused over relatively large areas. Where facilities or developments are provided, they are primarily for protection of the environment rather than comfort or convenience of the user.

Displacement (soil): The removal and horizontal movement of soil from one place to another by mechanical forces such as a tractor.

Dominant trees: Trees with crowns extending above the general level of the main canopy of even aged stands or, in uneven-aged stands, above the crowns of the tree’s immediate neighbors, and receiving full light from above and partly from the sides.

Duff: The layer of loosely accumulated debris underlying the litter layer on the forest floor.

E

Ecosystem: A unit comprising interacting organisms considered together with their environment (e.g., marsh, watershed, and lake ecosystems).

Endangered Species: Any species of plant or animal identified through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register.

Endemic: Species that are only known from a geographic area. Endemism can be narrow (one drainage) or regional (Pacific Northwest) or continental (North America).

Environmental safety standards: Design standards developed to protect the environment during road construction and reconstruction.

Epidemic: When a natural population of insects suddenly and greatly enlarges. Used interchangeably with the term outbreak.

Ephemeral streams: Streams that contain running water only sporadically, such as during and following storm events. Ephemeral streams with a definable channel are considered “intermittent” when they show evidence of annual scour or deposition.

Erosion: The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. There are different types of erosion; including gullies, sheets, and rills.

Evapotranspiration: The removal of water from the soil by plant roots and the use of that water in the growth process (transpiration) plus the evaporation of any excess water from the surface of leaves. When trees are harvested in a clearcut, little to no evapotranspiration takes place until the regenerating stand of trees and shrubs reestablishes.

Existence value: The value placed on a resource based on simply knowing that it exists in a certain state, irrespective of direct experience through visiting the site.

F

Fen: A wetland ecosystem in which the main source of water is usually nutrient rich groundwater

Fire hazard: A physical condition that describes how the area would burn if a fire started.

Fire intensity: A function of fire behavior. Specifically, for D-Bug, it refers to the amount of impact to the dominant overstory, described in terms of mortality, which is directly related to fire behavior. Therefore, a "high intensity" fire is one that replaces the overstory (i.e., crown fire). A low intensity fire burns the understory, leaving the overstory trees with green crowns.

Fire regime: The characteristic frequency, extent, intensity, severity and seasonality of fires in an ecosystem.

Fire risk: The probability that a fire will occur. It does not relate to the likelihood of a fire becoming large.

Fire severity: Generally applies to the post-fire condition (i.e., what is left after the fire). Fire severity is a function of fire intensity in combination with residence time; thus it is a product of temperature and duration (duration of burn at a specific location). For the D-

Bug project, fire severity applies to the impact of fire to the soil. Therefore, a high surface fuel loading (particularly large fuels) will produce a high severity fire.

Fluvial: Refers to creek and rivers. For instance, fluvial erosion of streambanks is caused by the forces of water during a flood.

Fragmentation: The process that divides a habitat into separate blocks and isolates the blocks through loss of connective habitat.

Fuelbreak: Fuelbreaks in this document refer to “shaded” fuelbreaks, defined as those “created by altering surface fuels, increasing the height to the base of live crown, and opening the canopy by removing trees” (Agee et al. 2000) to alter fire behavior within the treated area.

Fuel loading: The weight of fuel at a given site; usually expressed in tons per acre. This value generally refers to the fuel that would be available for consumption by a fire.

Fuel model: An identifiable association of fuel elements of distinctive species, form, size, arrangement or other characteristics that will cause a predictable rate of fire spread and intensity under specific weather and topographic conditions.

G

Geomorphic: Pertaining to the form or shape of those processes that affect the surface of the earth.

Geographic Information System (GIS): A computer system capable of storing and manipulating spatial (i.e., mapped) data.

Gradient: The degree of inclination or rate of descent.

Green tree retention (GTR): A Standard and Guideline from the Northwest Forest Plan that requires the retention of live trees as well as snags in dispersed and aggregate fashion within harvest units in order to provide for a biological legacy and to provide for habitat components through the next management cycle.

Groundwater: That portion of the water below the surface of the ground.

Group harvest: Method of regenerating uneven-aged stands in which trees are removed, and new age classes are established in small groups.

H

Habitat: A place where a plant or animal naturally or normally lives, grows, and reproduces.

Hand piling: Piling of limbs and branches from trees that have been cut during a logging operation in order to reduce the potential for a fire.

Hard snags: Trees that have been dead for a short period of time and have only slightly decayed.

Harvest unit: An area where timber cutting and logging operations take place.

Harvester-forwarder: A logging system where two separate pieces of equipment are used to fell the trees and then transport them to the landing. The harvester cuts the tree and then lays it next to the trail. The forwarder then loads the cut log onto a bunk where it is transported, fully suspended above the ground, to the landing.

Hazardous fuels: A fuel complex defined by kind, arrangement, volume, condition and location that form a special threat of ignition or suppression difficulty.

Hazard tree: A tree that has been identified as a potential risk for structural failure that could cause injury to a person or property.

Helicopter logging: Use of helicopters to transport logs from where they are felled to a landing.

Hiding cover: Generally refers to any vegetation used by wildlife for security or to escape from danger. More specifically for elk, it is any vegetation capable of providing concealment (e.g., hiding 90% of an animal from human view at a distance of 200 feet.

Home range: The land area used by an animal throughout the year, providing food, shelter, and breeding opportunity. For migratory animals, home range includes summer range, winter range, and any migratory lands in between.

Hydrologic recovery procedure: An analysis tool used to estimate the recovery and health of a stream.

I

Imminently dying tree: A tree that is damaged or attacked by pests and expected to have a dead or nonfunctional root system or a nonfunctional stem within 5 years may be considered either dead or imminently dead. A “dead tree” designation is justified for most species when at least three of the four quadrants from around the base of the root collar have cambium, inner bark, or phloem that are discolored and dead (Filip, et al., 2007).

Indirect effect: Caused by the action and are later in time or farther removed in the distance, but are still reasonably foreseeable.

Inorganic: Chemical substances which are derived from the external physical environment, and which are not organic.

Insect epidemic: When a natural population of insects suddenly and greatly enlarges. Used interchangeably with the term insect outbreak.

Interdisciplinary Team (IDT): A group of individuals with different training or knowledge in different resource areas assembled to perform a task or to solve a problem. The group works together to integrate the various disciplines while developing solutions.

Infiltration: Downward entry of water into the soil.

Interior forest habitat: That portion of a mature forest stand that receives little edge effect. For the purpose of this analysis, it is any portion of the stand more than 300 feet away from the edge bordering an opening.

Invasive plant species: Invasive plant species are alien plants whose introduction do or are likely to cause economic or environmental harm, or harm to human health

Inventoried Roadless Area: Areas that were inventoried prior to the development of the 1990 Umpqua LRMP and described in Appendix C of the Forest Plan.

Irretrievable: Applies primarily to the use of nonrenewable resources. For example, some or all of the timber production from an area is irretrievably lost during the time an area is used as a road. If the road is decommissioned, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

Irreversible: Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors such as soil productivity that are renewable only over long time periods. Irreversible also includes loss of future options.

Issue: As defined by the National Environmental Policy Act, an issue is an unresolved conflict over the use of available resources. Issues are points of debate, dispute, or disagreement over the effects of a proposed action.

J

Jackpot burning: prescribed ignition and burning of concentrations of slash or fuel as a result of harvest or post-harvest activities. Used where concentrations of slash are not continuous.

L

Ladder fuels: Midstory vegetation that provides vertical movement of fire burning on the ground into the crows of trees. Removing or limiting ladder fuels lowers the risk of stand-replacing crown fires

Land Allocation: Specific land areas usually with a set of management prescriptions or standards and guidelines established (in a FEIS for a Forest Plan) to achieve particular goals for the allocation.

LandFire: A dataset of vegetations types derived from Satellite images for the lower 48 states. It describes forest and fuels conditions appropriate for landscape-level analysis. It is available at LandFire.gov.

Large woody debris / material: Pieces of wood larger than 10 feet long and 6 inches in diameter, in a stream channel.

Late-successional forest: A forest in its mature and / or old-growth successional stage. The Northwest Forest Plan defines late successional forests as those 80 years of age or older.

Late successional reserves: Land allocation under the Northwest Forest Plan with the objective to protect and enhance conditions of late-successional and old-growth forest ecosystems that serve as habitat for late-successional and old-growth forest related species, including the northern spotted owl. Limited stand management is permitted, subject to review by the Regional Ecosystem Office (USDA, USDI 1994b).

Late seral stand: See late-successional forest.

Leave trees: Trees, pole-sized or larger, retained in either a dispersed or aggregated manner.

Legacy compaction: Soil compaction from past management actions that carries over to the present.

Lithic scatter: A cultural resource, specifically an archaeological site, consisting largely of the debris (flakes, cores, and broken tools) left behind from the making or sharpening of prehistoric chipped-stone artifacts.

Loamy: Intermediate in texture and properties between fine-textured and coarse-textured soils.

Logging systems: The use of specific logging equipment to achieve prescribed management objectives for an area planned for harvest.

Lop and scatter: A method of slash reduction where accumulations and concentrations are broken up (usually with chain saws) and dispersed from dense locations.

M

Maintenance level: See road maintenance levels.

Management Area (MA): Areas that have been allocated by the Land and Resource Management Plan. Each area has different resource goals and activity Standards and Guidelines.

Management Indicator Species (MIS): Animal species identified within the LRMP to represent specific habitats whose population changes are believed to indicate the effects of management activities.

Mastication: The grinding of woody fuel into small pieces using a grinding head mounted on an excavator or other hydraulic equipment.

Matrix: Lands identifies within the Northwest Forest Plan that are outside of Late-Successional Reserves, Administratively Withdrawn areas, and Riparian Reserves.

Merchantable: Refers to a product that is marketable.

Microclimate: Suite of climatic conditions measured in localized areas near the earth's surface. Microclimate variables important to habitat may include temperature, light, wind speed and moisture.

Mitigation: Modification of actions that: (1) avoid impacts by not taking a certain action or part of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (5) compensate for impacts by replacing or providing substitute resources or environments.

Model: An idealized representation of reality developed to describe, analyze, or understand the behavior of some aspect of it; often a mathematical representation of the relationships under study.

Modification: A Visual Quality Objective where land management activities may visually dominate the natural surrounding landscape but must borrow from naturally established form, line, color, and texture.

Mollusk: Invertebrate animals (such as slugs, snails, clams, or squids) that have a soft unsegmented body usually enclosed in a calcareous shell.

Multistoried/multilayered forest stands: Forest stands that contain trees of various heights and diameter classes and therefore support foliage at various heights in the vertical profile of a stand.

Mycorrhizal: The symbiotic association between certain fungi and plant roots which enhances the uptake of water and nutrients.

N

National Environmental Policy Act (NEPA): Federal Legislation related to actions on Federal land that encourages informed decision making. NEPA requires Federal agencies to: (a) use a systematic interdisciplinary approach in planning and decision making; (b) consider the environmental impact of proposed actions; (c) identify adverse environmental effects which cannot be avoided should the proposal be implemented; (d) consider alternatives to the proposed action; (e) consider the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity; and (f) identify any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. Established a Council on Environmental Quality (CEQ).

National Register of Historic Places: A Federal list of those cultural resource sites and structures that are found to be of national, regional, or local significance and worthy of special consideration during the planning of Federal or Federally approved undertakings.

Net Public Benefits (NPB): A conceptual comparison of all costs and benefits, whether or not they can be monetarily quantified.

Nitrogen: Nitrogen is an important component of all proteins and is required for most biochemical reactions. All living cells require nitrogen in relatively high amounts compared to other nutrients.

Notice of intent: A notice that an environmental impact statement will be prepared and considered.

Noxious weeds: Plant species designated as such by the Secretary of Agriculture or by the responsible State official, that generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and being new to or not common to the United States.

O

Old-growth forest: An old forest stand usually at least 180-220 years old with moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground (Definition from the 1992 Northwest Forest Plan).

Opportunity cost: The value of the foregone opportunities for alternative uses of a resource that are eliminated through the Proposed Action.

Optimal thermal cover: Stands of coniferous trees with a multi-layered canopy where greater than 70 percent of the canopy is from trees over 40 feet in height. Stands are generally between 30-60 acres in size and the dominant trees are of relatively large size.

Option Value: The value placed on a resource from knowing that the resource will be available for one's use in the future.

Overstory: Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage.

Overstory removal: The cutting of trees comprising an upper canopy layer in order to release trees or other vegetation in an understory. In the case of D-Bug, overstory removal refers to the harvest of the lodgepole pine overstory.

P

Partial Retention: A Visual Quality Objective where land management activities may be evident to the viewer but must remain visually subordinate to the surrounding landscape.

Particulates: Small airborne dust and debris particles.

Patch: Often refers to a small (20-60 acre) part of the forest. A patch is often equivalent to management units in even-age plantations (5 to 100 acres). In unmanaged forest areas, a patch would correspond to seral stages for each forest type. This term is used to describe the pattern of seral stages by forest type at the landscape scale. In the science of forest landscape ecology, the predominant seral stage in a forested landscape at any one time in forest succession is considered the forest "matrix", and the matrix vegetation that is surrounded by a pattern of seral-stage "patches". Patch is often used in forest management to indicate a type of clear-cutting (patch cut) associated with the “staggered setting” approach to distributing harvest units across the landscape.

Peak flow: The highest amount of stream or river flow occurring in a year or from a single storm event.

Perennial stream: A stream or portion of a stream that flows throughout the year.

Physiographic region: A geographic area having a similar set of biological and physical characteristics and processes because of the effects of climate and geology that result in patterns of soils and broad-scale plant communities. Habitat patterns, wildlife distributions, and historical land-use patterns may differ significantly from those of adjacent regions.

Plant association: A plant community type based on land site potential, successional patterns, and species composition.

Plantation: A forest stand raised as a crop, either by seeding or planting.

Plant series: A level of vegetation classification that is identified by the most common species found in the plant community.

Pole: A tree between the size of a sapling and a mature tree.

Porosity: Volume of pores in a soil sample (non-solid volume) divided by the bulk volume of the sample.

Post and pole harvest: An area designated for cutting of posts and poles.

Pre-commercial thinning: The practice of removing some of the trees less than merchantable size (less than 5 inches in diameter) from a stand so that remaining trees will grow faster.

Prescribed fire: Controlled application of fire to wild-land fuels in either their natural or modified state. It is accomplished under specified environmental conditions which allow the fire to be confined to a predetermined area while also producing the intensity of heat and spread required to attain fuel reduction objectives.

Probable Sale Quantity (PSQ): An estimate of scheduled timber yields from Matrix lands.

Pumice: An excessively, cellular, glassy lava; a sort of volcanic froth.

R

Range of natural variability: An assessment of the long-term variation in natural conditions including the natural disturbance regime.

Record of decision: Document signed by a responsible official recording a decision that was preceded by the preparation of an environmental impact statement.

Recreational Opportunity Spectrum (ROS): An array of recreational activities, settings, and experiences used as a basic framework in planning and managing the recreation resource, and divided into the following classes: primitive; semiprimitive non-motorized; semiprimitive motorized; roaded modified; roaded natural; rural; and urban.

Reforestation: The natural or artificial restocking of an area with forest trees; most commonly used in reference to artificial stocking.

Regeneration: Seedlings or saplings existing in a stand; or the act of establishing young trees naturally or artificially.

Regeneration harvest: Timber harvest conducted with the partial objective of opening a forest stand to the point where favored tree species will be reestablished.

Region 6: Forest Service Pacific Northwest Region, including the National Forests of Washington and Oregon.

Regional Guide: The guide developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act. Regional guides provide Standards and Guidelines for addressing major issues and management concerns that need to be considered to facilitate National Forest planning.

Release: Freeing a tree or group of trees from immediate competition by eliminating overtopping or closely surrounding vegetation.

Relief culvert: A culvert designed to drain ditches on forest roads.

Resilience (to stand replacement fire): A stand's ability to resist the mortality of overstory trees being killed By a fire. A resilient stand is one that is less likely to experience a crown fire and thus less likely to be killed by a stand-replacement fire.

Restoration: Activities designed to enhance or repair resources that were impacted from past management activities, fire exclusion, or natural events.

Retention: A Visual Quality Objective where land management activities are not visually evident. Management activities are permitted, but the results of those activities on the natural landscape must not be evident to the average viewer.

Riparian: That which is related to, living, or located in conjunction with, a wetland, the bank of a river or stream, or the edge of a lake or tidewater.

Road Maintenance Levels: Defines the level of service provided by, and maintenance required for a specific road. There are five Maintenance Levels (1-5). Maintenance level 1 roads are closed while maintenance level 5 roads are open and maintained to the highest level to allow use by low clearance vehicles. For example, Road 4795 around Diamond Lake, is a maintenance level 5 road.

Road prisms: Defined as the area from the top of the cut to the bottom of the fill of a road.

Roaded natural ROS: An area characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of people. Such evidences usually harmonize with the natural environment

Runoff: Portion of precipitation on an area that is discharged from the area through stream channels. Precipitation which is lost without entering the soil is called surface runoff.

Rural ROS: An area characterized by substantially modified natural environment, with sights and sounds of humans readily evident and interaction between users often moderate to high.

S

Sale area map: A map that identifies individual harvest unit locations within a timber sale.

Salvage harvest: Harvesting primarily to utilize dead or dying trees that would not be merchantable if left in the stand until the next harvest entry.

Scale: Refers to the geographic area of consideration for analysis of a particular resource. Examples include small scale (stream reach) or large scale (river basin).

Scenic Integrity: Scenic integrity is very similar to visual quality, measuring visual impacts to scenery in terms of contrast of color, and distracting elements of unnatural form, line, and texture. Under the scenery management system (SMS), high scenic integrity is equivalent to retention; moderate scenic integrity is equivalent to partial retention; low scenic integrity is equivalent to modification; and very low scenic integrity is equivalent to maximum modification.

Scenic Stability: The degree to which the valued scenic character and its scenery attributes can be sustained through time and ecological progression.

Scenic Quality: Scenic quality refers to the degree to which the appearance of a place, landscape or feature can elicit psychological and physiological benefits to individuals and, therefore, to society in general.

Scoping: As defined by the National Environmental Policy Act, scoping is an early and important process for determining the scope of issues to be addressed and for identifying the significant issues related to the proposed action.

Section 106: The “Section 106 compliance process” is the process mandated by the National Historic Preservation Act of 1966, as amended, whereby a Federal agency considers the potential effect of a proposed agency undertaking on significant cultural resources. The process typically involves field survey of a project area; documentation and evaluation of cultural resources that may be found within the project’s area of potential effect; agency determination of the effect (or lack thereof) of the proposed undertaking on those resources; and consultation with and review by the appropriate State Historic Preservation Office. The Section 106 process is implemented under the terms of Federal regulations 36 CFR 800.

Sediment: Transported and deposited particles derived from rocks, soil, or biological material.

Sediment potential: Rating system which measures the transport and deposition of particles or aggregates derived from rock, soil, or biological material.

Semi-primitive motorized recreation ROS: An area characterized by predominantly unmodified natural environment of a size or location that provides a good-to-moderate opportunity for isolation from sights and sounds of people except for facilities essential for the use of motorized equipment.

Sensitive species: Those plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by either a significant current or predicted downward trends in population numbers or density or a significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. (FSM 2670.5)

Seral stages: The series of relatively transitory plant communities that develop during ecological succession from bare ground to the climax stage. Stages include early, mid, and late.

Silviculture: The art and science of managing forest ecosystems to ensure environmental, social, and economic sustainability. This involves the knowledge of the nature of forested ecosystems and vegetation; how they grow, reproduce, and respond to environmental changes, and how vegetation interacts with other components of the ecosystem.

Site potential trees: A tree that has attained the maximum height possible given site conditions where it occurs.

Site preparation: Manipulation of the vegetation or soil of an area prior to planting or seeding. The manipulation follows harvest, wildfire or construction in order to encourage the growth of favored species.

Site productivity: The ability of a geographic area to produce biomass (such as wood fiber), as determined by conditions in that area.

Skid trail: A path created by dragging logs to a landing or gathering spot.

Skeletal soils: Having little productivity and substance; shallow, rocky soils.

Skyline logging: A system for transporting felled logs to a landing where they are loaded on trucks. This method transports logs using a wire rope suspended between two high points. The wire rope serves as an overhead track for a load-carrying carriage. A skyline system uses vertical lift to suspend at least one end of the log free of the ground during inhaul.

Snag: Any standing dead, partially dead, or defective tree.

Snowdown: A term used to describe trees that were knocked down during a winter storm.

Socioeconomic: Pertaining to, or signifying the combination or interaction of social and economic factors.

Soil compaction: Compression of the soil layers through mechanical pressure that increases the soil density and decreases the soil aeration.

Soil displacement: Soil particles moved from the soil surface by water, gravity or mechanical disturbance.

Soil moisture regime: Condition of the soil in relation to moisture; dry, moist, or wet.

Soil productivity: Capacity or suitability of a soil for establishment and growth of a specified crop or plant species, primarily through nutrient availability.

Special use permit: Permits issued by the Forest Service to the private sector when a business is established on, or revenues are generated from, public Forest Service managed lands. A percentage of the revenue generated from the business is paid to the federal government.

Stand: An aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition so that it is distinguishable from the forest in adjoining areas.

Standards and Guidelines: The primary instructions for land managers, and the principles specifying the environmental conditions or levels to be achieved and maintained (e.g., USDA and USDI 1994, 2001). Standards address mandatory actions, whereas Guidelines are recommended actions based on a land-management decision.

Stand replacement fire: A fire that is severe enough over a large enough area (for example, 10 acres) to kill the existing stand of trees and initiate a new stand.

Stocking: An indication of growing space occupancy relative to a pre-established standard. Usually expressed in number of trees per acre.

Subsoil: Soil horizon layer below the surface or surface layer.

Subsoiling: A treatment to loosen compacted soil at the compacted layer without inversion and with a minimum of mixing with the tilled zone.

Succession: A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax.

Surficial deposits: Pumice soils that flowed into the area when Mt Mazama erupted.

System road: Also referred to as Forest development roads. Defined as a road wholly or partially within or adjacent to a National Forest boundary and necessary for protecting, administering, and using National Forest System Lands, which the Forest Service has authorized, and over which the agency maintains jurisdiction.

T

Terrestrial: Referring to species that are associated with the upland, non-aquatic portion of the ecosystem.

Thermal cover: Cover used by animals against weather. For elk, thermal cover can be found in a stand of coniferous trees at least 40 feet tall with a crown closure of at least 70%.

Threatened species: Those plant or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future.

Timber stand improvement (TSI): Measures such as thinning, pruning, release cutting, fertilization, prescribed fire, or girdling of unwanted trees aimed at improving growing conditions for the remaining trees.

Torching Index (TI): The 20' windspeed necessary to take a fire from the ground into the crowns (a higher number indicates lower hazard). TI is a function of surface fuel loading, fuel moisture, canopy base height, slope, and wind reduction factor (canopy closure).

Total Maximum Daily Load: The calculated amount of pollutant a water body can receive and still meet Oregon water quality standards

Topography: Hills, slopes, and valleys in a landform.

U

Uncharacteristic fire: A fire that is burning in a way that does not emulate historical (reference) fire behavior. This may include fire intensity, severity, size, and landscape patterns. Unless otherwise indicated, this term refers to fires burning with greater intensity, severity, and size and with less variability across the landscape compared to historical effects.

Uncharacteristic wildfire effects: Effects of an uncharacteristic fire (see uncharacteristic fire).

Unclassified roads: A road that is not constructed, maintained, or intended for long-term highway vehicle use, such as roads built for temporary access for timber harvest that were never obliterated following use.

Underburning: Prescribed burning with a low intensity, under a tree canopy.

Unique habitat: Non-forested openings such as talus slopes, meadows, hardwood stands, caves, cliffs, and wetlands.

Upland: The portion of the landscape above the valley floor or stream.

V

Vascular plants: Plants that contain conducting or vascular tissue. They include seed-bearing plant (flowering plants and trees) and spore bearing plants (ferns, horsetails, and club-mosses).

Vertical structure: Refers to the appearance of vegetation from the forest floor to the tallest plants or trees defined by a limited area. Stands or areas that have many different heights are thought to have good vertical structure.

Visual Quality Objectives: The levels of visual quality that have been adopted by management through the Forest land management planning process.

W

Waterbar: An erosion control device usually constructed by digging a small ditch or piling dirt or other debris to interrupt the flow of over-the-surface water. Usually constructed on steeper ground in skid trails where the mineral soil is exposed.

Watershed analysis: A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis is a stratum of ecosystem management planning applied to Watersheds of about 20-200 square miles.

Wetlands: Areas that are inundated by surface water or groundwater with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that require saturated or seasonally saturated soil conditions for growth and reproduction.

White pine blister rust: A fungus (*Cronartium ribicola*) that causes damage and can lead to eventual death of five needle pine trees the Pacific Northwest.

Wilderness: Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped Federal Land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural condition, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude, or for a primitive and confined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecological and geological interest (USDA, USDI 1994a).

Wildfire: Any wildland fire that is not a prescribed fire.

Windthrow: A tree or trees uprooted or broken off along the bole and toppled by the wind.

Y

Yarding: The moving of logs from the stump to a central concentration area.

Young stands: Forest stands not yet mature (generally less than 50-80 years old); typically 20-40 years old).

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