United States Department of Agriculture

Forest Service

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Environmental Assessment

Sisters Area Fuels Reduction (SAFR) Project

Sisters Ranger District, Deschutes National Forest
Deschutes County, Oregon

T15S, R9E and T15S, R10E, Willamette Meridian

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Commonly Used Acronyms

BMP Best Management Practices
CAA Clean Air Act, as amended
CFR Code of Federal Regulations
CFS Cubic Feet per Second
CHU Critical Habitat Unit
dbh diameter breast height
DN Decision Notice
EA Environmental Assessment
EFH Essential Fish Habitat
FVS Forest Vegetation Simulator
GIS Geographic Information System
GPS Global Positioning System
GSC CWPP Greater Sisters Country Community Wildfire Protection Plan
HFRA Healthy Forest Restoration Act of 2003 (P.L. 108-148)
HRV Historic Range of Variability
LOS- Late and Old Successional Forest
LSH Late Successional Habitat
MBTA Migratory Bird Treaty Act of 1918
MMBF Million board feet
NFS National Forest System
NRHP National Registration of Historic Places
PAG Plant Association Groups
PETS Proposed, Endangered, Threatened and Sensitive
USDA United States Department of Agriculture
USDI Department of Interior
USFS or FS United States Forest Service
VQO Visual Quality Objective
WUI Wildland Urban Interface

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SUMMARY

The Sisters Ranger District of the Deschutes National Forest proposes to reduce hazardous fuels and improve forest health on approximately 17,573 total acres of forest lands located near the town of Sisters, Oregon, within the Whychus Watershed. The project will reduce hazardous fuels and improve forest health through a combination of thinning from below, ladder fuels reduction, the application of prescribed fire, mastication, and mechanized piling and slash pile burning. The analysis and project design was developed through a collaborative process working with those individuals who developed the Greater Sisters Country Community Wildfire Protection Plan (GSC CWPP) and from comments provided by the public.

This action is needed because the area is threatened by the potential for uncharacteristic fires and environmental degradation. The threat of uncharacteristic fires was emphasized during the planning of this project when the 9,000 acre Black Crater Fire burned during the summer of 2006, resulting in a portion of the planning area being burned. The unnaturally extreme fire conditions are the result of a century of well-intended fire suppression practices and other management activities that have allowed fuels to build to unacceptable levels. This proposal is a step towards returning public lands to a healthy condition.

The objective of this project is to improve forest health, provide safe escape routes throughout the area, reduce risk to homes and structures in the area, reduce the risk of uncharacteristic wildfire on forest ecosystem components, improve the sustainability of conifer stands to withstand frequent fire, and increase firefighter safety.

The action alternatives have been designed to avoid or minimize negative impacts to issues as described in the effects section of the environmental assessment. Where avoidance was not possible, mitigation measures have been developed that eliminate impacts (e.g., protection of cultural resources) or reduce impacts to acceptable levels.

The Proposed Action (Alternative 2) can remove trees up to 21 inches diameter at breast height (dbh) as provided by Eastside Screen management direction. In response to public comment during the collaboration process an additional action alternative (Alternative 3, Key Issue 1) was developed. Some members of the public believe that an upper diameter limit of 12 inches dbh could meet the Purpose and Need for Action of hazardous fuels reduction. The analysis compares the effectiveness of each of the Action Alternatives at meeting the objectives of the planning project.

During the evaluation of the proposed action and Alternative 3 against current management direction, it was found that some treatments were not consistent with the Deschutes National Forest Land and Resource Management Plan (Forest Plan) as amended. A ***Forest Plan amendment*** would be needed to implement the Action Alternatives. This amendment is briefly described below.

Amendment #1: Thinning also contributes to the primary purposes of fuel treatment: decreasing the probability of crown fires, decreasing the severity of the impacts, enhancing effectiveness and safety, and reducing costs. To be able to effectively treat areas of hazardous fuels, including defensible space around private property, it is proposed to include a second Forest Plan amendment for the action alternatives. Standards and guidelines for Deer Habitat (MA-7) would be amended to allow the exclusion of defensible spaces acres from the percent of the project area that meets the definition of cover; to remove the standard allowing 2 to 2.5 percent of the project area to receive prescribe fire per year; and to exclude defensible space areas that are treated by mastication and burning from the existing acreage limitation. This would allow more defensible space to be treated and would not apply to lands outside defensible space.

On the issue of forest vegetation and fuels the effects analysis determined that there would be positive affects in all indicator areas. Treatments would move treated areas towards the historic range of variability and return treated areas from Condition Class 2 and 3 to a Condition Class 1.

It is estimated that there would be approximately five miles of temporary roads associated with the action alternatives. None of the temporary road locations would require excavation of cut-and-fill slopes because they are located on nearly level to gentle slopes (less than 5 percent gradient). These temporary road segments would be obliterated upon completion of the vegetation management activities. The project would have 'No Effect" to Threatened and Endangered wildlife or fish species; formal consultation with U.S. Fish and Wildlife is not required. The following table summaries planned activities associated with the action alternatives. No acres would be treated under the No Action Alternative.

Table 1: Summary table for acres by treatment for Alternatives 2 and 3.

Treatment	Alternatives 2 and 3 (Acres Treated)
Burn	11
Masticate and Burn	568
Thin	1,436
Thin and Burn	79
Thin and Masticate	830
Thin & Masticate & Burn	11,267
Plantation Treatment	3,382
Total	**17,573**

Based on the analysis documented in this environmental assessment, the Responsible Official would determine which alternative would be implemented and if so, where and under what conditions.

The Responsible Official will do one or more of the following:

- Select either Alternative 2 (Proposed Action) or Alternative 3, or Alternative 1 (No Action)
- Modify an action alternative
- Amend the Forest Plan
- Identify what mitigation measures will apply.

The Responsible Official will determine if the selected alternative is consistent with the management direction for the area and meets the Purpose and Need for Action. The decision regarding which combination of actions to implement will be determined by comparing how each factor of the purpose and need is met by the Proposed Action or selected alternative and the manner in which the selected alternative responds to the Key Issue and analysis issues raised during public scoping and environmental analysis.

CHAPTER 1. PURPOSE AND NEED FOR ACTION

Document Structure

The USDA Forest Service has prepared the Sisters Area Fuels Reduction (SAFR) Environmental Assessment (EA) in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. The SAFR EA discloses the environmental effects that would result from the No Action and action alternatives. The document is organized into four chapters.

Chapter 1. Purpose and Need for Action: This chapter includes information on the history of the project proposal, the Purpose and Need for Action, Forest Plan amendment, and the agency's proposal for achieving that Purpose and Need.
Chapter 2. Alternatives, including the Proposed Action: This chapter provides a more detailed description of the action alternatives, including the Proposed Action. This chapter identifies issues that were raised by the public and other agencies during the collaboration process. Mitigation measures are also described.
Chapter 3. Environmental Consequences: This chapter describes the direct, indirect, and cumulative environmental effects of implementing the Proposed Action and a second action alternative. The No Action alternative is used as a baseline for comparison.
Chapter 4. Consultation and Collaboration: This chapter provides a list of people, agencies, and organizations consulted.

Background

Wildland fire is a natural part of the ecosystems of central Oregon. It has shaped the forest and rangelands valued by the area's residents and visitors. However, the forests and rangelands in the area of Sisters, Oregon have been significantly altered, resulting in increased forest fuels and more closed forest that tend to burn more intensely than in the past. In addition, recent population growth has led to more residential development close to the forests, in what is called the Wildland Urban Interface (WUI). These issues were addressed by a multi-jurisdictional group of agencies, organizations, and individuals who through a collaborative process developed the Greater Sisters Country Community Wildfire Protection Plan (GSC CWPP). Working in collaboration with the GSC CWPP steering team to implement the goals and objectives identified in the CWPP, the Sisters Ranger District, Deschutes National Forest, designed the Sisters Area Fuels Reduction (SAFR) Project. While not specifically a Healthy Forest Restoration Act (HFRA) project, the SAFR project used many of the HFRA project design criteria in developing the Proposed Action and a second action alternative, both of which focus project activities in the WUI.

The SAFR Project is located around the community of Sisters Oregon and other near by homes and subdivisions. The project area encompasses 31,329 acres of which 24,467 acres are National Forest System lands. The planning area is located in portions of T15S, R9E and T15S, R10E, Willamette Meridian. The western boundary of the project area consist of a line running north and south, which was established along the eastern boundary of the range of the northern spotted owl as designated in the Northwest Forest Plan. This boundary was later modified slightly to be consistent with the WUI boundary as established in the GSC CWPP. The project is bound on the east by the Deschutes National Forest boundary. The northern boundary of the planning area is contiguous with most of the earlier Highway 20 Integrated Vegetation Management Project. The southern boundary of the planning area is approximately two miles south of Whychus Creek and is adjacent to additional National Forest Systems lands (Figure 1-1).

The site specific and ecologically appropriate measures and methods used to implement this project include prescribed fire, mowing of brush and small trees, and thinning of trees from below. The project is located entirely on National Forest System lands and within the WUI areas identified by the GSC CWPP. The project is consistent with the goals and priorities of the GSC CWPP.

Brief History of Project Area

1994 – *Canal 16 Prescribed Burn Project.* The Canal 16 Project was implemented from 1994 until present and utilized prescribed burning to treat hazardous fuel accumulations. Project design was based on recognizing the need to reintroduce prescribed fire back into an ecosystem that has historically had a fire frequency of 4 to 20 years. To date approximately 6,633 acres have been treated in the WUI.

1993/1995 – *Underline Vegetation Management Project.* The Underline Project proposed to improve forest health and vigor while reducing fire hazard adjacent to developed areas. Following a decision the project was appealed and subsequently upheld; however, due in part to the timing of completion of the Northwest Forest Plan and East Side Screens process, the project was not implemented. In 1995 a decision was made to allow prescribed burning to treat hazardous fuels. To date approximately 6,927 acres have been treated in the WUI.

2000 – *The National Fire Plan (Public Law 106-291).* The plan is an umbrella under which subsequent policy and laws were enacted with the intent of actively responding to severe wildland fires and their impacts to communities while ensuring sufficient firefighting capacity for the future. An initial list of high risk communities was published in the Federal Register (Vol. 66, No.3, Thursday, January 4, 2001 and Vol.66, Mp.160/Friday, August 17, 2001). Sisters, Oregon were identified in both documents.

2002 – *The Healthy Forest Initiative (HFI).* The goal of HFI is to recognize that enhanced measures are needed to restore healthy forest conditions and is intended to expedite implementation of treatment of hazardous fuels, particularly in high risk areas.

2005 – *Development of a Community Wildfire Protection Plan (CWPP)*: In 2005 the community of Sisters developed the GSC CWPP. The SAFR project is consistent with the intent of the GSC CWPP which includes:

- Protect human life and property from wildland fires
- Restore fire adapted ecosystems
- Increase public understanding of living in a fire adapted ecosystem
- Instill a sense of personal responsibility for taking preventative actions regarding wildland fire
- Increase community ability to prepare for and respond to wildland fires
- Improve landscape fire resilience while protecting social and ecological values

Existing and Desired Future Condition

At the turn of the 20th century approximately 44% of the land within the SAFR Project area belonged to private logging companies. Most of the timber from this area was harvested between 1920 and 1930. The lands were subsequently purchased by the federal government shortly after for inclusion into the Deschutes National Forest. Most of the forest within the remainder of the planning area has either been selectively logged and reforested since World War II.

The existing condition consists predominantly of young ponderosa pine dominated forests. Fuel loading in these areas is characterized by a Fire Regime Group I, Condition Classes 2 and 3. Fire Regime Group I lands evolved with frequent, low intensity ground fires with average historic fire return intervals from 0 to 35 years. Condition Class 2 and 3 characterizes lands that have had their fire regimes moderately to significantly altered from their historical range of variability. The risk of losing key ecosystem components is moderate to high. When fire frequencies depart from historical frequencies by multiple fire return intervals it can result in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns.

Historically, fires maintained and thinned ponderosa pine forest within the project area by killing small understory trees and shrubs. The result was a landscape largely dominated by single storied, open, park like stands of large diameter, fire resistant ponderosa pine trees. This also resulted in a landscape with a low fire hazard. Current forest conditions have resulted from past forest management along with fire exclusion during the preceding 80 years. In the absence of fire, high stand densities and well developed understory shrub layers have resulted in fuel loads that are outside the historic natural range of variability. This has placed the forest and adjacent WUI communities at high risk of forest stand replacement wildfires.

The project area also has a high fire risk due to various human uses, including seasonal and full-time residents, businesses, and various recreational uses. Reducing fuels within the WUI in combination with defensible space around houses can reduce the rate of spread and increase the ability to control wildfires. In addition, the safety of the public and fire fighters could be increased by treating identified travel routes that may be used to evacuate the public when a fire occurs. These same travel routes may also be used by fire fighters as access routes and in some case as strategic locations to perform fire suppression activities.

All lands within the project area are within the WUI as designated by the Greater Sisters Country Community Wildfire Protection Plan (GSC CWPP). To meet current direction, reduce the danger of wildfire to at-risk communities, and to improve forest health, the Sisters Ranger District initiated this project to move the current conditions on federal lands in the WUI closer to the desired future condition of a more open, large tree dominated ponderosa pine forest that is less susceptible to large scale, stand replacing fire events.

Purpose and Need for Action

The ***purpose*** of the project is to protect structures, property, and human life and safety, improve forest health, and to restore the role of fire within the Greater Sisters Area Wildland-Urban Interface.

There is a ***need*** to reduce the threat of high intensity wildfire by reducing high levels of unwanted hazardous forest fuels. Existing fuel loadings are outside the historic range of natural variability. This could be accomplished by moving the project area to the desired future condition of a more open, large tree dominated ponderosa pine forest that is less susceptible to large scale, stand replacing fires.

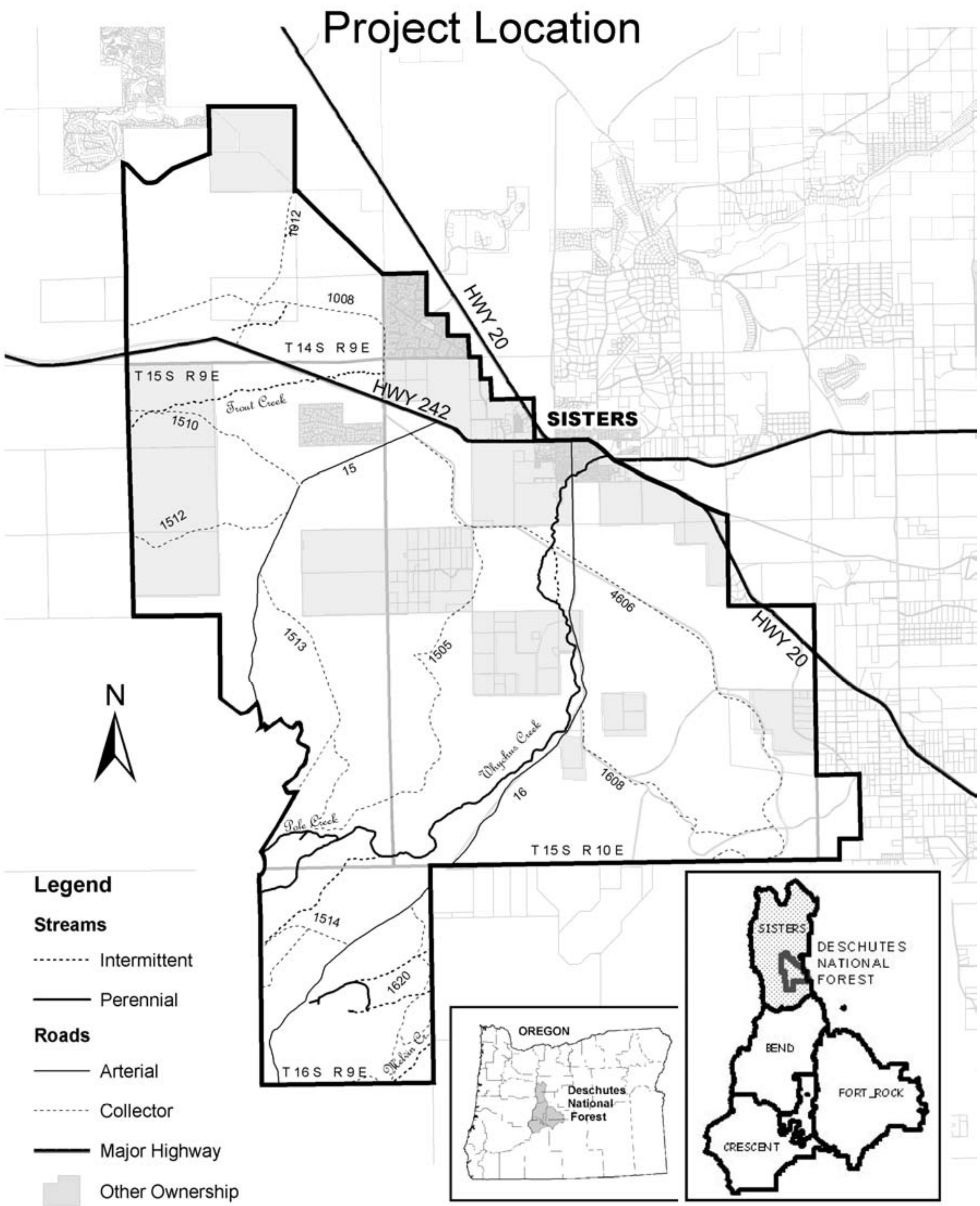
This action responds to the goals and objectives outlined in the direction and guidance in the Deschutes National Forest Land and Resource Management Plan and the Whychus Watershed Analysis.

The Purpose and Need for Action is based on public participation, collaborative efforts associated with the development of the GSC CWPP, and is consistent with the objectives of the GSC CWPP. Project design integrates silvicultural practices that reduce hazardous fuels and improve forest health.

Project objectives include:

- Improve forest health, sustainability, and resiliency and promote the development of old growth forest stands and large trees by reducing the uncharacteristically high levels of competing live vegetation and reintroducing the more natural role of low intensity ground fire
- Reduce the risk of high intensity wildfires to nearby communities, private properties, and special natural places by reducing uncharacteristically high levels of hazardous fuels in ground, ladder and canopy vegetation.
- Reduce the risk of high intensity fire to public and fire fighter safety.

Figure 1: Project Location



Proposed Action

What: The Forest Service proposes to address the Purpose and Need for Action and implement recommendations provided in the GSC CWPP by reducing fuel loading and the risk of uncharacteristic wildfire to the town of Sisters and other nearby communities within the Sisters Area Fuels Reduction (SAFR) Planning Area. The proposed action includes two Forest Plan amendments.

The Proposed Action would address the purpose and need by addressing the project objectives identified in the "Purpose and Need for Action." Actions could include thinning trees, mechanically treating brush, and prescribed burning.

Why: Existing forest conditions pose high risks of uncharacteristic wildfire due to high stand densities, a disproportion of trees in small size classes, high shrub densities, and other components that contribute to extreme fire intensity and spread. These conditions increase the risk of loss of key ecosystem components. Approximately 80 percent of the project area is at a high risk of extreme fire behavior potential putting people, property, and natural resources such as wildlife habitat and water quality at risk. High forest stand densities and stocking levels also compromise the health of these stands by increasing the risk of insect and disease outbreaks.

When: Project implementation would begin in 2008. The amount of acres treated per year would be dependent on available funding. Many treatment areas would receive more than one type of treatment. For example, thinning followed by prescribed burning and/or mechanical treatment of brush.

Where: Treatments would occur on 17,573 acres across the project area (Figure 2-1, Chapter 2), including focused fuel reduction treatments adjacent to defensible space corridors and along evacuation routes and access roads.

Table 2: Summary of treatment types and treatment acres within the SAFR Project area.

Treatment	Rx Burn	Masticate & Rx Burn	Thin	Thin & Rx Burn	Thin & Masticate	Thin & Masticate & Rx Burn	Plantation Treatments	Total
Treatment Acres	11	568	1,436	79	830	11,267	3,382	17,573

How: The project could be implemented through a combination of traditional service contracts, timber sale contracts, stewardship contracts, force account crews, and partnerships.

Management Direction

Management direction for the SAFR Project has been established via the following environmental documents to which the analyses in this EA are tiered:

Deschutes National Forest Land and Resource Management Plan

The project area encompasses lands within the Deschutes National Forest Land and Resource Management Plan (LRMP) as amended by the Inland Native Fish Strategy (INFISH) and the Eastside Plan Amendment No.2 (Eastside Screens).

The LRMP provides guidance for management activities. The LRMP establishes goals, objectives, and standards and guidelines for each specific management area on the Forest, as well as Forest-wide standards and guidelines. Management Areas (MA) and associated standards and guidelines are described in Chapter 4 of the LRMP. Management Areas within the project area are described in Table 3.

A brief summary of the direction for management areas where treatment is proposed follows:

Deer Winter Range – MA-7 is managed to provide optimum habitat conditions on deer winter and transition range while providing wood products, visual quality, and recreation opportunities.

General Forest – MA-8 emphasizes timber production while providing visual quality, wildlife habitat, and recreational opportunities for public use and enjoyment.

Scenic Views – The goal of MA-9 is to provide high quality scenery representative of the natural character of Central Oregon. Landscapes seen from selected travel routes and use areas will be managed to maintain or enhance their appearance and forest health.

Front Country – The goal of MA-18 is to provide and maintain a natural appearing forested landscape on slopes northeast of the Three Sisters and Tam MacArthur Rim, while providing for sustainable levels of timber production.

Old Growth Areas – MA-15 is managed to provide naturally evolved old growth forest ecosystems that provide habitat, representations of landscape ecology, as well as other needs of the public.

Wild and Scenic River Corridor – The goal of MA-17 is to manage waterways that are components of the National Wild and Scenic Rivers System while protecting the outstandingly remarkable values identified for each river segment identified in the Draft Whychues Creek Wild and Scenic River Resource Assessment.

Eagle Habitat – MA-3 emphasizes old growth stands with large trees that provide nesting habitat and foraging areas for bald eagle.

Riparian Habitat Conservation Areas (RHCA) – Portions of the watersheds where riparian dependent resources receive primary emphasis and management activities are subject to specific standards and guidelines. RHCAs include traditional riparian corridors, wetlands, intermittent headwater streams, and other areas where proper ecological functioning is crucial to maintenance of the stream's water, sediment, woody debris, and nutrient delivery systems.

Table 3: Land Resource Management Plan (LRMP) Management Areas within the planning area.

Management Area (Number)	Total Area in Planning Area (acres)	Total Treatment Area under Alternatives 2 and 3 (acres)	Percent of Area
Deer Habitat (MA-7)	7485	4654	62
General Forest (MA-8)	6043	4591	76
Scenic Views (MA-9)	6318	5288	84
Front Country (MA-18)	2199	1644	75
Old Growth Areas (MA-15)	534	510	96
EagleHabitat (MA-3)	666	519	78
Wild and Scenic River Corridor (MA-17)	1222	367	30
Total	24467	17573	75

Regional Forester Amendment #2–Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales (Eastside Screens)

In August 1993, the Regional Forester issued a letter providing direction to National Forests on the eastside of the Cascade Mountains on retaining old-growth attributes at the local scale and moving toward the historic range of variability (the range of forest conditions likely to have occurred before European settlement*)* across the landscape. This direction was called "Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales, Regional Forester's Forest plan Amendment", and became known as the "Eastside Screens". The screens limit certain types of activities in watersheds where old growth forests are now less common than the historic range of variability.

A decision notice issued in May 1994 amended all eastside Forest plans to include this direction. The May 1994 decision notice was revised in 1995 and was called "Revised: Interim Management Direction Establishing Riparian, Ecosystem and Wildlife Standards for Timber Sales, Regional Forester's Forest Plan Amendment #2", and has continued to be known as the “Eastside Screens”. Since the 1995 revision, there have been several letters of clarification from the Regional Office regarding the eastside screens.

The Eastside Screens are intended to maintain management options for the future. More detailed discussion on project consistency with the screens can be found in the Forest Vegetation and Wildlife sections of this document.

LRMP Management Indicator Species (MIS)

The LRMP identified various species of wildlife as Management Indicator Species (MIS). These species were selected because their welfare can be used as an indicator for other species dependent upon similar habitat conditions. Indicator species are used to assess the impacts of management actions on wildlife habitats. These species are not assigned Management Areas; rather, Standards and Guidelines are applicable Forest-wide. The species selected for the Deschutes National Forest are listed in the LRMP, Chapter 3, under the Wildlife section, Management Indicator Species (MIS). MIS species are addressed in the Wildlife section of the EA.

Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program

This environmental assessment is tired to a broader scale analysis, the Pacific Northwest Region Final Environmental Impact Statement for the Invasive Plant Program (referred to as R6 2005 EIS). The associated Record of Decision amended the Deschutes National Forest Plan by adding management direction relative to prevention and treatment of invasive plants. This project is intended to comply with the new management direction (USDA, 2005).

Inventoried Roadless Areas

There are no inventoried Roadless areas within the project area. There are no proposed closures of existing roads and no planned construction of new permanent roads associated with this project. Based on the action alternatives and in consultation with the Forest Road Manager, it was determined that a Road Analysis was not required for this project.

The entire SAFR project area is east of the Northwest Forest Plan boundary (owl line).

Analysis Considered and Incorporated By Reference

Whychus Watershed Analysis (1998)

The Whychus watershed is one of seven Key Watersheds identified on the Deschutes National Forest. A Watershed Analysis is required in Key Watersheds in order to develop a landscape level assessment to guide project planning. Goals and treatment objectives identified for the SAFR Planning project are consistent with recommendations made in the Whychus Watershed Analysis.

Greater Sisters Country Community Wildfire Protection Plan (2006)

The purpose of the GSC CWPP is to provide a framework to protect human life and reduce property loss due to uncharacteristic wildland fire in the communities and surrounding areas of the Sisters, Camp Sherman, Black Butte Ranch, and Cloverdale Rural Fire Protection Districts. The SAFR project is consistent with the objectives identified in the GSC CWPP.

Proposed Forest Plan Amendment

During the evaluation of the Proposed Action and Alternative 3 against current management direction, it was found that some of treatments were not consistent with the Deschutes National Forest Land and Resource Management Plan (Forest Plan) as amended. A Forest Plan amendment would be needed to implement the Action Alternatives. The amendment is described below.

Proposed Amendment #1

Treatments Occurring Within LRMP Deer Habitat (MA-7)

To be able to effectively treat areas of hazardous fuels, including defensible space around private property, it is necessary to amend the standards and guidelines for areas allocated to Deer Habitat (MA-7) in the Deschutes National Forest LRMP. The proposed amendment would apply to Alternative 2 (Proposed Action) and Alternative 3. Standards and Guidelines, Deer Habitat, M7-13, M7-15, and M7-26 would be amended. The rational for a proposed amendment(s) is given below.

Summary of Applicable LRMP Deer Habitat Management Direction (MA7)

Goal – Manage vegetation to provide optimum habitat conditions on deer winter and transition ranges while providing some domestic livestock forage, wood products, visual quality and recreation opportunities (LRMP 4-113).

General Theme and Objectives –

- Vegetation will be managed to provide optimum habitat considering the inherent productivity of the land.
- Herbaceous vegetation will be managed to provide a vigorous forage base with a variety of forage species available.
- Foraging areas will be created where forage is lacking, maintained when in proper balance, or reduced when overabundant.
- Ideally, cover and forage areas should be in close proximity for optimum use by big game, with cover making up 40 percent of the land area. Approximately three-quarters of cover areas should be thermal cover with the remainder being hiding areas. A crown cover greater than 40 percent with trees 30 feet high is recommended for thermal cover (M&-5).

Standards and Guidelines Applicable to Proposed Amendment–
Timber

- Generally, programmed timber harvest is appropriate when required to regenerate new cover stands, maintain tree vigor for resistance to stand-threatening insect damage, or encourage desirable forage in deficient areas (M7-3).

- Stocking levels will be based on site-specific conditions. A crown cover greater than 40 percent with trees 30 feet high is recommended for thermal cover. Canopy-cover should be managed at the highest percentage that will maintain healthy stand conditions with a low risk of catastrophic damage due to insects or disease. As a minimum canopy cover must be 40 percent, but a greater canopy cover percentage is preferred (M7-5).
- Silvicultural prescriptions will be based on the Timber Management standards/guidelines and Deer Habitat objectives (M7-7).

Wildlife

- Habitat management will be designed to provide a mosaic of forested conditions which incorporates the concepts of escape and hiding cover, thermal cover, travel corridors, visual screens, and harassment potential (M7-10).
- The analysis area used for habitat management planning should be large enough so that meaningful habitat conditions can be determined. Normally this would be greater than 3,000 acres in size and may include other ownerships (M7-11).
- Where forage improvement activities involve crushing or prescribed burning, the size of the treatment normally will be 300 to 500 acres. If more than one area is treated areas should be 600 to 1200 feet apart (M7-15).
- Forage conditions will be maintained or improved with emphasis on increasing the variety of plants available for forage and a mixture of age classes of shrubs.

Prescribed burning

The prescribed use of fire will be necessary to maintain diversity within the plant communities. Burning prescriptions will provide for the reestablishment of bitterbrush within 20 years. Approximately 2.0-2.5 percent of this Management Area could be burned annually (M7-26).

Cover

Current LRMP guidelines state cover should make up 40 percent of the land area. Approximately three-quarters of cover areas should be thermal cover with the remainder being hiding areas. A crown cover greater than 40 percent with trees 30 feet high is recommended for thermal cover.

Timing

- The Forest Plan has been in effect since 1990 and revision is scheduled to begin in the near future. Amendment 2 is occurring during the second decade of the plan period and is less likely to be significant.
- The commercial harvest treatments in the Proposed Action and Alternative 3 are expected to be implemented within the next 10 years.

Location and Size

- Approximatly 7492 acres of Defensible Space is identified for treatment.

- Approximately 3964 acres of Thermal Cover was identified within MA-7.

Goals, Objectives, and Outputs
The **proposed amendment** would allow Sisters Ranger District to exclude defensible space (600 feet around private property) acres from the percent of the land area that is required to meet the cover definition within the SAFR project area. Defensible space areas are key areas adjacent to private lands where fuels treatments need to occur in order to reduce fire risk to private land owners. To break up the continuity of fuels within MA7, defensible space (1,323 acres) needed to be subtracted from the calculations due to the large amount of private in holdings within Deer Habitat in the SAFR project area. Outside of identified defensible space the SAFR project should still meet the 40% cover standard.

Site productivity within MA7 of the SAFR project shows very few areas that can support a crown cover greater than 40%. Therefore different qualities of thermal cover will be recognized and managed for. The SAFR project will meet the 40% standard by maintaining the highest quality cover, either thermal or hiding cover that is available. These different qualities are outlined in Table 4.

Table 4: Different qualities of thermal cover that will be recognized and managed for within MA7 in the SAFR Project Area.

Cover Type	**Quality (DBH and Canopy Closure) from highest to lowest**
Thermal	9 inch DBH at least 40% CC
	9 inch DBH 30-39% CC
	5 inch DBH at least 40% CC
	5 inch DBH 30-39% CC
	9 inch DBH 25-29% CC
	5 inch DBH 25-29% CC
	9 inch DBH 20-24% CC
	5 inch DBH 20-24% CC

Forage
The LRMP provides management direction regarding shrubs. The goal of the LRMP in Management Area 7, Deer Habitat, is to manage vegetation to provide optimum habitat conditions on deer winter and transition ranges. The general theme and objective is to manage vegetation to provide optimum habitat considering the inherent productivity of the land. Herbaceous vegetation would be managed to provide a vigorous forage base with a variety of forage species available. Forage conditions would be maintained or improved with an emphasis on increasing the variety of plants available for forage and a mixture of age classes of shrubs. Variety in areas that are dominated by poor vigor shrubs would be created (LRMP M7-14).

Recommendations for the management of shrubs are also provided by the Integrated Natural Fuels Management Strategy (IFMS 1998). The IFMS identified interim management goals of managing shrubs in shrub dominated landscapes (Deer Habitat) to have 33% of shrubs in an early seral condition, 33% in a mid seral condition, and 33% in a late seral condition.

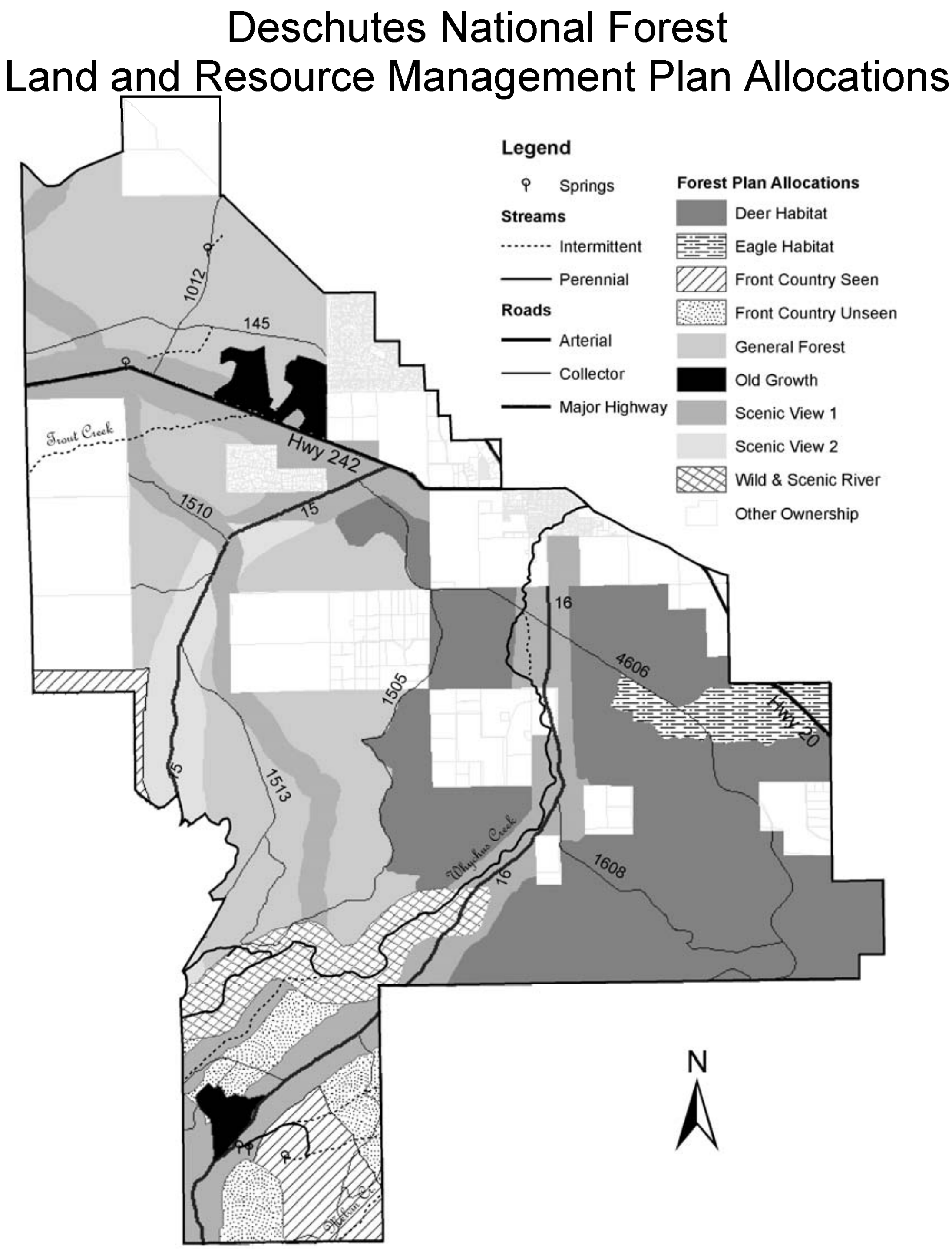
The **proposed amendment** would remove the standard limiting the use of prescribed fire to 2 to 2.5 percent of this allocation in a year. The new standard would require the Sisters Ranger District to manage MA-7 within the SAFR project at 33% of shrubs in an early seral condition, 33% in a mid seral condition, and 33% in a late seral condition in areas not identified as defensible space. The defensible space will remain in an early seral stage to maintain lower fire risk adjacent to private property, and not be included in the 33% calculations. Outside of identified defensible space the SAFR project should still meet the 33% of shrubs in the early, mid, and late seral stage conditions.

The **proposed amendment** would also allow the Sisters Ranger District to exclude defensible space (1,323 acres) that are treated by mastication and burning to be removed from the guideline that states treated blocks (mastication and burning only) should be limited to approximately 300-500 acres per year with approximately 600 to 1,200 feet between treatment blocks. This amendment would allow more defensible space to be treated (mastication and burning) to reduce the fuel loading adjacent to private in holdings within Deer Habitat in the SAFR project area. Outside of identified defensible space the SAFR project will continue to following the guideline: Where forage improvement activities involve crushing or prescribed burning, the size of the treatment normally will be 300 to 500 acres. If more than one area is treated areas should be 600 to 1200 feet apart (M7-15).

Management Prescription

- This amendment applies only to this project area and alternative and would not apply to future decisions within the project area.
- This amendment does not alter the desired future condition of the land or resources or the anticipated goods and services to be produced.
- Options for future management would be maintained.

Figure 2: Deschutes National Forest Land and Resource Management Plan Allocations.



Applicable Laws and Executive Orders

The following laws and executive orders, with implementing regulations as appropriate, apply to the analysis and implementation of the SAFR Project.

- American Antiquities Act of 1906
- Migratory Bird Act of 1918
- Multiple-Use Sustained Yield Act of 1960
- National Historic Preservation Act of 1966 (as amended)
- National Environmental Policy Act (NEPA) of 1969 (as amended)
- Endangered Species Act (ESA) of 1973 (as amended)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended)
- National Forest Management Act (NFMA) of 1976 (as amended)
- Clean Water Act (CWA) of 1977 and 1982 (as amended)
- Clean Air Act of 1990
- Executive Order 13186 (migratory birds)
- Executive Order 13112 (invasive plants)
- Bald and Golden Eagle Protection Act of 1940 (as amended)
- Federal Noxious Weed Control Act of 1974 (as amended)
- American Indian Religious Protection Act of 1980
- Archaeological Resource Protection Act of 1980
- Decision Notice for the Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales, (Eastside Screens, 1995).
- Executive Order 11593 (cultural resources)
- Executive Order 11988 (flood plains)
- Executive Order 11990 (wetlands)
- Executive Order 12898 (environmental justice)

Decision Framework

Based on the analysis documented in this EA, the Responsible Official would determine which alternative would be implemented and if so, where and under what conditions.

The Responsible Official will do one or more of the following:

- Select either Alternative 2 (Proposed Action) or Alternative 3, or Alternative 1 (No Action)
- Modify an action alternative
- Amend the Forest Plan
- Identify what mitigation measures will apply.

Decision Factors

The Responsible Official will determine if the selected alternative is consistent with the management direction for the area. The decision regarding which combination of actions to implement will be determined by comparing how each factor of the project purpose and need is met by the Proposed Action or selected alternative and the manner in which the selected alternative responds to the Key Issues and analysis issues raised during public scoping and environmental analysis. Other decision criteria could include financial and economic considerations.

Collaboration and Public Involvement

Collaboration with the public and other agencies was used to invite and encourage participation in project design. Information received during collaboration was used to determine the extent of the analysis needed to reach an informed decision. In order to fully involve the public collaboration was begun early in planning process. Public issues were used to develop a second action alternative.

The SAFR project was announced in the Deschutes and Ochoco National Forest Schedule of Proposed Action (SOPA) in February 2005. Scoping letters were sent to the public and other agencies, including the Confederated Tribes of Warm Springs, on November 4, 2005 for a 30-day comment period. A total of 32 replies to the scoping were received, of those 12 were formal letters. Public meetings and two open houses were also held on November 16 and 19 in 2005. Several newspaper articles were published describing the project.

Key to the development of the SAFR project was the collaboration with the GSC CWPP steering committee. The core ID team periodically provided an overview of the project to the committee to assure the project was in line with the goals and objectives of the steering committee. The Sisters City Council was also periodically updated on the project and provided input to the project design. Both the GSC CWPP steering committee and the Sisters City Council submitted letters of support for the SAFR project. A detailed listing of the collaboration process in chronological order is provided in Table 5.

Table 5: Project collaboration

Contact	Date	Number of Individual/Groups Contacted
Greater Sisters Country (GSC) Community Wildfire Protection Plan (CWPP) Committee – Introduced SAFR project and the proposed project area	January 11, 2005	13 members on GSC CWPP committee
B&B Working Group - Briefed group on SAFR planning project	February 7, 2005	15 members of working group
Sisters City Council Meeting – Presented SAFR planning project at meeting	February 17, 2005	8 members of the Sisters City Council
Provincial Advisory Committee (PAC) Meeting – Briefed group on SAFR planning project	February 17, 2005	11 members of the PAC
Sisters City Council	March 17, 2005	Received letter of support for SAFR project
Greater Sisters Country (GSC) Community Wildfire Protection Plan (CWPP) Committee	March 18, 2005	Received letter of support for SAFR project
Confederated Tribes of Warm Springs – Briefed group on SAFR project and provided update of project	April 11, 2005	Approximately 20 individuals attended
Mayor of Sisters	September 30, 2005	Received letter of support for SAFR project
Letter – Inviting comments on the proposed SAFR planning project	November 4, 2005	500 letters sent
Newspaper Article – The Nugget – Article seeking comments on SAFR planning	November 9, 2005	Newspaper circulation in Sisters area (with website)
Newspaper Article – The Source – Article about SAFR planning process	November 10, 2005	Newspaper circulation in Sisters/Bend/Redmond
Newspaper Article – The Nugget – Article about project and announcing upcoming public meeting	November 16, 2005	Newspaper circulation in Sisters area (with website)
Newspaper Article – The Bend Bulletin – Article about project and announcing upcoming public meeting	November 16, 2005	Newspaper circulation in Sisters/Bend/Redmond

Contact	Date	Number of Individual/Groups Contacted
SAFR Planning Project Public Meeting/Open House – Sisters Ranger District	November 16, 2005	8 people attended
SAFR Planning Project Public Meeting/Open House – Sisters Ranger District	November 19, 2005	9 people attended
Newspaper Article – The Nugget – Article covering open houses on project	November 23, 2005	Newspaper circulation in Sisters area (with website)
Presented Proposed Action at a Public Meeting of the Crossroads Homeowners Association	February 25, 2006	Approximately 40 individuals attended

Consultation

The action alternatives "May affect, but not likely to Adversely Affect" Northern Bald Eagle. The SAFR Project is consistent with Project Design Criteria as outlined in the 2006-2009 Programmatic Biological Assessment. Treatments within bald eagle habitat are expected to be beneficial in the long term.

In accordance with 36 CFR 800 regulations, the State Historic Preservation Office (SHPO) concurred with the Forest's finding of "no historic properties affected/no effect" by virtue of site avoidance. If the project scope of work changes, consultation with the Confederated Tribes of Warm Springs and the SHPO will be reinitiated. Appropriate measures used to protect sites that are listed or eligible for the National Register of Historic Places would be taken. If any additional cultural resources are discovered during the project, work would be halted in the area of discovery and the District Archaeologist would be notified to evaluate the discovery in consultation with local tribes and the SHPO.

Issues

The following issues were identified through collaboration with other agencies, the public, as well as by the Forest Service Interdisciplinary Team (IDT). Issues are of three types (1) **Key Issues** – which are used to design alternatives to the Proposed Action; (2) **Analysis Issues** – which are used to address environmental effects and to compare alternatives. (3) **Issues Not Addressed in Detail** – issues or concerns that are addressed through alternative design and/or mitigation or are beyond the scope of the project.

Key Issues: During the scoping and the collaborative process one Key Issue was identified. This key issue was used to design a second action alternative (Alternative 3).

Key Issue #1 Size of trees removed

What size trees could be removed and still meet the Purpose and Need for Action?

Important structural elements in the SAFR Planning area are large diameter ponderosa pine trees. Highly valued, both socially and ecologically, there is concern about the potential loss of large trees through project implementation or to fire, insects, or disease. The action alternatives are intended to reduce the risk of loss of large pines due to uncharacteristic wildfire, improve the ability of existing large trees to survive, and create conditions that are more favorable for the development of future large trees. However, there is disagreement about the maximum size of trees that should be removed to meet project objectives.

The Proposed Action implements Eastside Screen Management direction which identifies an upper limit of 21 inches dbh for trees that could be removed during project implementation. During scoping and the collaborative process a few members of the public suggested that only smaller diameter trees, ranging up to 10 to 14 inches dbh, should be removed and still meet the intent of the Purpose and Need for Action. This issue was used to design a second action alternative (Alternative 3).

Measures used to evaluate issues related to size of trees removed and impacts to forest health:

- Predicted effects on the ability to meet goals of wildfire risk reduction and forest health improvement by maximizing the retention of large trees, as appropriate for the forest type, to the extent that the trees promote fire-resilient stands.

Analysis Issues

Analysis issues were identified by the IDT, as well as by the public and other agencies, through the scoping and collaboration process. These issues, together with applicable laws, regulations and policies, were used to design the Proposed Action and a second action alternative. Issues are specific to the planning area. Measures for each issue were developed to analyze how each of the action alternatives addresses the Purpose and Need for Action.

Improvements to Forest Health Sustainability and Resiliency

Will the planned treatments of thinning trees from below and treatments to reduce insect and disease be effective in maintaining and restoring forest health and diversity?

The action alternatives propose to thin 16,994 acres (including 3,382 acres of plantations) of ponderosa pine stands. Treatments to reduce the spread of dwarf mistletoe would also occur as a part of the action alternatives.

Measures include:

- Effects of the alternatives on continued risk of losses to insects and diseases, especially the risk of continued loss of old-growth and mature pines to bark beetles.
    - Acres of thinning to restore forest health and reduce insect and disease related mortality.
- Effects of the alternatives on stand structure and species composition in relation to historic conditions.
    - Acres of prescribed burning and or mechanical treatment of brush and small trees.
    - Acres of treatment that maintain or accelerate the development of late or old structural stage ponderosa pine.
- Effects of the alternatives on stand structure/species composition and its relationship to Late and Old Structural (LOS) Habitat
    - Acres of treatments in Late and Old Structural (LOS) Habitat

Fire Hazard Reduction

Are the vegetation treatments which include thinning trees from below, mechanical treatment of brush and small trees and the use of prescribed underburning effective at reducing fire hazard and thus the risk of uncharacteristic wildfire?

Prescribed burning, in combination with thinning and mowing, could help reduce fuel levels across large portions of the landscape. The action alternatives (Alternatives 2 and 3) treat 17,573 acres of forest vegetation by thinning from below, under burning, mechanical treatment of brush, and prescribed burning. The action alternatives prescribe vegetation treatments intended to promote a defensible space adjacent to private lands as well as road side evacuation routes and access treatments.

Measures include:

- Reduce the risk of high intensity fire to the public and firefighters for reasons of safety. The measure is the amount of area (acres) with conditions that would support active crown fire or flame lengths greater than 4 feet.
- Improve forest health, sustainability, and resiliency and promote development of old growth forest stands and large trees by reducing the uncharacteristically high levels of competing live vegetation and reintroducing the more natural role of low intensity ground fire. The measure is the percent departure from reference condition or improving condition class.
- Reduce the risk of high intensity wildfires to nearby communities, private properties, and special natural places. The measure is burn probability combined with fire intensity.

- The negative effect to air quality which would likely result from a wildfire. The measure is the amount of smoke and the tons of particulate matter.

Wildlife

Vegetation treatments have the potential to affect wildlife habitat. Vegetation treatments also have the potential to reduce elements of cover used by different wildlife species and potentially reduce the amounts of wildlife forage availability during critical times of the year.

Action alternatives were designed to maintain at least a minimum level of hiding and thermal cover for wildlife needs as well as provide conductivity corridors for movement of wildlife. In addition, alternatives were designed to provide a mixture of shrub size classes that reduce fire hazard and, at the same time, maintain forage species for wildlife.

Measures include:
- Habitat
    - Total number of acres of fuel treatment within the Cloverdale Bald Eagle Management Area (BEMA).
    - Total number of acres of fuel treatment within golden eagle habitat.
    - The amount of potential goshawk nesting and foraging habitat impacted by fuel treatments.
    - Acres of young stands treated within identified post-fledgling areas.
    - Acres of fuel treatments within both ponderosa pine and mixed conifer habitats that could effect cavity nesters
    - Acres of mature forest treated and effects of openings on flammulated owl.
    - Effects of conifer reduction in aspen stands on red-naped sapsucker habitat.
- Cover and Forage
    - Acres of hiding and thermal cover retained for mule deer and elk habitat.
    - Acres of brush forage retained for mule deer.
    - Acres of mechanical fuel treatment and underburning and the effect on grass and forb production in elk winter range.

Soil Quality

The Deschutes NF LRMP and the Region 6 Soil Quality Standards provide direction for minimizing detrimental impacts to the soil resource. The use of ground based equipment can potentially increase the amount and distribution of detrimental soil conditions within activity areas proposed for mechanical treatments. The removal of trees from activity areas and or prescribed burning can potentially cause adverse changes in soil organic matter levels which also may be considered determental.

Measures include:

- Changes in extent of detrimental soil conditions following proposed harvest and mitigation treatments within the individual activity areas proposed for mechanical treatments.
- Amount of coarse woody debris (CWD) and surface organic matter that could likely be retained to protect mineral soil from erosion and provide short and long term nutrient supplies for maintaining soil productivity on treated sites.
- The probable success in project design and implementation of management requirements and mitigation measures that would be applied to minimize adverse impacts to soil productivity.

Water Quality

Proposed activities have the potential to affect water quality.

Water quality parameters associated with beneficial uses for water bodies in the SAFR analysis area that have been altered from historic conditions include flow, temperature, dissolved oxygen, and sediment. The Whychus Watershed Analysis discusses how the State designated beneficial use of the Deschutes Basin applies to each water body in the Whychus analysis area (USDA Forest Service 1998).

Hydrology Measures

- Streamflow
    - Acres of compaction in RHCA
- Channel Conditions
    - Change in streamflow – acres compacted in RHCA
    - Change in sedimentation – acres of soil detrimentally impacted in RHCA
    - Change in riparian vegetation – trees killed along streambanks
    - Change in large wood recruitment – acres harvested in primary wood recruitment area (within a 100 ft of a stream)
- 303(d) Listed Streams/Temperature
    - Number of trees felled within primary shade zone
- Sedimentation
    - Acres of soil detrimentally impacted in RHCA

Fisheries

Proposed activities have the potential to affect fish populations and habitat.

Whychus Creek, upstream of the flow gage and all water diversions, has been identified as having Outstandingly Remarkable Values (ORVs) for fisheries based on the presence of native red band trout population (listed as Sensitive) that is genetically pure and has been isolated for 100 years. Whychus Creek is historic steelhead and bull trout habitat and the aquatic habitat and riparian habitat is currently in excellent condition.

Measures include:
- Water temperature.
- Stream embeddedness.
- Large wood.
- Pool frequency/ pool quality.
- Off channel habitat.
- Spawning gravel quality.
- Fish passage.
- Refugia.
- Streambank condition.
- Floodplain connectivity.
- Wild and Scenic River – Fisheries ORV.

Botany

Proposed activities have the potential to affect botanical resources, primarily Penstemon peckii, and the spread of invasive plant species.

The Deschutes National Forest Sensitive Plant List includes 31 taxa, either known or suspected to exist on the Forest. One of these taxa, *Penstemon peckii*, is known to occur within the project area. Invasive plant species are undesirable in forest ecosystems because they tend to displace native plants, including, potentially rare and protected species, degrade habitat for animal species, promote soil erosion, and lessen the value of recreational experiences. Design elements aim at preventing the introduction and spread of invasive plants are incorporated into the action alternatives.

Measures include:
- Acres of treatment within identified populations of *Penstemon peckii*
- Acres of treatment within identified populations of invasive plant species

Scenic Quality

Proposed activities have the potential to effect scenic quality.

Design elements intended to maintain a “sense of place” by reducing stand replacement wildfire risk and enhancing scenic quality are incorporated into the action alternatives.

Measures include:
- Acres of proposed treatments including thinning, mowing, and underburning.
- Filtered views into foreground.
- Residual stumps, slash and debris following treatments.

Cultural Resources

Proposed activities have the potential to affect Heritage resources.

The project area contains the following prehistoric and historic resources:
- 53 heritage sites total
    - 34 prehistoric sites
    - 17 historic sites
    - 2 with both prehistoric and historic components, and
    - No known traditional cultural properties or traditional use areas

Measures include:
- Heritage resources will be avoided and protected from proposed activities.

Recreation

Proposed activities have the potential to affect recreation resources.

The area contains numerous points of interest and dozens of miles of hiking, horse back riding and biking trails. Design elements incorporated into action alternatives could minimize effects to recreational resources.

Measures include:
- Acres of proposed treatments including thinning, mowing, and underburning.

Economics

Activities associated with the action alternatives may generate various economic benefits and costs, depending on design. The economic values provided under these alternatives may, however, be less than associated costs. Proposed treatments would improve the chances of protecting valuable resources during future fire events and would likely reduce the costs of management.

Measures include:
- Market values
- Non-market values
- Wildfire costs
- Employment

Issues Not Addressed in Detail

Road Building: No new permanent roads are planned. Five miles of temporary roads will be required. Effects related to temporary roads are discussed in Chapter 3.

Northwest Forest Plan Species and Habitats of Concern: The project area is located entirely outside of the range of the northern spotted owl. Land allocations contained in the Northwest Forest Plan are not found on the project area; therefore standards and guidelines do not apply.

CHAPTER 2 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes the alternatives and alternative development, including the Proposed Action. The Proposed Action (Alternative 2) was developed by the interdisciplinary team (IDT) in response to the Purpose and Need for Action. To develop the Proposed Action the IDT first reviewed the goals and objectives identified in the GSC CWPP. Next, direction from the Deschutes National Forest Land and Resource Management Plan (LRMP) was reviewed to assure proposed activities were in compliance with plan direction and management area standards and guidelines. Finally compliance with other legal requirements (i.e. Endangered Species Act, National Forest Management Act, etc.) was considered during the development of the Proposed Action. In addition, comments, issues, and concerns about project design were sought from the public, other agencies, and organizations throughout the collaborative and scoping process.

During the development of the Proposed Action and while working collaboratively with the public, several individuals suggested an additional action alternative that placed an upper diameter limit (below that which is required in the Eastside Screens) on the size of trees that would be removed. Based on this Key Issue, a second action alternative was developed (Alternative 3).

The action alternatives include an amendment to the Deschutes National Forest Land and Resource Management Plan which address: (1) Thinning and fuel reduction treatments within Deer Habitat (MA-7).

Alternatives

Alternative 1 (No Action)

Alternative 1 is the No Action alternative. This alternative assumes that no thinning, mechanical treatment of shrubs or small trees and prescribed underburning described in the proposed action would occur. This alternative provides baseline information on the affected resources, including expected trends. Under this alternative, the only management activities that would occur would be fire suppression and the already approved and on going Canal and Underline projects. The Canal and Underline projects would continue to utilize prescribed fire on approximately 200 to 500 acres each year. However, this amount of treatment is not expected to have a significant effect on reducing the risk to near by communities. Under the No Action alternative ecological processes in the project area would continue largely without intervention.

Under this alternative, very limited management actions would be taken to reduce the risk of wildfire at the landscape scale, or to actively develop areas of defensible space around residential areas, high public use areas, and roads identified as critical for evacuation and/or access in the event of a fire. The project area would continue to be at risk of high intensity stand replacement fires.

Alternative 2 (Proposed Action)

Alternative 2, the Proposed Action, was developed in collaboration with adjacent communities, organizations, and individuals. This alternative implements the recommendations contained in the GSC CWPP. The Proposed Action focuses on the goals of reducing the risk of wildfire, providing for the safety of people, protection of property, and improving forest health. At the same time, the Proposed Action is designed to balance the needs and preservation of other resources.

Alternative 2 would result in a mosaic of landscape treatments strategically placed and managed to improve forest health, reduce fire behavior potential, facilitate the suppression of wildfires, and protect valuable resources. This could help to reduce the risk of wildfire impacting nearby communities. In addition, treatment areas that provide for defensible space adjacent to private lands and along identified escape and access corridors could reduce risk.

The Proposed Action addresses reducing the risk of wildfire to communities by various fuel treatment strategies including (i) strategies for improving forest health (ii) fuel and large fire reduction strategies; and (iii) strategies for balancing needs and preservation of other resources. Each of these treatment strategies are described in detail in the following section.

Alternative 2 proposes to treat approximately 17,573 acres using one or more of the following treatments: (i) thinning from below, (ii) mechanical treatment of brush, (ii) prescribed underburning, (iii) hand thin and under burn, and (iv) plantation treatment (Table 2). Of the total acres treated, approximately 3,022 acres is LOS or 69% of the total LOS acres (4,350) in the project area. An estimated five miles of temporary roads would be established to access portions of the SAFR project units that are not readily accessible from existing forest roads. All temporary roads would be obliterated following vegetation management activities. It is expected that under the Proposed Action, and heavily depending on levels of funding along with the receipts generated by the thinning treatments, approximately 1,000 to 5,000 acres of treatments could be accomplished each year. Commercial forest products (post, poles, fire wood, saw logs, and biomass) could be a by-product of the fuels reduction and forest restoration treatments.

Alternative 3

Alternative 3 was developed based on an issue provided by several groups during the collaboration process. This alternative modifies the Proposed Action by placing an upper diameter limit of 12 inches on the size of trees that would be removed during treatment. Areas where treatments would occur would be the same as that identified in the Proposed Action (Alternative 2). An estimated five miles of temporary roads would be established to access portions of the EA units that are not readily accessible from existing forest roads. All temporary roads would be obliterated following vegetation management activities. The economic returns from the thinning in Alternative 3 will be less than Alternative 2 and therefore it can be expected that the acres treated each year using Stewardship Contract authorities will be less. It is expected that under the Alternative 3, and heavily depending on levels of funding and the receipts generated by the thinning treatments, approximately 1,000 to 5,000 acres of treatments could be accomplished each year. Commercial forest products (post, poles, fire wood, saw logs, and biomass) may be a by-product of the hazardous fuels and forest health treatments.

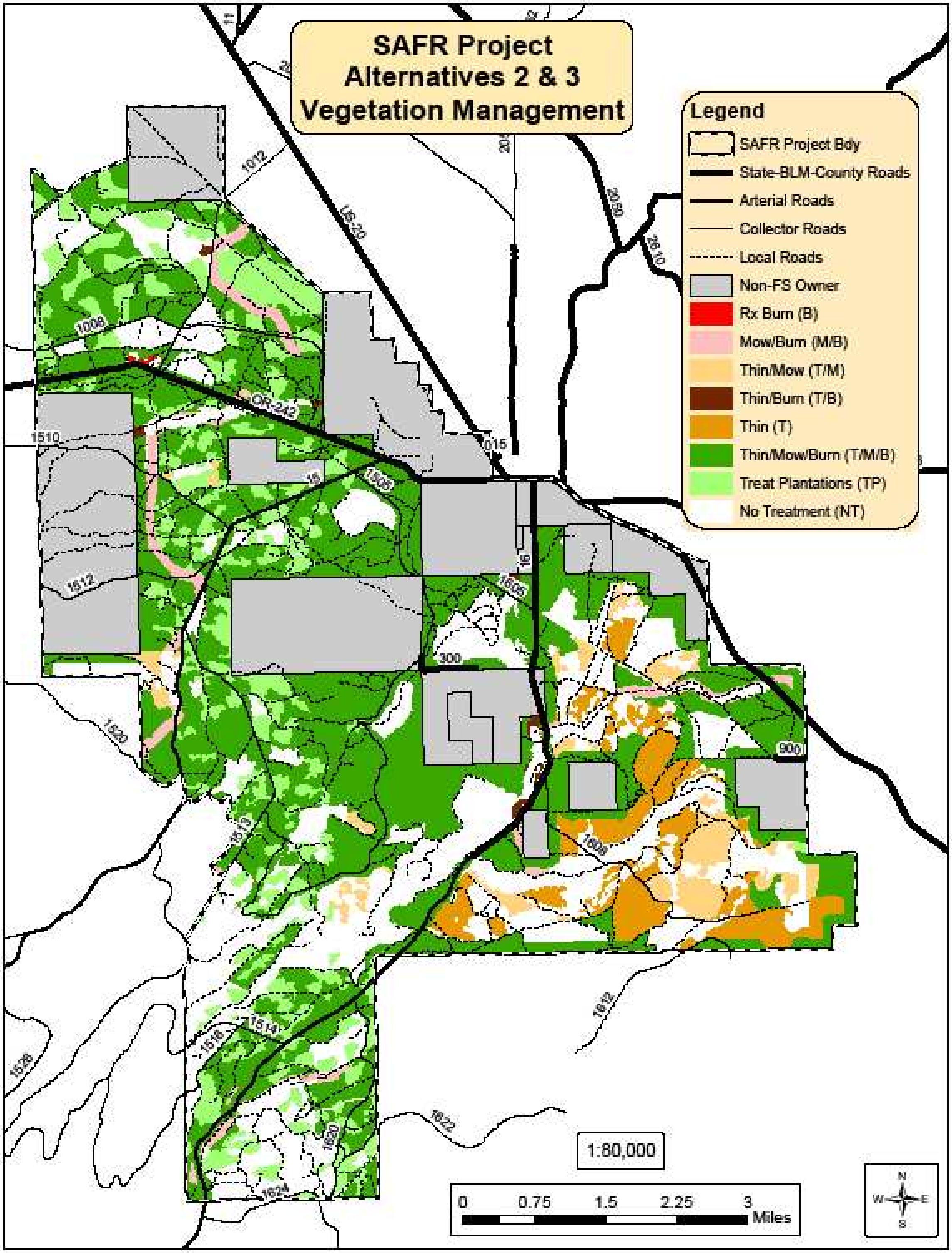
Table 6: Summary table of proposed treatment acres.

Treatment	Alternatives 2 and 3 (Acres Treated)
Burn	11
Masticate & Burn	568
Thin	1,436
Thin & Burn	79
Thin & Masticate	830
Thin & Masticate & Burn	11,267
Plantation Treatment	3,382
Total	**17,573**

Elements Common to the Proposed Action (Alternative 2) and Alternative 3

- Five miles of temporary road are necessary to access treatment units.
- The amount of treatment acres are the same (17,573 acres).
- The amount of LOS treated is the same (3,022 acres)
- 287 units would be treated. Average units size is 61 acres.
- The types of hazardous fuel treatments are the same.
- 28% of the project area would not be treated (6,894 acres).
- Forest Plan amendment to standards and guidelines Deer Habitat (MA-7): M7-13, M7-15, and M7-26.

Figure 3: Alternatives 2 and 3 Treatment Areas.



Description of Treatment Strategies

The City of Sisters, Oregon and nearby communities are located on the lower east flank of the Cascade Mountain Range in eastern Oregon. Ponderosa pine forests within the project area are dry, fire-adapted ecosystems. These forests historically burned every 8-12 years. However, 80 years of fire exclusion means that 7-10 fire cycles have been missed, allowing decades of vegetation to accumulate. When fire frequencies depart from historical frequencies, and multiple fire return intervals are missed, there can be dramatic changes to one or more of the following: fire size, intensity, severity, and landscape pattern. These conditions increase the risk of uncharacteristic wildfires burning within the vicinity of nearby communities. To address these issues four resource strategies were developed by the IDT to move the landscape to the desired future condition while balancing the needs and preservation of other resources. Treatment strategies are linked to the Key and Analysis Issues identified in Chapter One and are common to all action alternatives.

I. Strategies for Improving Forest Health

Forest health in over-dense stands is declining, resulting in an increased risk of losing potential late successional habitat to wildfire, insects, or disease. In addition, due to the extensive accumulation of fuels, there is a higher risk of losing well-established old-growth ponderosa pine, which are more resilient to low-intensity fires but can be lost in high-intensity fires. Larger diameter ponderosa pines are considered a highlight of the forests in the SAFR project area.

1. *Thinning from Below:* This treatment, also known as "low thinning", is "the removal of trees in the lower crown classes to favor those in the upper crown classes." (Helms, 1998). Thinning from below accomplishes several important management objectives including (i) reducing fire hazard and (ii) improving forest health and tree growth. In general, the smallest trees at any particular location will be removed and the largest, healthiest trees would be retained. (see "Guiding Principles for Thinning from Below" below.)

   Thinning from below reduces fire hazard, and in turn, the risk of large uncharacteristic wildfire, by removing small diameter trees that create ladder fuels, which are capable of carrying fire from the ground fuels (e.g., woody material, forbs, grasses and shrubs) into the tree canopy. Thinning also reduces crown density and continuity to reduce the potential spread of crown fires. The resulting more open stand structure allows ground fire to move through the remaining larger tree stand, removing the build up of ground fuels without moving into the tree canopy. The remaining trees experience low levels of damage. Thinning from below improves forest health and tree growth by decreasing competition, providing the remaining trees with increased moisture and nutrients.

Thinning from below also begins the process of moving the landscape back toward the historic range of variability, where smaller trees were removed with frequent low intensity wildfire and large established trees remained on the landscape. Historically, the majority of this project area was dominated by ponderosa pine; consequently, ponderosa pine will be the preferred leave species across most of the project area. However, the objective will not be to eliminate other tree species; other species will be left for a variety of ecological reasons. In the project area, ponderosa pine is the preferred species because it is the most resistant and resilient to wildfire, insects and disease.

The density of trees remaining after thinning would be variable between stands across the project area based on site capability. In general, the lowest densities would be on the lowest sites at the lower elevations in the eastern part of the project area and the highest densities would be on higher sites at the higher elevations in the western and southern portions of the project area. Structural diversity would also be promoted within stands by not treating some patches and by favoring the largest and healthiest trees available regardless of spacing.

2. *Guiding Principles for Thinning from Below:*
    - The objectives for all thinning from below are to:
        - Reduce hazardous fuels (ladder fuels and crown bulk densities)
        - Improve forest health
        - Maintain existing large trees and promote the development of future large trees.
        - Restore the role of natural disturbance processes, primarily fire but includes insects and diseases.
    - Producing wood products is not the primary purpose of this project; rather, wood products are considered a by-product of the thinning designed to reduce fuels and restore forest health.
    - Stand Densities:
        - Overall, stand densities will be managed to maintain or improve tree vigor and stand resiliency to natural disturbances.
        - Spatial diversity will be strived for by managing for variable densities.
        - Variable densities could include the extremes of no-treatment clumps (5% to 15% of the acres) to small gaps (i.e., openings) of 0.1 to 0.5 acres (2.5% to 7.5% of the acres) and 2 to 3 stand densities between the extremes that would be dependent on site capabilities.
        - No-treatment clumps are designed primarily for hiding cover and screening for various wildlife species but will also strive to include a variety of existing stand structures.
    - Trees <21" dbh with desirable old-growth characteristics (i.e., older trees with well developed, healthy crowns) will be favored over younger black-bark trees.

- Thinned trees will always be the smaller trees at any particular location with only three exceptions.
    - Favor healthy trees. Exception 1 will be when a smaller tree is in better physical condition (i.e., the least number of forks or crooks, no dead top, greener crown, fuller crown, less evidence of disease or insect infestation, etc.), than a larger tree, in which case the larger tree may be removed to favor the smaller tree. It is not the intention to remove all physically defective, diseased or insect infected trees; the intention is to leave the best trees with the best chance for long-term presence on the landscape. We recognize that some defective trees are desirable on the landscape even after thinning and that a percentage of trees that are not now defective will become defective over the long life of ponderosa pine.
    - Restore historic tree species composition. Exception 2 will be when a smaller tree is a more desired species than a larger tree, in which case the larger tree may be removed instead of the smaller tree. For example, a larger white fir or western juniper may be removed to favor a smaller ponderosa pine.
    - Favor healthy smaller old growth trees. Exception 3 will be when a smaller tree has desirable old-growth characteristics. For example, a younger, larger black-bark tree may be removed to favor a smaller tree with desirable old-growth characteristics.
- The thinning operation will not be considered completed until the thinning slash is treated, consequently, treatment of thinning slash will be a high priority.
- The treatment of ground fuels will be given higher priority in units that have been thinned.

II. Late and Old Structure (LOS) Strategy

The strategy for LOS in the SAFR project area follows the direction contained in the "Regional Forester's Forest Plan Amendment #2" also known as the "Eastside Screens". The direction in the eastside screens regarding LOS was to retain old-growth attributes at the local scale and move toward the historic range of variability (HRV) across the landscape. To meet this direction, treatments for stands within the SAFR project area are designed to:

1. Maintain existing large trees (trees 21"+ dbh).
2. Move mid-seral, second growth stands toward LOS.
3. Move multi-stratum LOS to single-stratum LOS.

Treatments that would be utilized to accomplish this strategy include a combination of thinning trees from below, mechanical treatment of brush and small trees, and prescribed burning.

III. Fuel Reduction Strategies

The absence of fire over the last 80 to 100 years combined with the development of shrubs and dense thickets of trees in the understory have placed ponderosa pine stands at high risk of uncharacteristic stand replacing wildfires.

1. *Restoration of historic fire regimes in ponderosa pine ecosystems:* To mitigate the potential for crown fire initiation, trees within stands should have a height of live crown that is well above the shrub component. Shrub cover would also be maintained at a density and height that would reduce the potential for crown fire initiation. The combination of thinning of trees, mechanical treatment of brush, and reintroduction of fire could be used as needed to achieve the desired stand condition. Prescriptions for underburning could be developed for low intensity prescribed fire to begin a return to historic conditions. Subsequent prescribed fire entries would then be conducted through time to create a fire tolerant stand condition that would help maintain fire resistant ponderosa pine forest.

   Mechanical shrub treatments may be used prior to burning if the shrub size and densities could cause unacceptable scorch or mortality in the residual trees. LRMP Standards and Guidelines prohibit treating all of the project area for fire and fuels hazard reduction

   Taking expected fire behavior into account and the strategic placement of treatment units the IDT decided that the percentage of the project area in the low fire behavior category Fire Regime Condition Class 1 (FRCC 1) should be greater than 50 percent over both the short (5 to 10 year) and long term (10 to 20 year) timeframes.

2. *Defensible space (adjacent to private land):* Creating a defensible space adjacent to private lands not only provides a better chance of stopping intense wildfires from entering private lands, it also aids in suppression of fires that start on private land and burn on to public lands. **The action alternatives propose a defensible space treatment 600 foot wide adjacent to private lands.** By reducing crown densities and ladder fuels through thinning, mechanical treatment of brush, and prescribed underburning fire behavior would be reduced to primarily a surface fire that suppression forces will have a better ability to control. The thinning of dense canopies also allows retardant to become more effective by getting to the ground fuels and not being intercepted in the canopy.

3. *Defensible space (along safety corridors):* In the event of a wildfire, road systems provide the needed escape routes which are critical to public and fire fighter safety. **The action alternatives propose a defensible space treatment of 300 foot on each side of identified safety corridors**. Road systems also allow ground suppression forces (engines, crews and equipment) to access wildfires. Under extreme fire behavior conditions, fuels that allow surface fires to get into the canopies of trees (ladder fuels) create conditions in which direct attack by ground forces becomes impossible. Wildfire under these conditions will cross roads with such intensity that suppression forces have little chance of stopping

fire at roads. Use of the major roads in a fuel break and safety corridor strategy can greatly assist suppression forces in containing a wildfire. These treatments are especially important in the WUI where public safety and evacuation is of high concern.

4. *Landscape treatments to reduce fuels and break up continuity:* Unit boundaries are designed using roads and natural barriers to form a mosaic pattern of treated and untreated areas. Ideally no two untreated units abut each other except where wildlife connectivity corridors or other mandatory land management allocations apply. Utilizing existing roads reduces the cost of implementing prescribed burns because control lines do not need to be constructed and resource impacts are minimized. Using roads allows fire suppression forces ready access to an area while providing escape routes. In addition, this design provides for efficiencies in implementing prescribed burning where ignition and patrol can be accomplished from the roads.

5. *Thinning to reduce crown fire susceptibility and long range spotting*. Crown fires occur during extreme fire conditions and can produce long range spotting which often further hampers control efforts. High stand densities supporting crown fires allow these fires to burn through the canopies of trees independent of the ground fire. Torching and crowning in conjunction with ground fire is also a common problem during wildfires in dense stands of trees. Breaking up the continuity of the tree canopy by thinning trees greatly decreases the chance of an independent crown fire occurring. Thinning also reduces the amount of torching and crowning that occurs with ground fires and thus reduces long range spotting potential.

IV. Wildlife Habitat Maintenance and Improvement Strategies

Proposed treatments to reduce hazardous fuels and improve forest health have the potential to impact wildlife habitat. Forest plan standards and guidelines for maintaining and improving wildlife habitat are described in the LRMP and the Eastside Screens. Proposed treatments were designed to meet these Forest standards and guidelines.

1. *Cover:* Wildlife cover was addressed in the action alternatives by initially subdividing the planning area into two areas (i) areas outside of MA-7 Deer Habitat and (ii) areas within MA-7 Deer Habitat. Areas outside of MA-7 were further subdivided into areas with 50 to 80 year old ponderosa pine stands “black bark stands” and areas greater than 80 years of age.

2. *Areas outside of MA-7:* In areas of younger stands, the LRMP requires that a minimum of 10% of the area be retained as clumps that will provide visual screening for wildlife. This standard would be addressed by retaining a minimum of 10% of treatment areas in black bark stands in screening clumps. Screening clumps would be identified and retained prior to thinning trees and may or may not receive mowing and/or prescribed burning treatments. In areas that do not

meet the definition of black bark stands, the LRMP requires that a minimum of 30% of the area provide for hiding cover. This standard would be addressed by retaining a combination of vegetative conditions throughout the planning area.

a. Methods used to meet this requirement include
    i. identifying some stands that currently meet the definition for hiding cover as no treatment.
    ii. maintaining 10% of the area within plantations as hiding cover.
    iii. retaining 10% of the area in thinning units in un-thinned clumps (in some cases clumps may receive mowing and/or prescribed burning treatments).

3. *Areas within MA-7:* Within MA-7, the LRMP requires that a minimum of 40% of the area be retained as cover. Of this 40% cover, ¾ should meet the definition of thermal cover and ¼ should meet the definition of hiding cover. Initially, stands having 30% or more canopy cover were identified as thermal cover. These stands may be treated as long as the canopy cover requirement is maintained. There was not enough existing areas meeting the definition of thermal cover to meet the area requirement so additional hiding cover was identified to meet management area requirements.

4. *Connectivity Corridors:* Consistent with Eastside Screens, wildlife connectivity corridors were designated to connect Old Growth Area allocations MA-15 and late and old structural stands (LOS) within and adjacent to the project area. Treatments within wildlife connectivity corridors were designed to maintain canopy cover in the corridors. Prescribed burning and /or mechanical treatment of brush and trees up to 4 inches dbh would be permitted. No additional thinning would occur in the corridors. Areas in which the connectivity corridors and evacuation and access routes overlap will be treated as described for adjacent connectivity corridors and the evacuation and access treatments in these areas would be dropped. In areas in which connectivity corridors and defensible space adjacent to private lands overlap, these areas will be treated as described for defensible space with the exception that all trees 12 inches dbh and larger will be retained to provide canopy cover.

5. *Wildlife Forage Requirements in Areas of (Deer Winter Range):* Bitterbrush *(Purshia tridentata)* is a major component of the potential natural vegetation, and an important food source for deer during the winter months. Providing high quality winter forage in adequate quantity and distribution to meet nutritional demands of wintering mule deer and adequate shrub structure and patch size to maintain quality habitat for shrub associated species is an LRMP requirement and an objective of the SAFR project. The LRMP provides direction regarding the management of shrubs for high quality winter forage. The objective is to manage vegetation to provide optimum habitat considering the inherent capability of the land. Recommendations for the management of shrubs are provided by the Integrated Natural Fuels Management Strategy (IFMS 1998). The IFMS

identified interim management goals of managing shrubs in shrub dominated landscapes (Deer Habitat) to have 33% of shrubs in an early seral condition, 33% in a mid seral condition, and 33% in a late seral condition.

V. Wood Utilization Strategy

1. Ability to utilize material will depend on appropriate technologies to remove the material, markets for the material and funding to subsidize the removal of this material if the value of the material is less than the costs to remove it. The trees that are cut by thinning under this project can be disposed of in two basic ways, by removing them from the site through utilization or by burning them on site. The likely scenario for this project is a combination of the two methods. The objective of this project is to utilize as much of the thinned material as possible through commercial means to help offset the costs of meeting project objectives. Stewardship contracting authorities will be used as much as possible to implement this project. However, traditional timber sale contracts, service contracts, FS force account, and grants and partnerships would be utilized as well.

2. Additionally, there is uncertainty regarding future technology, markets and funding for the disposal and utilization of the material generated by thinning; consequently, flexibility is incorporated into the project to be able to take advantage of new technology, markets and funding sources.

VI. Strategies for Balancing Needs and Preservation of Other Resources

Strategies for addressing analysis issues identified in Chapter One are described below. Project design and implementation strategies were developed to avoid or minimize potentially adverse impacts to these resources.

1. *Soil Quality*: Techniques used to protect the soil resource include minimizing the extent of new soil disturbance from mechanical treatments by using existing log landing and skid trail networks whenever possible. In areas that require additional transportation systems, locations for new trails and landings that best fit the terrain will be designed to minimize the extent of soil disturbance. Skidders and tractors will be restricted to designated areas (i.e. roads, landings, designated skid trails), and the amount of traffic from other specialized equipment off of designated areas will be limited.

2. *Water Quality*: The State of Oregon is required by the Clean Water Act, Section 303(d), to identify waters that do not meet water quality standards. Whychus Creek is listed as water temperature limited from the mouth to the irrigation diversion at river mile 21. Approximately 0.5 miles of the listed reach of Whychus Creek is within the northern portion of the SAFR project boundary. Dissolved oxygen is directly related to water temperature and biological activity. Although dissolved oxygen in Whychus Creek has not been measured according

to the State protocol, water temperatures indicated it could be below State standards (USDA Forest Service 1998). Project design elements included in the action alternatives and tracked through the analysis process will be used to avoid adverse effects to water quality which may result from this project.

3. *Air Quality and Smoke Management*: The community of Sisters and the surrounding areas are designated as areas with high population densities and are closely monitored for smoke intrusion from prescribed fire. All prescribed burning would comply with the Clean Air Act and would be coordinated with the Oregon State Department of Environmental Quality and Oregon State Department of Forestry. All prescribed burning would be in compliance with State smoke management plans and ignition would occur only under prescribed conditions.

4. *Cultural Resources*: Surveys of cultural resources were conducted during the planning process. The project was designed to avoid all identified cultural resource sites either through layout or during project implementation. There are no Tribal cultural resources identified in the project area.

5. *Scenic Quality*: Design elements intended to maintain the "sense of place" by reducing stand replacement wildfire risk and enhancing scenic quality have been incorporated into the action alternatives.

6. *Rare plants:* Limited areas of Peck's Penstemon (*Penstemon peckii*) occur throughout the planning area. Two types of Peck's Penstemon populations have been identified and their locations within the planning area mapped. Population types include (i) managed populations and (ii) protected populations. Hand thinning of trees, mowing of brush, and prescribed burning treatments will be allowed within areas of both managed and protected Peck's Penstemon populations. In managed populations additional mechanical thinning treatments would also be allowed as long as the areal extent of soil disturbance is limited to 20% or less of the activity area (see mitigations section). Mechanical thinning treatments will not be allowed in areas of protected populations. Thus, when mechanical thinning treatments are planned near protected population these populations will be identified on the ground and avoided.

7. *Invasive Species:* The prevention of introduction and spread of invasive plant species is critical to the success of the weed management program. Knowledge of the locations of existing weed occurrences, awareness of the major agents of weed dispersal, and adherence to specific practices designed to limit the opportunities for weed introduction and spread have been incorporated into project design.

8. *Recreation:* Design elements incorporated into the action alternatives would minimize effects to recreational resources.

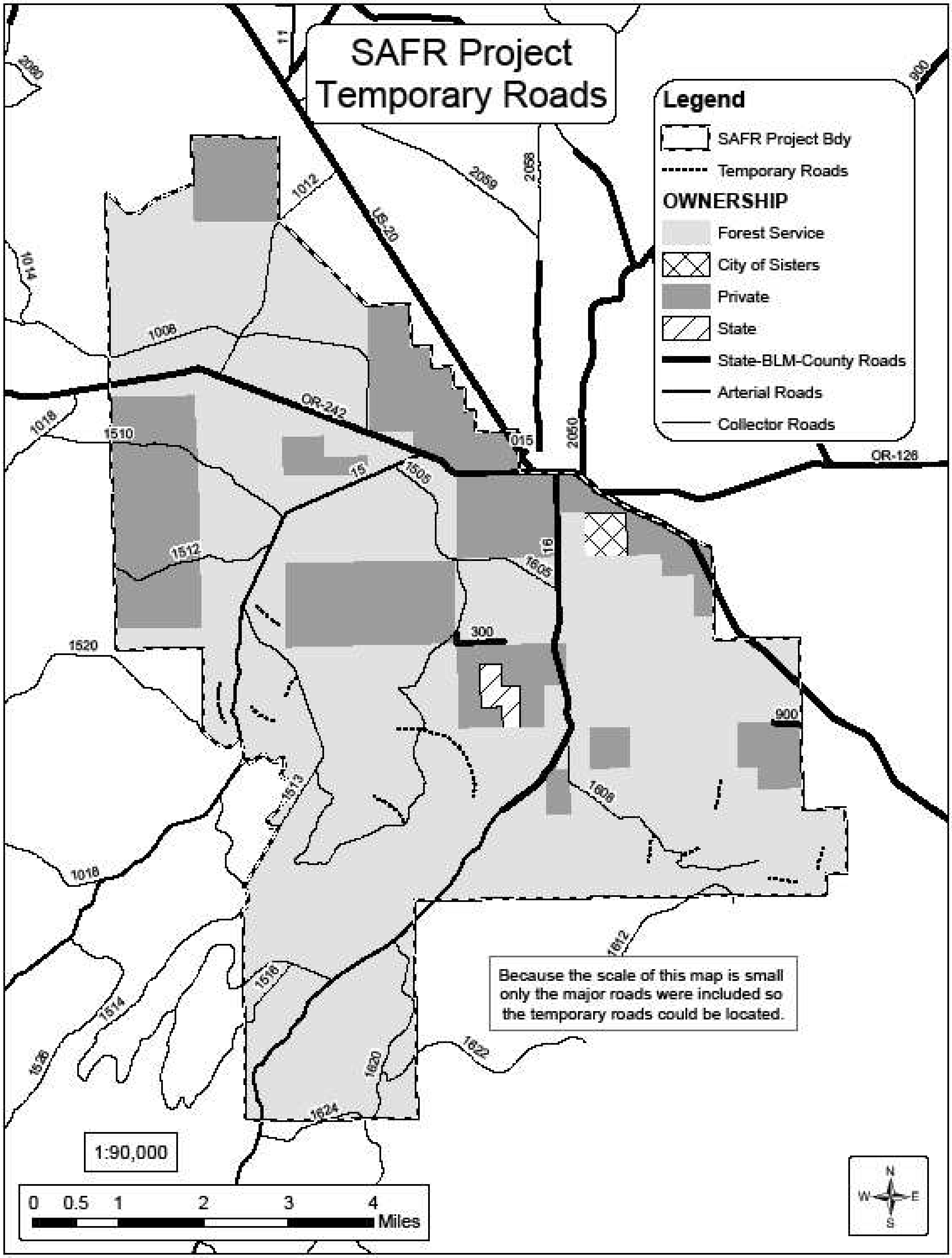
9. *RHCA Treatments:* Activities occurring in RHCAs include 50 acres of underburning and 34 acres hand-thinning, piling and pile burning to reduce fuels

(Table 73; figure 31). Only trees less than 9 inch dbh would be hand removed or burned and no ground-based equipment would be used for felling or removing trees. Hauling on existing roads in the RHCAs may occur, but effects would be mitigated. No mowing, road construction, or temporary road construction is proposed in RHCAs. Necessaraly

10. *Fisheries Wild and Scenic River Outstanding and Remarkable Values (ORV):* A total of 366 acres are proposed for treatment within the Whychues Creek Wild and Scenic River Resource Assessment area. Most of this area would be recieve thinning, mowing and burning treatments within young plantations. Within the Riparian Habitat Conservation Area (RHCA), 1.2 acres are proposed for prescribed burning only. Project design will minimize disturbance in the RHCAs.

11. *Forest roads:* Access to treatment units for fuels treatments, potential timber harvest and hauling of commercial wood products would occur to the extent possible on existing Forest system roads. Where feasible, existing logging facilities used during previous harvesting would be used. All temporary roads would be closed and subsoiled after use.

Figure 4: SAFR Project Temporary Roads



Proposed Treatments

The maximum diameter of trees at breast height (dbh) that could be removed is 21 inches dbh in Alternative 2 and 12 inches dbh in Alternative 3. Otherwise the types of treatments proposed are the same for both of the action alternatives. Many of the individual treatments described below would be used in combination with other treatments (see Table 7 for proposed treatments by unit).

Thinning from Below (T): The project would thin trees from below with an upper limit of 21" dbh for the Proposed Action (Alternative 2) and 12" dbh for Alternative 3. In other words, no trees above the upper limit dbh could be removed anywhere in the project area. The only exception would be for trees that are considered hazardous under Occupational Safety and Health Administration (OSHA) guidelines.

The majority of the trees to be removed by thinning from below in the project area are generally small diameter trees for which markets are not very dependable. Consequently, market conditions will determine utilization. In general, trees less than 8" dbh would be used for biomass (hog fuel), chips, or special forest products (e.g., firewood, posts, poles, etc.) and trees that are > 8" could be utilized for sawlogs plus additional non-sawlog material (e.g., the top/last log on the tree).

Tree cutting, will be done with a variety of methods from hand cutting with chainsaws to mechanical cutting using ground-based, boom-mounted saws or shears such as used in cut-to-length or feller-buncher systems. Tree removal to the landing will be accomplished by a variety of methods including forwarders (cut-to-length system), skidders (feller-buncher system), ATVs, or in some limited cases, by hand. All machinery will be restricted to designated skidder/forwarder trails; however, existing skid trails and landings would be utilized to the extent possible and logging over snow and/or frozen ground will be utilized when weather condition are favorable.

Thinning slash would be treated utilizing a variety of methods including whole tree skidding, prescribed underburning, handpiling, machine piling in which the machines are limited to roads or forwarder/skidder trails and burning of piles. Potential soil impacts in areas identified for mechanical fuel treatments were based on the most impactive treatment scenario (i.e. the worst case). It is expected that impacts in many areas will be less than that which was analyzed for. Hand piling would involve piling slash (small boles, limbs and tree tops) by hand. This treatment may be used with any thinning treatment, as a stand alone activity fuels treatment or in combination with other fuels treatments. It could also be used on sensitive soils and within RHCAs to minimize soil disturbance and compaction.

Machine piling on skidder/forwarder trails involves piling slash concentrations on or adjacent to skidder/forwarder trails by machine (e.g., grapple piling) and would be applied where a harvester/forwarder system (cut-to-length) is used to thin.

Mechanical Treatment (e.g., mowing, mastication) of Brush and Small Trees (M): Mechanical treatments consist of mastication (e.g., mowing) of brush, thinning slash and small trees (4 inch dbh and smaller) to alter the fuel profile by eliminating ladder fuels. Commonly, these mechanical treatments are used prior to prescribed burning to reduce flame lengths and rates of fire spread. The terms mowing and mastication are used interchangeably in this document. The types of machines that could be used for mowing/mastication may include but are not limited to the following: tractor mowing and or towing flail type mowers, skid type all season vehicles (ASV), bobcat, or caterpillar with a front mount horizontal or rotary head, and boom-mounted slash buster on a tracked vehicle such as an excavator or harvester.

Prescribed Underburning (UB): Prescribed underburning consists of burning the surface fuels to consume dead and unwanted woody material such as needle litter, limbs, thinning slash, ground vegetation (i.e., grass, forbs and shrubs) and small trees. An estimated 95% of the proposed treatment units in the project area will require pre-treatments such as thinning, mowing and piling and pile burning before underburning can be done safely and effectively. Most initial underburning would be accomplished in the spring; however, some may be done in the fall or winter if the conditions are within prescription. Follow-up underburns are more likely to be conducted in the fall because the initial fuel loadings have been reduced and the stands will better fit the burning prescription.

Plantation Treatments (PT): Managed stands or plantations (previously reforested regeneration harvest units, i. e. clear-cuts) will be treated by thinning from below, pruning lower branches for fire hazard reduction, pruning for dwarf mistletoe control, hand piling or mastication of thinned trees, hand-pile burning, mastication of brush and other ground fuels and prescribed burning. Any combination of these individual treatments may be used on plantations to reduce fire hazard, improve forest health, and to improve or maintain tree growth. Thinning may be accomplished by hand with chainsaws or by machine (e.g., boom-mounted slash buster, etc.). Utilization of thinned trees, for biomass (hog fuel) or other commercial products, could be done whenever market conditions allow.

Thinning plantations will be done with the objective to create or advance more structural complexity and to emulate natural/historical stand conditions. Plantations will be thinned to produce mature stands that are widely spaced and having gaps and openings. This thinning technique will emulate natural stand conditions that exist in older stands and will help to produce more fire-resistant stands for the future. Gaps and openings will range in size from ¼ acre to approximately 1 acre in size. Between gaps, trees will be thinned from below to a variable density. Pruning might occur to lift lower crowns to emulate scorching from fire, which will also serves to improve fire resistance by eliminating ladder fuels.

Control of ponderosa pine dwarf mistletoe would be done within plantations and within 100’ adjacent to existing plantations in the southern half of the project area. This treatment involves pruning dwarf mistletoe out of lightly and moderately infected trees, removing or girdling heavily infected trees <21” dbh, girdling heavily infected trees >21” dbh and thinning from below favoring the least infected trees (lightly and moderately infected trees). The objective of this treatment would be to reduce or prevent the spread of ponderosa pine dwarf mistletoe into plantations.

Table 7: Proposed treatment acres by EA unit for Alternative 2 and Alternative 3.

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
1	7			72			6		85
2							41		41
3							85		85
4							49		49
5							23		23
6							4		4
7							78		78
8							18		18
9							20		20
10							79		79
11							37		37
12							33		33
13			22				38		60
14							58		58
15	1		19				87		107
16							373		373
17	7				4		2		13
18				119					119
19	33								33
20	45		5	6			33		89
21	27								27
22	21			77			44		141
23							9		9
24	75								75
25							8	4	12
26							33		33
27	45						14		59
28	89								89
29	6						8		14
30	36								36
31							13		13
32	58						6		64
33	9				11		21		42
34							30		30
35	132								132
36	2			78					80
37	151						20		171
38			11				21		31
39	5				2		108		115
40	274								274
41	205				18		5		228
42	5						110		115

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
43	583				3		27	79	691
44	12						24	27	63
45	93					25	2	9	129
46	4						38		41
47							15		15
48							10		10
49	7						20		27
50			9				17		26
51	41						24		64
52							127		127
53	51						57		107
54							43		43
55	20					25	23		67
56	15			17			4		36
57							13		13
58	16						86		102
59	36						9		44
60	24			45					69
61	43					46	14		103
62	180					52	16	7	256
63	96			66					162
64					5		24		28
65							142		142
66	70					61			131
67	49			137			14		200
68	40						31		71
69	50								50
70							86		86
71	46						43	1	90
72			14				34		48
73							151	2	152
74	54			29			31		114
75							37		37
76							27		27
77	32								32
78							22		22
79	3				4				7
80	3				2		19		24
81	4				3		37		45
82							71		71
83							20		20
84							87		87
85	34								34
86	1						32		33
87							60		60
88	41					38	20		100

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
89	36						3		39
90	52								52
91	26			62					89
92	139						34		173
93	36					70	25		131
94							34		34
95			13				55		67
96			7				35		42
97	53								53
98			2				87		89
99							35		35
100	10		15				77		103
101							57		57
102	108								108
103							32		32
104	61			33			35		128
105	49					29	9		88
106	1						34		35
107	4						47		51
108	14			58			5		77
109	28			109			22		160
110	33			57					91
111	80								80
112	70					310			380
113	80								80
114							24		24
115	14			180			7		201
116	104			33			44	11	192
117	26			84					110
118	105			89					194
119							38		38
120	104						64		168
121							27		27
122	92						75		167
123	61					70			131
124			43				159		203
125							26	5	31
126			7				143	23	173
127	18						49	26	93
128	32						9	1	41
129			3				90	72	165
130							180	32	212
131							32	71	103
132							86		86
133							62		62
134							44	5	48

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
135							109	4	114
136							137		137
137							76	33	108
138							47	38	85
139	50						71	47	168
140							138	60	198
141							63	6	68
142							56	13	69
143							78	10	88
144	91							21	112
145			4				105	46	155
146							29	8	36
147							62	41	103
148							84	48	132
149							8	10	18
150							89	39	129
151	45								45
152	61								61
153							36	15	50
154			6				81	17	104
155			1				51	18	69
156			5				91	76	173
157	134						3	3	140
158	2		3				31	21	57
159	41						39	55	135
160							25	24	49
161	84							29	112
162	27								27
163	1				2		36	37	75
164							64		64
165	100						4	50	155
166							52	30	81
167	1		5				47	16	70
168	8		25				64	25	122
169			17				10	1	28
170	6						101	13	121
171	53								53
172	23								23
173			6				9	6	20
174	57						7	57	122
175	107							35	142
176	59						4		63
177	134								134
178	86							12	98
179	5						20	27	52
180	16						3	46	65

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
181							38	12	51
182					2		32	23	56
183							40	6	46
184			3				27		29
185	94						4	23	120
186	34						12	18	64
187	2						31		33
188							82	3	85
189							43	1	43
190							113	1	114
191							73		73
192							27		27
193							41		41
194			2				1	10	13
195					3		13		15
196							30		30
197	1						23		25
198							30		30
199	100					81	43	8	232
200	24			56			28		108
201	3			29			45		77
202							50		50
203							76		76
204								25	25
205			26				50	1	77
206							29	15	44
207							126	19	145
208	25					24	17	47	113
209							72	36	108
210							24		24
211							4	16	20
212							12	19	31
213							67	42	110
214	16		4				74	24	119
215							116	80	196
216	85						7	55	146
217							79	31	110
218							118	49	167
219	68								68
220			22				22	20	65
221							41	16	58
222							43	1	44
223							103	76	179
224	93							36	129
225	82						1	39	123
226							170	88	258

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
227							34	5	39
228							15	21	35
229	88				8			57	154
230	5		18					48	71
231			6				77	9	92
232			6				1	120	127
233							7	128	135
234			2				14	22	37
235			16				23	18	56
236	49							4	53
237	84								84
238	11						12		23
239	6	1					8		16
240			30				56	6	91
241	111								111
242							15	24	39
243	27								27
244							22	20	42
245							7	1	8
246			1				53	36	90
247							51		51
248	1						48	1	50
249	9						27	25	62
250	8				1		32	1	41
251			15				124	33	172
252							20	8	28
253							33	14	47
254	5		4				21		30
255	1						50		50
256							86	28	114
257	7		5				26		38
258	3				1		45	12	62
259	14		30		7		24	1	76
260			5				19		24
261			32				86	11	129
262							93	46	139
263			1				66	47	114
264	16		12				61	41	130
265			21				47	4	72
266			1				35	21	57
267			1				41	5	46
268	53						10	30	93
269							23	38	60
270	3						2	31	35
271							59	22	81
272							62	2	65

EA Unit	No Treatment	Burn	Masticate & Burn	Thin	Thin & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Total
273							112	8	120
274							72	17	89
275							28	10	38
276	136						22		158
277	54		14				130	70	268
278							98	14	112
279							68	35	103
280					1		18		19
281	58						21		79
282	1		24				100	14	138
283							64	8	72
284	6	10					27		42
285			23				36	7	67
286							20		20
287					3		22		24
288							8		8
289	2	0	0	0	0	0	22	9	33
Totals	**6,894**	**11**	**568**	**1,436**	**79**	**830**	**11,267**	**3,382**	**24,467**

Change in Condition Due to the 2006 Black Crater Fire

On July 24, 2006 a fire started in the Three Sisters Wilderness. The fire subsequently burned to the east and outside the Wilderness and was named the Black Crater fire. At the time of containment the Black Crater fire had burned about 9,407 acres, including 4,827 acres of National Forest lands. Approximately 932 acres of the Black Crater fire occurred within the eastern portion of the SAFR Planning Area.

Initially about 416 acres of potential salvage opportunities, outside of wilderness and Inventoried Road less Areas were identified from District stand exam records. Further field reconnaissance narrowed this to about 262 acres of economically viable ground-based salvage opportunities. None of the proposed salvage units occurred in the SAFR Planning Area. The Black Crater fire also burned across 10 miles of roads that were identified as a potential risk to public safety due to danger trees created by the fire. Approximately 10 danger trees were removed within the SAFR Planning Area along the 15 and 1510 roads as a part of the Black Crater fire danger tree removal effort.

The majority of the area that burned within the SAFR Planning Area burned at night, under favorable conditions, and was a part of a back burn to control the wildfire. Most of the back firing was done from the 15 road and the 1510 road, thus limiting the need for dozer fire line. Approximately one half mile of dozer line was installed in the southern portion of the fire and within the SAFR Planning Area. This fire line has since been rehabilitated as a part of the fire suppression rehabilitation. There was approximately 70 acres in the southern portion of the fire and within the SAFR Planning Area which resulted in a stand replacement fire. The remainder of the fire within SAFR Planning Area resulted in an underburn with most of the trees surviving and only scattered, small patches of stand replacement mortality. Thus, most of the area within SAFR Planning Area that burned was moved towards meeting some of the objectives of the SAFR planning project. Not all of the area that burned was planned for treatment under the SAFR project (Table 8).

Table 8: A breakdown of the initial planned treatments for the area burned in the 2006 Black Crater Fire.

EA Unit	Proposed Treatments					
	No Treatment	Masticate & Burn	Thin & Masticate	Thin & Masticate & Burn	Plantation Treatment	Totals
122*	92			75		167
123	61		70			131
240		30		56	6	92
251		15		124	33	172
260		5		19		24
261		32		86	11	129
263		1		66	47	114
264	16	12		61	40	129
265		20		47	4	71
266				35	21	56
Totals	**16**	**115**	**70**	**569**	**162**	**932**

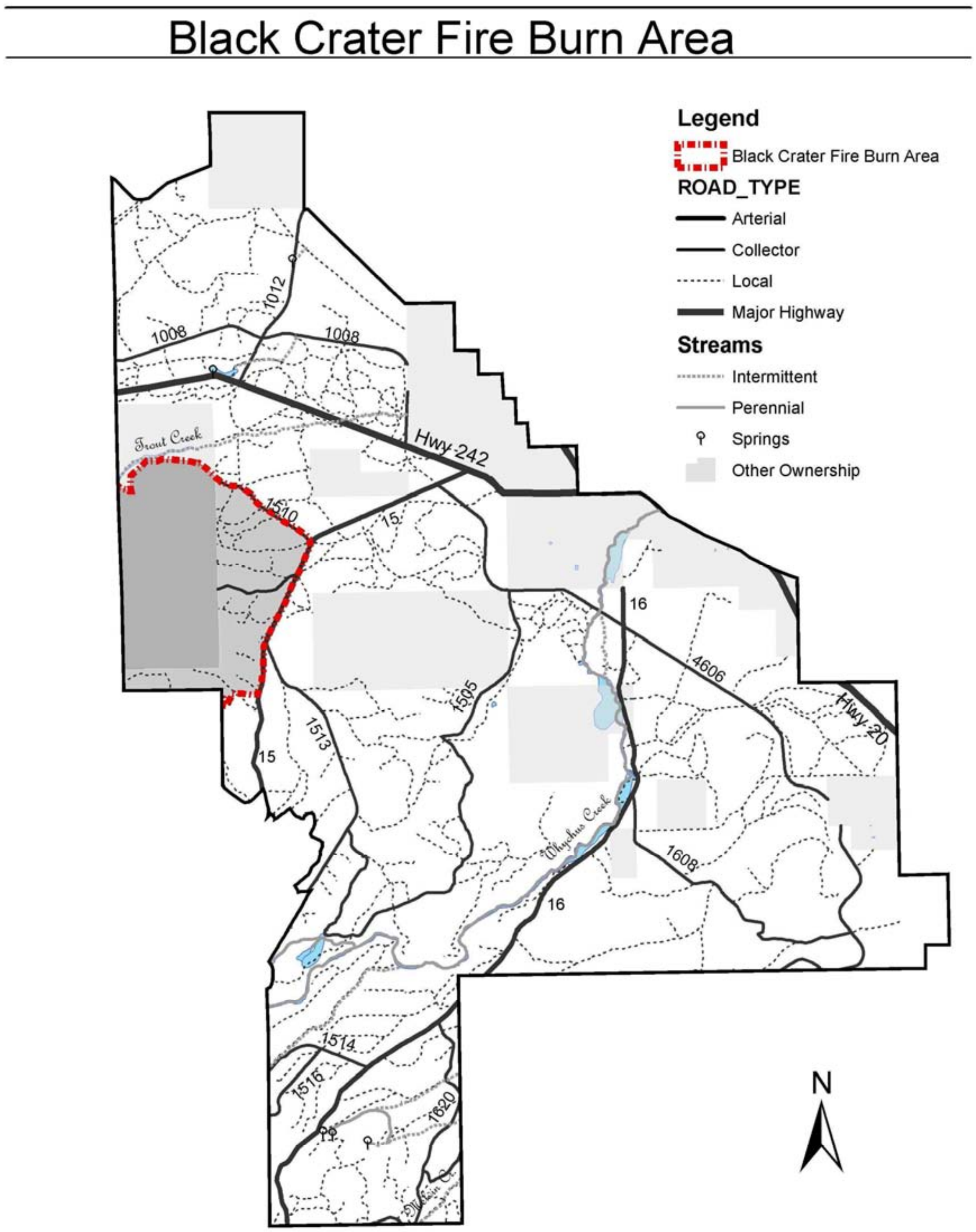
* Note: Only the North portion of the EA Unit burned in the fire.

Proposed Treatments in EA Units Burned in the 2006 Black Crater Fire

Burn intensity in EA Unit 123 resulted in a stand replacement fire. Consequently this unit was dropped from future treatments. The remaining EA Units 122, 240, 251, 260, 261, 263, 264, 265, and 266 burned at a lower intensity with most of the trees surviving. Because the burn in these areas appeared to meet some of the objectives of the prescribed fire portion of the Action Alternatives, treatments proposed in the original treatment table (Table 7) would be retained.

Within the planning area, the Black Crater Fire burned in areas outside of MA-7 (Deer Habitat). Outside of MA-7 there is a wildlife cover requirement of retaining at least 30% of the area in hiding cover (black bark stands are excluded from this requirement). The original analysis for retaining hiding cover shows that after treatment by the Proposed Action and Alternative 3, a total of 32% of the area would remain in hiding cover. As a result of the Black Crater Fire entering the project boundary hiding cover was reduced by approximately 80 acres. These acres were subtracted from the original calculation total and the percentage of hiding cover was recalculated for the planning area. Results show a reduction in hiding cover from 32% to 31%, which is still above the 30% requirement. Thus, no additional hiding cover was identified for retention following the Black Crater Fire.

Figure 5: 2006 Black Crater Fire



Mitigation Measures

Mitigation measures are specific actions that could be taken to minimize, avoid or eliminate potentially significant impacts on the resources, or rectify the impact by restoring the affected environment (40 CFR 1508.02). Mitigation of adverse effects would involve changing or modifying the activities described under the action alternatives that may cause effects.

The following mitigation measures are an integral part of the project and would be carried out through project implementation. Actions would meet direction in relevant laws and policies, and the standards and guidelines in the Deschutes National Forest Land and Resource Management Plan (LRMP). In addition, actions would comply with the project design criteria for the Deschutes and Ochoco National Forests Programmatic Biological Assessment (2001-2003).

The effectiveness of each measure is rated as ***high, moderate,*** *or* ***low*** to provide a qualitative assessment of expected effectiveness the management activity could have on preventing and/or reducing impacts on resources. Effectiveness ratings are based on the following criteria: (i) literature and research, (ii) administrative studies (local or within similar ecosystem), and (iii) professional judgment.

- ***High:*** Practice is highly effective (greater than 90%), meets one or more of the rating criteria, and documentation is available.
- ***Moderate:*** Documentation shows that practice is 75 to 90 percent effective; or logic indicates that practice is highly effective, but there is no documentation. Implementation and effectiveness of this practice needs to be monitored and the practice will be modified if necessary to achieve mitigation objectives.
- ***Low:*** Effectiveness is unknown or unverified, and there is little or no documentation; or applied logic is uncertain and practice is estimated to be less than 60 percent effective. This practice is speculative and needs both effectiveness and validation monitoring.

The effects analysis discussed in Chapter 3 is based on mitigation measures being implemented.

Air Quality

All prescribed fire operations will adhere to the Oregon State Implementation Plan (SIP) for smoke management. *High effectiveness.*

Wildlife

Seasonal Restrictions
Bald Eagle Nest and Roost Sites:

- Restrict disturbance activities within ¼ mile non-line-of-sight or ½ mile line-of-sight for any known or newly discovered nests from January 1 through August 31 (all treatment units). *High effectiveness.*
- Project activities that have potential to disturb bald eagle winter roosts shall be restricted within 400 m (0.248 miles) of the roosting area from November 1 to April 30th (***All Treatment Units***). *High effectiveness.*

MIS Bird Species:

- Restrict disturbance activities within ¼ mile of known or newly discovered nest sites. Table 9, displays the dates for seasonal restrictions by species (***All Treatment Units***). *High effectiveness.*

Table 9**:** Seasonal restriction dates for various species nest sites (applies to ¼ mile).

Species	**Seasonal Restriction Dates**
Cooper's Hawk	April 15 to August 31
Golden Eagle	February 1 to July 31
Great Blue Heron	March 1 to August 31
Northern Goshawk	March 1 to August 31
Osprey	April 1 to August 31
Red-tailed Hawk	March 1 to August 31
Sharp-shinned Hawk	April 15 to August 31
Haul restrictions will be assessed on a case by case basis. This condition may be waived in a particular year if nesting or reproductive success surveys reveal that the species indicated is non-nesting or that no young are present that year. Waivers are valid only until the start date of the restriction of the following year.	

Mule Deer:

- Within the Tumalo Winter Road Closure there will be a seasonal restriction on all treatments except for prescribed fire from December 1 through March 31 (***All Treatment Units***). *High effectiveness.*

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White-headed woodpeckers and flammulated owls:

- If white-headed woodpeckers or flammulated owls are found to be nesting during implementation, suspend activities until young have fledged (***All Treatment Units***). *High effectiveness.*

Treatment Restrictions
Bald Eagle within LRMP Eagle Habitat:

- All snags that are eagle perches within 500 meters (1650 feet) of nests or roosts should be preserved. In addition, all snags utilized for roosting or foraging

within nesting territories or communal roosts should be protected (***All Treatment Units***). *High effectiveness.*
- Protect all existing nesting, roosting, and perch trees. Generally, these are any live trees (Douglas-fir, ponderosa pine, etc.) or snags over 21" in diameter at breast height (***All Treatment Units***). *High effectiveness.*
- A portion of the LRMP Eagle Habitat occurs within the Tumalo Winter Road Closure. Within the winter road closure there will be a seasonal restriction on all treatments except for prescribed fire from December 1 through March 31 (***All Treatment Units***). *High effectiveness.*

All areas within the project:
- Prescribed fire managers need to use smoke management forecasts in order to minimize smoke entering into suitable habitat and to ensure that dissipation would be adequate (***All Treatment Units***). *High effectiveness.*

Crater Lake Tightcoil:
- No treatments will occur within 30 feet of perennial streams (***All Treatment Units***). *High effectiveness.*

Northern Goshawk:
- Protect every known active and historically used goshawk nest-site from disturbance. (For the purpose of this screen, "historical" refers to known nesting activity occurring at the site in the last five years). If a new nest is discovered the following are required (***All Treatment Units***):
  - 30 acres of the most suitable nesting habitat surrounding the nest tree(s) will be deferred from treatment. *High effectiveness.*
  - A 400 acre "Post Fledging Area" (PFA) will be established around every known active nest site. While harvest activities can occur within this area, retain the old and late structural stands and enhance younger stands towards this condition, as possible. *High effectiveness.*

Mule Deer Common to Entire Project:
- Approximately 10 percent of each thinning unit will be left in unthinned clumps to provide visual screening throughout the area. This applies to all thinning treatments including plantations except within designated defensible space (***All Treatment Units***). *High effectiveness.*

Within Allocated Deer Habitat:
- Where mastication and burning occur, the size of individual treated blocks in any one year should not exceed 500 acres in size. A minimum of 1,200 feet should remain untreated between individual treatment blocks (MA 7-15). This will be evaluated for the year that the treatments are occurring. This does not apply to areas identified as defensible space (***All Treatment Units***). *Moderate effectiveness (some disturbance would still occur).*

Other Raptors:

- For newly discovered golden eagle, osprey, or red-tailed hawk nest sites; provide a 300' radius around the nest site. Do not remove any perch trees within this radius (i.e. trees greater than 16 inches dbh) (***All Treatment Units***). *High effectiveness.*

Snags, Down Wood and Log Associated Species (All Areas):

- Harvest activities, both pre-commercial and commercial, will retain all existing snags greater than or equal to 10 inches dbh except where they create a safety hazard, following applicable OSHA safety requirements. Protect large snags during post harvest activities (***All Treatment Units***). *High effectiveness.*

Within Identified Treatment Areas:

- Down Wood (if present) – Meet the standards listed below with pre-activity and logging debris down wood. Do not fall materials to meet requirements.
- Ponderosa Pine Stands - Leave 20 to 40 lineal feet of down wood per acre with a small end diameter of 12 inches. *High effectiveness.*
- Mixed Conifer Stands - Leave 100 to 140 lineal feet of down wood per acre with a small end diameter of 12 inches. *High effectiveness.*

Within Prescribed Fire Treatment Areas:

- During prescribed fire operation, consumption of down wood at least 12 inches diameter at small end and at least 6 feet in length at rate of 40 lineal feet per acre in ponderosa pine and 140 lineal feet per acre in mixed conifer will not exceed 3 inches total (1 ½ inches per side) as outlined in Forest Plan Amendment #2 (USDA 1995).

Connectivity Corridors:

- Prescribed burning and mechanical treatment of brush and trees up to 4 inches dbh is permitted; however, no additional thinning will occur. There are two exceptions:
    - Thinning of trees up to 12 inches dbh is allowed in connectivity corridors that occur within identified defensible space adjacent to private lands. *Moderate effectiveness (some reduction in canopy cover).*

Soils

Appropriate Best Management Practices (BMPs) would be applied to all ground disturbing management activities, as described in General Water Quality Best Management Practices (Pacific Northwest Region, 1988). These BMPs are tiered to the Soil and Water Conservation Practices (SWCP) Handbook (FSH 2509.22) which contains conservation practices that have proven effective in protecting and maintaining soil and water resource values. The LRMP states that BMPs will be selected and incorporated into project plans in accordance with the Clean Water Act for protection of waters of the State of Oregon (Forest Plan 4-69) (***All Treatment Units***).

Specific BMPs commonly used to minimize the effects of road systems, fuels and timber management activities on the soil resource are briefly described below.

- Use old landings and skidding networks whenever possible. Assure that water control structures are installed and maintained on skid trails that have gradients of 10 percent or more. Ensure erosion control structures are stabilized and working effectively. *High effectiveness.*
- In all proposed activity areas, locations for new yarding and transportation systems would be designated prior to the logging operations. This includes temporary roads, spur roads, log landings, and primary (main) skid trail networks. *Moderate effectiveness.*
- Surface drainage on temporary roads – minimize the erosive effects of concentrated water through the proper design and construction of temporary roads (Road BMP R-7). *Moderate effectiveness.*
- Road maintenance – conduct regular preventive maintenance to avoid deterioration of the road surface and minimize the effects of erosion and sedimentation (Road BMP R-18, R-19). *Moderate effectiveness.*
- Protect soils and water during prescribed burn operations – a burn plan addressing compliance with all applicable LRMP standards and guidelines and Best Management Practices will be completed before the initiation of prescribed fire treatments in planned activity areas (LRMP SL-1 & SL-3; Timber BMP T-2, T-3 & T-13; Fuels Management BMP F-2, F-3). *Moderate to High effectiveness.*
- Coarse woody debris/down wood – assure that on Ponderosa Pine sites, a minimum of 5 to 10 tons per acres of large woody debris (greater than 3 inches in diameter) is retained within activity areas to provide organic matter reservoirs for nutrient cycling that helps maintain long-term site productivity (LRMP SL-1). Assure that on Mixed Conifer sites, a minimum of 10 to 15 tons per acres (greater than 3 inches in diameter) is retained for long-term nutrient cycling. *Moderate effectiveness.*
- Maintain duff layer – strive to maintain fine organic matter (organic materials less than 3 inches in diameter; commonly referred to as the duff layer) over at least 65 percent of an activity area (pertains to both harvesting and post harvest operations). If the potential natural plant community (i.e., site) is not capable of producing fine organic matter over 65 percent of the area, adjust minimum amounts to reflect potential vegetation site capabilities (LRMP SL-6; Fuels Management BMP F-2; Timber Management BMP T-13). *Moderate effectiveness.*
- Use sale area maps for designating soil and water protection needs (Timber Management BMP T-4). *Moderate effectiveness.*

Hydrology/ Fish

- No treatment in RHCAs except underburning to specified roads in the outer edge of the RHCA and defensible space treatments at :

  - 2 sites in Trout Creek RHCA at private land boundaries (hand thin, pile, burn (HTPB)) ***EA Units 255,256,258,259***.
  - 3 sites in Whychus Creek RHCA at private land boundaries (HTPB) ***EA Units 33, 79, 195***.
  - Watson Reservoir at private land boundary (HTPB) ***EA Unit 33***.
  - Cold Springs Campground (underburn) ***EA Unit 284*** *High Effectiveness*
- Flag RHCAs to identify no treatment areas (see Table 67 for RHCA buffer widths). *High Effectiveness*

Thinning within RHCA:

- Do not use ground-based equipment (i.e. mower or harvest equipment). *High Effectiveness*
- No treatment within 60 ft of Whychus Ck to prevent loss of shade. *High Effectiveness*
- Do not fell trees within 30 ft of Trout Creek to protect streambank stability. *High Effectiveness*
- Maintain a 10-20 foot vegetated buffer along irrigation ditches to reduce off-road vehicles from crossing. *Moderate Effectiveness*
- Leave trees along roads within RHCAs to prevent off-road vehicle use. *Moderate Effectiveness*
- No off-road vehicle travel or equipment operation in RHCA. *High Effectiveness*

Burning within RHCA:

- Do not construct fire line in RHCAs. *High Effectiveness*
- Use existing roads as fire breaks or wet line if needed. *High Effectiveness*
- Burn piles should not exceed 100 ft^2 in size. *High Effectiveness*
- Slash should be piled and burned at least 100 feet away from perennial and intermittent stream channels and at least 50 ft from riparian vegetation. *High Effectiveness*
- Avoid consumption of large wood near stream channels which retain moisture and can protect/maintain stream channels during high water and floods. *High Effectiveness*
- Burn intermittent RHCA with low intensity to maintain stream bank vegetation and stability. Early winter or spring burns may give best results. *High Effectiveness*
- Protect head gate structures in irrigation ditches from prescribed fire. *High Effectiveness*
- In the case of an escaped prescribed fire, avoid using application of retardant within or near flowing streams. If possible, keep retardant drops at least 300 feet back from flowing streams and intermittent streams. Do not drop retardant or foam directly in streams. *High Effectiveness*
- Avoid using surfactants when there is a potential for stream contamination. If surfactants are needed, use a fold-a-tank from which to pump water. *High Effectiveness*
- Require the use of pump containment kit. *High Effectiveness*

- Screen water pump intakes with appropriate size mesh (3/32") to prevent entrapping fish. *High Effectiveness*
- Keep refueling, fuel storage, and fuel trucks at least 150 feet away from flowing streams. *High Effectiveness*

Recreation / Social Concerns

- Use signing and put notice in local newspaper to inform public about ongoing landscape treatments along bike and horse trails and to inform public when trails will be obstructed or closed. *Moderate effectiveness.*
- Restrict transport of wood material as needed to reduce conflicts with recreation activities (LRMP M19-29). When restrictions are not practical, short term closure of public access may be necessary. *Moderate effectiveness.*
- Protect trail tread by minimizing travel across trails by logging equipment and restore damaged tread to standard (coordinate with trails specialist). *Moderate effectiveness.*
- Minimize amounts of logging debris down on trails. Remove any debris within a reasonable time period. *Moderate effectiveness.*
- When equipment operations occur within areas identified as having noxious weeds, equipment will be cleaned prior to moving to into other areas. *High effectiveness.*

Plants

Areas of Peck's Penstemon within Areas of "Managed" Populations: EA Units 6,12,22,30,61,65,67,129,173,247.

- Within "managed" populations: a) avoid severe ground disturbances, such as landings or pile burnings, in population concentrations; b) limit skid trails to less than 20% of population area. *High effectiveness.*
- To reduce incidence of in advertent, gouging-induced mortality of existing Peck's Penstemon plants in "managed" populations, mechanical thinning over snow or frozen ground is preferable to thinning on exposed or non-frozen soil. *Moderate effectiveness*
- To reduce risk of inadvertent introduction or spread of invasive plants, do not allow harvest of Special Forest Products, specifically, firewood, in portions of treated units occupied by Peck's Penstemon. *Moderate effectiveness.*

Areas of Peck's Penstemon within Areas of "Protected" Populations: EA Units 23,24,25,27,28,29,31,37,38,39,41,43,44,45,46,80,81,82,83,92,96,110,115,176,195,202,210,254,255,257.

- Within "protected" populations: do not conduct mechanical thinning. Underburning, hand thinning, mowing - activities observed to generally cause minimal ground disturbance - are allowed. *High effectiveness.*

Areas in which Invasive Plants Occur:

- Survey project area to detect new weed sites and assess current condition of known sites. Update weed database and associated spatial layers. Hand-pull, bag, remove, and properly dispose of weeds at small sites encountered during these surveys. *Moderate effectiveness*
- Before ground-disturbing activities begin, prioritize and treat weed infestations in project operating areas and along access routes. *Moderate effectiveness*
- Use clean-equipment contract clauses (local and regional) to minimize the introduction and spread of noxious weeds by contractors. *High effectiveness*
- To reduce the risk of spreading weed infestations, fuels reduction treatments in roadside weed sites should be conducted en masse, with remaining fuels reduction activities occurring, inside to outside, on a unit by unit basis. Any on-Forest cleaning of equipment should be done at specified sites. *Moderate effectiveness*
- Known weed sites will be shown on the Project Area Map. Landings and skid trails will not be allowed within these sites. *Moderate effectiveness*
- Minimize soil disturbance and retain native vegetation, in and around project activity areas, to the extent possible consistent with project objectives. *High effectiveness*
- Conduct post-treatment monitoring and control of weeds within and adjacent to the project area and along haul routes for at least three growing seasons following completion of the project. *Moderate effectiveness*

Scenic Quality

Mitigation measures are designed to help reduced impact on Scenic Resources resulting from proposed management activities, while at the same time meeting the LRMP standard and guideline directions for Scenic Views.

Applicable for all proposed treatment units*,* including units within the foreground landscape areas (0-1/2 mile) of primary and secondary scenic and travel corridors, including Highway 242, Forest Road 15, Forest Road 16, along Whychus Creek Wild and Scenic River corridor, and along the Metolius Windigo trail.

- Vegetation treatment activities should be subordinated to existing landscape character and result in landscape patterns that mimic patterns created by natural disturbance (e.g. fire) to the greatest extent practical. The line, form, color, and texture elements found within the existing landscape should be present and maintained. *High effectiveness*
- Proposed treatments to reduce fuel loading should not dominate naturally established line, form, color or texture elements within the proposed treatment areas. *High effectiveness*
- Approximately 80% of the slash generated in the treatment areas should be removed (to be coordinated with other resource areas) from the immediate foreground landscape area (0-300') and slash piles should be small and not be

obvious to the casual forest visitor following post treatment activities. *High effectiveness*

- Clean-up activities for foreground landscape within the proposed treatment units and landings along scenic and travel corridors frequented by the recreating public should be completed within one year for Retention, and two years for Partial Retention allocation areas. A Forest Plan amendment would be necessary if the time frame for such post harvest treatment activities cannot be met. *High effectiveness*
- When a prescribed fire is utilized, avoid scorching above 2/3 of the live crown in units located within the Foreground landscape of recreation sites, scenic and travel corridors. Severely damaged and/or burned trees shall be treated, such as pruning, and/or removed soon after as part of post treatment activities, within a one and two year time frame. *High effectiveness*
- Minimize ground disturbance and damage to vegetation in foreground landscape areas seen from scenic and travel corridors. *High effectiveness*
- Slash clean up within scenic and travel corridors should be completed by hand piling. This recommendation is applicable primarily within the immediate foreground landscape area (0-300 feet from roadway). *High effectiveness*
- Flush cut stumps in the proposed units along scenic and travel corridors within the immediate foreground landscape area (0-300 feet from roadway). *High effectiveness*
- Where possible, design and locate skid trails and landing areas at least 300 feet away from scenic and travel corridors. Use parallel (to a travel corridor) skid trails to help reduce visual effect. *High effectiveness*
- Where possible, use cut tree marking (blue paint) to minimize the amount of marking paint visible from recreation sites, scenic and travel corridors. Paint back side of tree if leave tree marking (orange paint) is utilized to reduce residual visual effect in the landscape. *High effectiveness*
- Removal of all flagging materials soon after project completion. *High effectiveness*

Heritage Resources

Where sites need to be avoided, an archaeologist will mark the area to be avoided prior to project layout or design. Avoidance areas will be marked in contractor files or maps as areas to be avoided and *not* as archaeological sites. All areas to be avoided or otherwise within treatment areas should be monitored by an archaeologist once during and once after implementation to confirm that avoidance measures were implemented and effective.

- Exclude Heritage resource sites from mechanical harvest units. Unit boundaries may need to be modified or the resource site may de designated as a “no treatment/leave area.” No landings, skid trails or temporary roads will be located to include any portion of known Heritage resource area. *High effectiveness*.

- In units that need protection, and during post sale operations (including road decommissioning) mark sites on the ground for avoidance prior to layout. An Archaeologist will monitor. *High effectiveness*
- Mowing operations will be conducted to minimize ground disturbance from equipment and would avoid historic or prehistoric properties. *Moderate effectiveness*
- Burning operations will not include any pile burning or containment line construction in heritage resource areas. Avoid Historic resource areas that contain combustible historic materials during underburning. *Moderate effectiveness*.
- Burn plans will be reviewed by the Archaeologist. *High effectiveness*
- Avoid ground disturbance within known Heritage resource locations (i.e. subsoiling). Road decommissioning should avoid subsoiling, waterbarring, or other ground disturbance within site areas. These locations can be decommissioned by placing or spreading trees, rocks, slash or other debris over the road surface without anchoring or installing any of these elements. *High effectiveness.*

Comparison of Alternative

The following table provides a summary of implementing each alternative. Information in the table is focused on activities and effects where different levels or outputs can be distinguished qualitatively or quantitatively among alternatives.

Table 10: Comparison of Alternatives.

Resource Area	Alternative 1 (No Action)	Alternative 2	Alternative 3
Forest Health, Sustainability, and Resiliency **Key Issue #1**	Recruitment of large trees would be slowed due to the continued density-related decline in tree growth and vigor	Thinning from below to meet the upper management zone densities would occur on 16,994 acres thereby reducing competition stress on large older ponderosa pine	Under this alternative the same number of acres would be thinned as in alternative 2, however it is estimated that 20% of those acres would not be thinned to densities that are below the upper management zone.
Forest Health, Sustainability, and Resiliency **Key Issue #1**	Over-dense stands within the planning area are declining, resulting in an increasing risk of losing late successional habitat to wildfire, insects or disease.	Thinning from below to meet the upper management zone densities would occur on 16,994 acres thereby reducing stand densities and improving conditions for tree and stand health and vigor.	Under this alternative the same number of acres would be thinned as in alternative 2, however it is estimated that 20% of those acres would not be thinned to densities that are below the upper management zone.

Resource Area	Alternative 1 (No Action)	Alternative 2	Alternative 3
Forest Health, Sustainability, and Resiliency **Key Issue #1**	Approximately 75% of the project area acres would remain above the Upper Management Zone and considered at risk for bark beetle mortality	Approximately 30% of the project area acres would remain above the Upper Management Zone and considered at risk for bark beetle mortality	Approximately 41% of the project area acres would remain above the Upper Management Zone and considered at risk for bark beetle mortality
Forest Health, Sustainability, and Resiliency **Key Issue #1**	Approximately 98% of the Late and Old Growth Structure acres would be above the Upper Management Zone and considered at risk for bark beetle mortality	Approximately 38% of the Late and Old Growth Structure acres would be above the Upper Management Zone and considered at risk for bark beetle mortality	Approximately 63% of the Late and Old Growth Structure acres would be above the Upper Management Zone and considered at risk for bark beetle mortality
Forest Health, Sustainability, and Resiliency **Key Issue #1**	The trend in some portions of the project area toward increase in fire intolerant species (primarily western juniper and white fir) would continue to increase	The trend in treated portions of the project area would be toward a decrease in fire intolerant species (primarily western juniper and white fir) in the size classes less than 21” dbh	The trend in treated portions of the project area would be toward a decrease in fire intolerant species (primarily western juniper and white fir) in the size classes less than 21” dbh

Resource Area	Alternative 1 (No Action)	Alternative 2	Alternative 3
Fire Hazard Risk Reduction **Key Issue #1**	Approximately 79% of the planning area is in a fuels condition class 2 or 3, where fire regimes/vegetation patterns have been substantially altered from historic ranges. This has resulted in a high risk of uncharacteristic wildfires.	A total of 17,605 acres would receive one or more of the following fuel treatments; thinning from below, mechanical treatment of brush, and underburning. Areas of condition class 2 and 3 would be moved to the lower risk condition class 1.	Same as Alternative 2
Fire Hazard Risk Reduction **Key Issue #1**	High fuel loads exist directly adjacent to many homes and structures on NFS lands, making them difficult to protect	By treatment of approximately 3179 acres of NFS lands within 600' and adjacent to private lands the ability to protect homes and other structures would be increased.	Same as Alternative 2
Fire Hazard Risk Reduction	Escape routes within the planning area primarily condition class 3.	A total of 26 miles of major and secondary roads providing escape routes would be reduced to condition class 1	Same as Alternative 2
Fire Hazard Risk Reduction	Existing high vegetation crown bulk densities increase the risk of moderate and high severity wildfire and at the costs of wildfire suppression.	Alternative 2 would reduce crown bulk densities and thus the risk of moderate and high severity wildfire and the potential costs of wildfire suppression.	Same as Alternative 2

Resource Area	Alternative 1 (No Action)	Alternative 2	Alternative 3
Fire Hazard Risk Reduction	The absence of fire in the ecosystem has resulted in a shift in vegetation from fire tolerant species to fire intolerant species.	A total of 16,994 acres would be thinned, 15,308 acres would be prescribed burned and 16,047 acres would be masticated (e.g. mowed). This would result in the movement of stand composition, structure and density to historical conditions.	Same as Alternative 2
Wildlife	In the short term maintains the maximum amount of cover and forage for wildlife	Vegetation treatments would occur in some areas currently functioning for wildlife cover and forage, however amounts would still exceed LRMP standards	Same as Alternative 2
Soil Productivity	The extent of detrimental soil conditions would not increase above existing levels because no new activities would occur	The use of ground-based equipment for vegetation management treatments would increase the amount and distribution of soil impacts within activity areas. The extent of soil impacts would, however, remain within LRMP Standards	A smaller diameter limit on the size of trees removed is expected to result in an increase in the required entries into stands over their long term rotation,100 plus years (additional entries results in additional soil impacts over the long term)

Resource Area	Alternative 1 (No Action)	Alternative 2	Alternative 3
Hydrology	No actions would occur within RHCAs	Actions would not affect streamflow, channel conditions, or water temperature; in addition sedimentation from activities would be negligible	Same as Alternative 2
Botany	Peck's Penstemon occurrences would experience no elevation in short term risk of disturbance	Effects of mowing, hand thinning, mechanical thinning, and underburning in managed populations would be compliant with the Species Conservation Strategy	Same as Alternative 2
Botany	Peck's Penstemon occurrences would experience no elevation in short term risk of disturbance	Mechanical thinning would not occur in protected populations, again in compliance with the Species Conservation Strategy	Same as Alternative 2
Fish	No actions would occur within RHCAs	Actions would not affect water temperature, stream enbeddedness, large wood, pool frequency, channel habitat, fish passage, refugia, stream condition, and floodplain connectivity	Same as Alternative 2

Resource Area	Alternative 1 (No Action)	Alternative 2	Alternative 3
Scenic	The area could be at risk of losing key scenic elements to wildfires	In the long term (5 years and beyond) treatments are expected to benefit and enhance landscape character	Same as Alternative 2
Heritage Resources	No actions would occur	Any and all effects to heritage resources would be avoided or mitigated	Same as Alternative 2
Recreation	There would be no impacts on recreationists from restoration activities	There would be short term impacts such as displacement from forest settings during restoration activities	Same as Alternative 2
Recreation	There would be no impacts on recreationists from restoration activities	The predicted reduced risk of severe disturbance would reduce the potential impacts to recreation	Same as Alternative 2
Economics	No actions would occur	Under alternative 2, total costs are estimated at $16,479,425 and total product values estimated at $6,070,000 resulting in an estimated net value of negative $10,409,425.	Under alternative 3, total costs are estimated at $16,027,339 and total product values estimated at $3,593,000 resulting in an estimated net value of negative $12,434,339.
Timber Volume (MBF = 1000 board feet)	No timber would be harvested	12,894 MBF	6,480 MBF

CHAPTER 3 ENVIRONMENTAL CONSEQUENCES

This chapter presents information about current resource conditions, and the direct, indirect and cumulative effects of implementing the Proposed Action and a second action alternative. These effects are the scientific and analytic basis for the comparison of alternatives. The information presented in this chapter summarizes and cites the specialist's reports that are found in the project analysis file. Full versions of the specialist's reports are available at the Sisters Ranger District office Sisters, Oregon.

Effects are classified as follows by the National Environmental Policy Act:

- Direct – effects which are caused by the action and occur at the same time and place.
- Indirect – effects which are caused by the action and are later in time or farther removed in distance, but are still reasonable foreseeable.
- Cumulative – impacts that result from the incremental impact of the action, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions.

The project IDT identified past, present, and reasonably foreseeable future actions that might have cumulative impacts with the Proposed Action early in the analysis process. These actions are listed below. Each resource area considered different mixes of these actions, depending on the cumulative effects boundary for the resource area and the resource affected. For example, the cumulative effects boundary for forage hiding cover in mule deer winter range considers the Deer Habitat MA-7 Allocation as the cumulative effects boundary, whereas hydrology considers the analysis watersheds as the cumulative effect boundary. Only those past, present and reasonably foreseeable actions that overlap the geographic analysis area boundary for each particular resource are considered, and only if those actions are expected to have environmental effects that accumulate with the other project effects.

The suite of past, present and reasonably foreseeable future actions developed by the project IDT, and examined for overlapping effects with each resource in the SAFR project area are listed below.

Past Actions

- Wildfires
    - Squaw Creek Burn (1960)
    - Weir Burn (1967)
    - Peterson Burn (1968)
    - Squaw Bench (1976)
    - Ditch (1978)
    - Plainview Fire (1978)
    - Sisters Fire Salvage (1980)
    - Snow Creek #2 (1981)

    - Big Buck (1981)
    - Pine Flat (1981)
    - Overpass (1983)
    - Six Mile (1985)
    - Tollgate Fire (1986)
    - Indian Ford (1987)
    - Pole Creek (1987)
    - Seed (1987)
    - Cow Camp Fire (1993)
    - Dugout (1999)
    - Street Creek (2002)
- Large fires (>25 acres) within the project area between 1919 and 2005
    - Cold Springs #1, 226 acres in (1919)
    - Cold Springs #2, 193 acres in (1919)
    - Peterson Mill, 577 acres in (1941)
    - Melvin Butte, 691 acres in (1947)
    - Squaw Creek, 609 acres in (1959)
    - Wier Grade, 585 acres in (1969)
    - Tollgate, 339 acres in (1979)
    - Delicious, 2041 acres in (1990)
    - Cow Camp, 278 acres in (1991)
    - Steven’s Canyon, 1,080 acres in (1991)
    - Park Meadow, 598 acres in (1996)
    - Cache, 382 acres in (1999)
    - Cache Mountain, 3,886 acres in (2002)
    - Eyerly, 27,020 acres in (2002)
    - B&B, 90,681 acres in (2003)
    - Link, 3,590 acres in (2003)
    - Black Crater, 9,335 acres in (2006)
    - Lake George, 4,645 acres in (2006)
- Timber Sales
    - Candle Ridge (1983)
    - West Highway (1984)
    - Island Lake (1986)
    - Orchard (1997)
    - Santiam Corridor (1997)
    - Round (1988)
    - Cold Springs (1989)
    - Corridor Follow-up (1998)
    - Little Buck (1989)
    - Scout (1989)
    - Jack Canyon (1990)
    - Wizard (1990)
    - Twin Swamp (1993)
    - Walla Bear (1995)
    - Davis Creek Thinning (1996)

  - Big Bear (1997)
  - Happy Jack (2000)
  - Highway 20 (2000)
  - Coil Fiber (2002)
  - Bear Garden (2002)
  - Broken Rim (2003)
  - Eyerly Fire Salvage Timber Sales (2004)
  - Lower Jack Re-offer (2004)
  - B&B Fire Timber Sales (2006)
- Routine Hazard and Danger Tree Projects
- Road construction
- Noxious weed treatment
- Recreational use along Whychus Creek
- Development of recreational bike trails through area
- Sale of land parcel to City of Sisters for city sewer development
- Canyon Creek Crossing
- Cannel fuel reduction project
- Underline fuel reduction project

Present Actions
- Bulltrout Stream Restoration Project
- Whychus Creek Riparian Protection Project
- Canal 16 Prescribed Burn Project (1994)
- Underline Vegetation Management Project (1993/1995)
- Metolius Basin Vegetation Management (2005)
- B&B Road Closures (2007)
- Routine Hazard and Danger Tree Projects

Reasonably Foreseeable Future Actions
- Glaze Meadow Restoration Project
- West Trout Restoration Project
- Routine Hazard and Danger Tree Projects
- Potential future wildfires
- Prescribed fire smoke outside of area
- Plantation thinning
- Increased recreational impacts due to increased public use
- Road maintenance
- Further expansions of Sisters sewer system onto National Forest lands

Forest Health Sustainability and Resiliency

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Forest Health Sustainability and Resiliency Report. Reference information is contained in the full specialist report.

Introduction

This section provides information on forest health, sustainability, and resiliency. The Key Issue of size of trees removed is also discussed along with the resulting effects on forest health.

Affected Environment

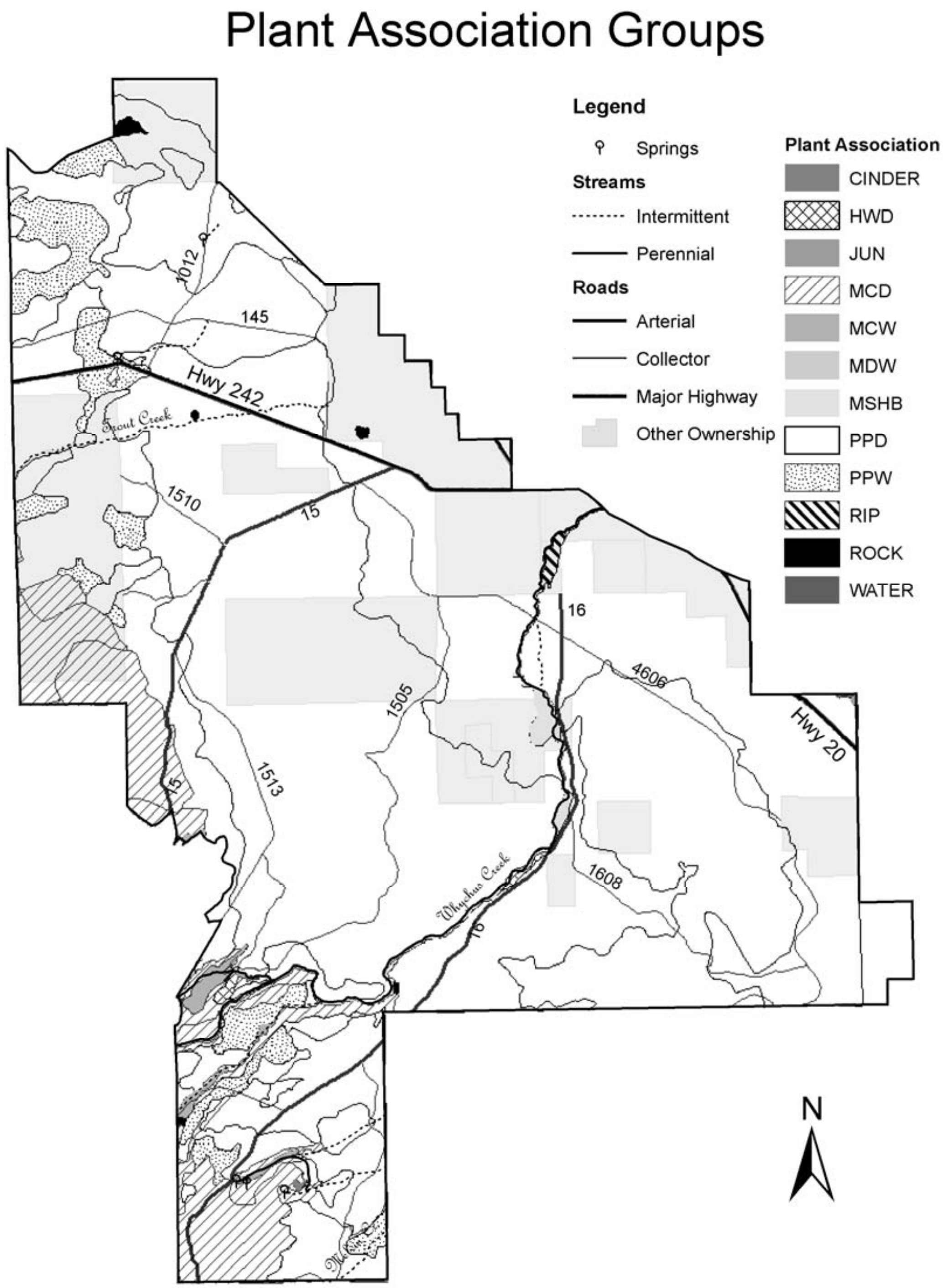
How a forest ecosystem is structured and functions within the landscape depends on the type of vegetation the landscape can support over the long-term. This is based, in part, on productive capabilities of the soil, precipitation, aspect and slope. The type of vegetation is categorized into plant association groups. Plant associations were determined through field mapping of the potential natural vegetation using the protocol established by Volland (1985), with input from the Area IV Ecologist and other Forest Specialists including silviculturists, ecologists, botanists and forest inventory personnel. The associations and series were then grouped by their climax species, site potential, and temperature and moisture similarities into Plant Association Groups, using the categories listed in the Deschutes WEAVE (Watershed Evaluation and Analysis for Viable Ecosystems) document (USDA, 1994) and are displayed in Table 11 and Figure 5.

Table 11: Plant Association Groups.

Plant Association Group	Acres	Percent
Ponderosa Pine (wet and dry)	22,373	91%
Mixed Conifer (wet and dry)	1,923	8%
Riparian	145	<1%
Non-Forest (Cinder, Rock, Water)	20	<1%
Juniper Woodlands	6	<1%
TOTAL	24,467	100%

Ponderosa pine: Ponderosa pine (wet and dry) plant associations are found over a majority (91%) of the project area. The ponderosa pine wet plant associations were combined with the ponderosa pine dry because the ponderosa pine wet plant associations represent only approximately 5% of the ponderosa pine plant associations. In this plant association group, ponderosa pine is the main seral and climax species, growing in small, even-age groups. Minor amounts of western juniper, lodgepole pine, white fir, and Douglas-fir may be present particularly in the ecotones between the juniper woodland, mixed conifer and riparian plant associations. Ponderosa pine is the dominant species across this plant association; however, due to adjacent seed sources and protection from fire, fir and lodgepole pine is increasing adjacent to the mixed conifer and riparian plant associations, and western juniper is increasing in the eastern portion of the project area.

Figure 4: Plant Association Groups in the SAFR Project Area



Mixed Conifer (Wet and Dry): Mixed Conifer plant associations, where the dominant climax species is grand fir/white fir comprise approximately 7 percent of the SAFR Project Area. The mixed conifer wet plant associations were combined with the mixed conifer dry because the mixed conifer wet plant associations represent only approximately 7% of the mixed conifer plant associations. These plant associations are found primarily in the higher elevations on the south and west portions of the project area. The majority (approximately 86%) of the acres in these plant associations are dominated by early seral species such as ponderosa pine and lodgepole pine with minor amounts of late seral species such as white/grand fir, Douglas-fir and Engelmann spruce. Approximately 15% of the acres contain enough late seral species to be considered mid to late seral in species composition.

Riparian: This type is found on less than 1% of the project area and is found in the interface between terrestrial and aquatic ecosystems. This interface is primarily associated with streams and springs and Trout Creek swamp. These are the plant associations were plants that are dependent on a year-round or nearly year-round source of water are found; consequently, vegetation in these plant associations can be very diverse.

Non-Forest: Consist of small areas of bare cinder cones, rock and water bodies within the planning are. This type makes up a very small percentage of the planning area.

Juniper Woodlands: Extensive areas of juniper woodlands exist to the east of the planning area. Small areas of these juniper woodlands occur within the planning area along the eastern fringe.

Existing Condition

The historic conditions of the vegetation in the SAFR project area is described in the Whychus Watershed Analysis (USDA, 1998). This analysis indicates that fire played a significant role in creating open, fire-climax forests across the SAFR project area. The ponderosa pine and mixed conifer dry plant associations, 90% and 9% of the project area, respectively, were part of a large landscape patch dominated by medium/large tree (21”+ dbh) ponderosa pine habitats with open canopies of 1 to 2 stories.

At the turn of the 18^{th} century, the SAFR project was bisected by the eastern boundary of the Cascade Forest Reserve (CFR) that was established in 1893 and was the precursor to the National Forests (Langille and others, 1903). The CFR boundary, which split the project area in approximately half, was the boundary between Range 9 East and Range 10 East. The western half of the project area was within the boundary of the old Cascade Forest Reserve (CFR) and the eastern half of the project area was in private ownership.

Aerial Photo Interpretation from 1953 photos indicate very little timber harvest had occurred in the western half of the project area within the boundaries of the old CFR. However, extensive timber harvest had occurred on the lands within the eastern half of the project area, east of the old CFR boundary. From the 1953 photos, conditions in the western half of the project area were similar to those described in the late 1800's surveyor's notes, except that years of fire exclusion had increased the number of small trees and in the mixed conifer and riparian plant associations allowed the establishment of fire intolerant species such as white fir, Douglas-fir, lodgepole pine, Engelmann spruce and western juniper in the ponderosa pine plant associations. The ponderosa pine and dry mixed conifer areas were dominated by large unfragmented patches of open, medium-large sized ponderosa pine. The eastern half of the project area, as a result of extensive timber harvest in the early 1900's and therefore has experienced dramatic changes in forest structure and density.

Over the past 100 years, dramatic changes (fire exclusion, timber harvesting, road construction, etc.) have occurred in the SAFR project area (USDA, 1998). Perhaps the greatest single impact on ecosystem stability has been the exclusion of fire. Historically, the mixed conifer and ponderosa pine forests were strongly influenced by frequent fire disturbances that maintained open under stories and a dominance of long-lived, fire adapted species such as ponderosa pine. All of these processes, in turn, helped reduce competition for water and nutrients, prevented extreme effects from insect and disease cycles, and maintained vigor in the dominant tree species.

Historic Disturbance Regimes

Table 12 displays the historic disturbance regimes that were dominant within the SAFR project area based on similarly described natural fire regimes (Agee 1990, 1993; Brown 1995; Hann and Bunnell 2001).

Table 12 Historic Disturbance Regimes within the SAFR Project Area

Biophysical Environment	Dominant Disturbance Factors	Disturbance Regimes * (Agee, 1990)	Average Disturbance Patch Size Acres	Typical Landform Setting	Typical Elevation	Aspect
Non-Vegetated	n/a	n/a	n/a	n/a	n/a	n/a
Ponderosa Pine	1) Fire 2) I &D	Low Low	40 – 100 1 – 20	Elevated and dry Sites	3,200 to 4200	Flat / Rolling
Mixed Conifer	1) Fire 2) I &D	Low to Moderate Low to Moderate	100 – 500 100 – 500	Elevated and dry Sites	3,600 to 4800	North and East

*Low severity regimes: 0-35 year return interval, 0-25% tree mortality,
Moderate severity regimes: 35-100 year return interval, 26-75% tree mortality,
High severity regimes: 100+ year return interval, 75% + tree mortality

Influences of Disturbance Size and Intensity on Forest Vegetation

Disturbances are an important process in continuing the cycle of renewal in most ecosystems, and some amount of mortality from disturbances is desirable, particularly for those species such as woodpeckers that are associated with snags. However, there has been an important change in the type of disturbances that are now affecting this ecosystem. The primary historic disturbance was frequent, low-intensity fire, which helped maintain stable ecosystem functions and old growth characteristics in the ponderosa pine plant associations that dominate the SAFR project area. Other important historic disturbance agents in the project area were western pine beetle and western dwarf mistletoe. In general, historical disturbances in the SAFR project area caused mortality from single trees to small groups of trees and rarely, larger patches. This resulted in the important, though minor, structural elements of diseased, dead, damaged and down trees. Many species (wildlife, plant, insect, fungi, microorganisms, etc.) have evolved with the historic cycles and scales of disturbance and successional patterns.

The current primary types of disturbances on the Sisters Ranger District are uncharacteristic wildfire (less frequent, moderate to high severity) (USDA, 1998) and insects and diseases, primarily bark beetles and western dwarf mistletoe. This change may result in fluctuations in habitat conditions more extreme than historic levels for this forest, with potential loss of important habitat elements, such as larger long-lived trees, canopy cover, and large snags and down wood (Graham et al., 1999). In addition, there may be a trend of slower recovery of the system, partly due to the effect of high intensity wildfires on soil productivity. The result is a greater impact on those species which have adapted to dense habitat conditions, while it may benefit some early seral species, which can tolerate extreme disturbances.

Mortality across the SAFR Project Area is generally low; however, large ponderosa pines are declining and may eventually become rare (personal communication, Bill Hopkins, Zone Ecologist). The effects of the drought of the 1980's and early 1990's caused many of these old (250-350 years) trees to succumb to western pine beetle and root disease. This mortality has had the positive effect of moving toward restoring the historic snag component, much of which was removed in harvest activities over the last 50 years. However, it is also indicative of stand conditions that are placing stress on the overstory, and when drought conditions return another wave of mortality would be expected.

Fire

The historical fire regime for the ponderosa pine series, which dominates the SAFR project area, has been described by Agee (1993 and 1994). Prior to fire suppression, ponderosa pine forests within the SAFR project area experienced frequent, low-intensity surface fires. Frequent fires in the ponderosa pine type maintained surface fuels at fairly low levels, kept understory trees and vegetation at low levels preventing the formation of ladder fuels that could carry fire into the upper canopy. The high crowns and thick bark of mature trees protected them from the low-intensity wildfires common in the ponderosa pine type.

The frequent low-intensity fire regime of the ponderosa pine type led to the most stable landscape pattern of all the eastside forest vegetation types. The historic landscape pattern in the ponderosa pine type was uneven-aged at the landscape scale but even-aged at the stand or group scale that resulted in a landscape of open park-like stands of trees with the understory dominated by herbaceous vegetation. The even-aged patches within the landscape pattern were created when individual trees or small groups of trees died creating gaps in which new even-aged clumps would develop.

Insects and Disease

The roles of insects and diseases as disturbance agents in the forest are very closely tied to vegetation patterns. Factors such as species composition, size structure, and density of forest stands are all very important in determining which agents are likely to be present in the forest, their abundance, and how profound their effect is likely to be on that vegetation. By their actions, forest insects and diseases sometimes alter the vegetative patterns that provided them with suitable habitat, and set the stage for new processes to occur.

The primary insects within the project area include the western pine beetle, mountain pine beetle and pine engraver beetle. Bark beetles prefer old trees in dense stands with low vigor (USDA, 2000) and so may present an additional risk to large trees in the project area. Acres above the upper management zone or density are considered imminently susceptible to bark beetles.

The primary disease found in the project area is western dwarf mistletoe. Dwarf mistletoe is widespread across Central Oregon, and a study (DeMars, 1980) on the Deschutes National Forest showed that the parasite could be found in approximately 45% of the ponderosa pine stands, with about 24% of the trees in these stands exhibiting some level of infection. Based on field surveys, an estimated 10,000 to 13,000 acres of ponderosa pine in the project area are infected by dwarf mistletoe.

Moving forest densities, structure and fuels to conditions similar to the natural or historic range of variability is expected to reduce the risk of severe stand-replacing wildfires and widespread insect and disease outbreaks, and intensity of effects when disturbances occur (Brookes et al., 1987). These actions could also help maintain old-growth ponderosa pine longer. The remaining old trees may have genetically inherent survival traits that make their gene pool important and rare. They have survived centuries of droughts, fires, insect/disease outbreaks, and human impacts but are reaching the end of their lifecycle which could be extended by reducing competition, stress, and bark beetle susceptibility (Wickman, 1992).

Timber Harvest

The Sisters Ranger District has had an active timber harvest program that began in the mid 1940's, after World War II. Past timber harvest in the SAFR project area has been extensive and evidence of past timber harvest can be found across the project area except on the steep slopes above Whychus Creek. Most of the harvesting involved harvesting a portion of the original overstory component and some commercial thinning. However, approximately 3,466 acres of regeneration harvest (shelterwood and clearcut) have occurred and another 2,016 acres of salvage harvest.

Typical tree size and density in many stands in the project area

Currently, the forests in the SAFR project area is composed of stands that are either multi-layered with large old trees present, dense to moderately dense second-growth pine where most of the older trees were removed, or plantations resulting from regeneration harvesting (e.g., clearcutting, shelterwood systems) in the 1970's through the early 1990's. The multi-layered conditions that have developed in many stands favor some species such as goshawks, while having a negative effect on other species, such as the white-headed woodpecker and Peck's Penstemon.

Historic range of Variability (HRV)

Historic range of variability (HRV) is a term used by ecologists to describe the natural fluctuation of ecosystems over time. In this project, HRV refers to the range of conditions and processes likely to have occurred prior to settlement by Americans of European ancestry (mid-late1800s). HRV serves as a reference point from which change can be measured, rather than a condition that ecosystem management tries to attain. In fact, science findings suggest that such a condition could not be achieved. This misunderstanding about HRV is common, as is the tendency to equate HRV with "natural" conditions. American Indians altered the landscape in many ways, though nowhere near the scale of change as populations increased, land uses evolved, and technology for altering the environment was developed." (USDA, PNW-GTR-385).

HRV assumes minimal disturbance by human activities and is often used as a baseline for conditions that are assumed to have existed on the landscape more than 100 years ago. In some areas, Native Americans played a large part in shaping the vegetative structure, particularly with the use of fire, and the conditions present across the landscape a century ago took hundreds of years to develop. This development took place under environmental conditions that may or may not have been similar to environmental conditions today. For these reasons, HRV is a conceptual idea of the vegetation that may have been present historically. HRV is not an objective used in order to recreate a precise percentage of each structural stage that may have been present at any point in time.

Structural Stages, HRV and Comparison to Current Conditions

Forest structure within the project area is described according to the structural stages found in the "Eastside Screens". The Historic Range of Variability (HRV) can be viewed as an estimate of the historical percentage of the forested area in each structural stage. The HRV conditions were established by using survey notes, site visits, fire records, type maps, historic disturbance patterns and photos. Current conditions used as the basis of comparison to historical conditions were initially derived from the 1995 Photo Interpretation layer in GIS and enhanced with stand exam data and field reconnaissance.

In general, the structure of the stands across the project area is multi-storied, unevenaged, second growth consisting of small, even-aged cohorts of trees of various sizes and ages with the majority of trees less than 21" DBH. Although the majority of the project area is dominated by trees less than 21" dbh, trees 21"+ dbh can be found across the landscape. In most stands, trees 21"+ dbh are found as scattered individuals or in small clumps; however, approximately 11% of the acres in the project area are dominated by trees 21"+ dbh and 18% of the acres in the project area have enough trees 21"+ dbh to be considered possible old growth stands.

Tables 13 and 14 display the comparison of HRV and current condition of structural stages for the ponderosa pine and mixed conifer plant associations found in the SAFR project area.

Table 13: Ponderosa Pine PAG Structural Stage HRV / Current Condition Comparison

Structural Stage		Seral Stage	Historic Range of Variability (HRV)	Current % of the PAG Area	Relation to HRV
1	**Stand Initiation**	Early	10-25%	10%	Within
2 3 4 5	**Stem Exclusion, Open Canopy** **Stem Exclusion, Closed Canopy** **Understory Reinitiation** **Multi-stratum without Large Trees**	Mid	30-65%	72%	Above
6	**Multi- stratum with Large Trees**	Late (LOS)	0-7%	18%	Above
7	**Single-stratum with Large Trees**	Late (LOS)	25-60%	<1%	Below

Table 14: Mixed Conifer PAG Structural Stage HRV / Current Condition Comparison

Structural Stage		Seral Stage	Historic Range of Variability (HRV)	Current % of the PAG Area	Relation to HRV
1	**Stand Initiation**	Early	8-19%	14%	Within
2 3 4 5	**Stem Exclusion, Open Canopy** **Stem Exclusion, Closed Canopy** **Understory Reinitiation** **Multi-stratum without Large Trees**	Mid	35-55%	68%	Above
6	**Multi- stratum with Large Trees**	Late (LOS)*	8-15%	21%	Above
7	**Single-stratum with Large Trees**	Late (LOS)*	18-38%	2%	Below

*LOS = Late and Old Structural Stage

The trends in structural stages are similar for both the ponderosa pine and mixed conifer plant associations. As a result of fire suppression and timber harvest and, to a limited extent, wildfire, there far more small trees and far less large trees across the project area than there were historically. Fire suppression has allowed large numbers of small trees to become established and timber harvest removed a significant percentage of the larger/older trees (generally over 21” dbh but also as small as 12” dbh). This has resulted in the mid seral structural stages (2-5) being above the HRV, the multi-stratum with large trees late and old structural stage (6-LOS) being above HRV and the single-stratum with large trees (7) LOS being far below HRV.

Species Composition

With a few exceptions, species composition of trees across the SAFR project area has not changed dramatically from the historical range of variability as on other parts of the Sisters Ranger District. Ponderosa pine is still the dominant species across the project area as it was historically (i.e., prior to 1900). The only exceptions to this are the increased presence of western juniper in ponderosa pine plant associations in the eastern portion of the project area, an increase of riparian species in stands adjacent to riparian areas and an increase in late seral species such as white/grand fir and Douglas-fir in, and adjacent to, the mixed conifer plant associations.

Stand Density

Different environments can support different levels of tree density (e.g. wetter, richer soils tend to be able to support more trees per acre). The maximum biomass that a plant association can sustain, before growth is suppressed and trees begin to decline in health, is the “upper management zone” (Cochran et al. 1994, Eglitis, 1997; and Maffei, 1997). Approximately 92 % of the project area is above the upper management zone (75%) and/or has high densities of small trees (18%). High stand densities tend to increase stress and reduce vigor among all size classes, and increase the likelihood of mortality from insects and diseases, especially during droughts. High stand densities also contribute to increase fire hazard.

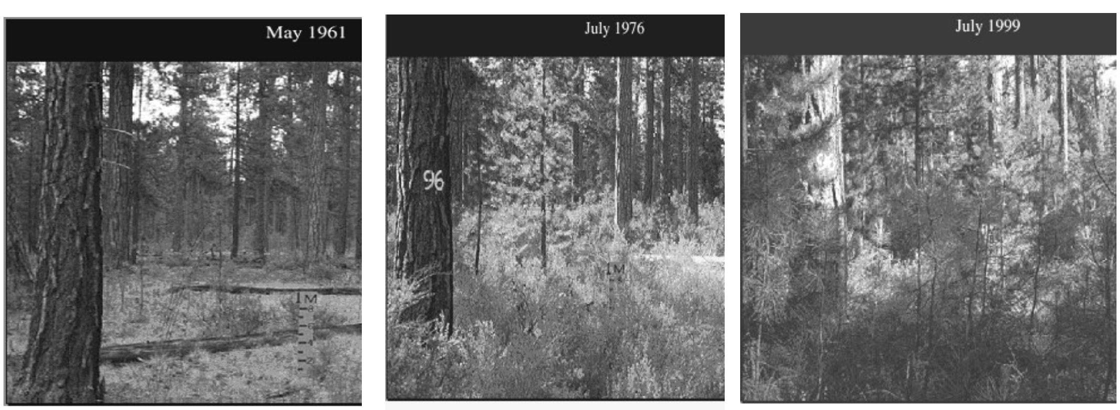


Photo points on the Sisters Ranger District that demonstrate the rate of understory growth over 38 years

Maintaining stand densities at sustainable levels is essential for promoting forest health and maintaining or creating large trees and habitats in dry areas. The upper management zone is a site-specific threshold density, above which forest health conditions and large tree health are likely to deteriorate. The primary cause is that, on any given piece of ground, there are limits to growing space or the resources available for plant growth. When these limits are reached, loss of plant growth and/or mortality can become common elements of the stand. In addition, due to stress on the existing stands, they may be at a high risk of impacts from wildfire, insects or disease.

Forest Stand Densities: What is the "Upper Management Zone"?

The *upper management zone* is a concept described by Cochran and others (1994) and is one way to describe and analyze the density of forest stands. It is defined as a threshold density level at which a suppressed class of trees begin to develop in a stand. This is the point at which trees begin to come under stress because they are intensely competing for growing space (Oliver and Larson, 1996). Growing space is the aggregate of all the factors necessary for the growth of plants. These factors include, but are not limited to, the following: sunlight, water, mineral nutrients, suitable temperature, oxygen, carbon dioxide and physical space. Because plants have unique anatomies they need to grow to survive. The growth of plants can become limited when any one of the growth factors becomes limited. The higher stand densities are above the upper management zone, the more the growing space becomes limited and the greater the risk is of losing trees in the stand.

What is the upper management zone based on? There are certain biological limits to growing vegetation. For example, if you were to plant 1,000 carrots in a 5-gallon bucket, you would expect many of them never to survive. Of those that survived, there would be such competition for food, water and light that you would not expect the carrots to grow very well. In addition, physical space would play a factor in limiting how large the carrots could grow. However, if you were to try planting 20 carrots in the 5-gallon bucket, you could expect much less competition for food and water, much less mortality, and much larger and healthier carrots.

The forest operates on the same principles that dictate what happens with carrots in the 5-gallon bucket. The forest is limited in space, water, nutrients and light available for plant growth. These factors, along with other climate and site factors help set the limits of the type, size, and amount of forest vegetation that can be grown on a given site. If we want healthy forests with large trees, then it is important to help control how dense the forest is growing.

Scientific studies have determined certain "normal" density limits for conifer species. The upper management zone is the density level that is approximately 75% of the density of the "normally" stocked stand.

Trees per Acre versus Basal Area: There are numerous ways to characterize stand density. Two of the most common ways are trees per acre and basal area. Basal area is the surface area, in square feet, of the cross-section of the bole of a tree at 4.5 feet above ground level. When you relate the amount of basal area or trees per acre to some unit of land, an acre for example, then that tells you something about the density of trees on that acre. Trees per acre and basal area are related in that small trees have very little basal area and large trees have a relatively high amount of basal area. For example, a 5" tree contains 0.14 square feet of basal area and a 30" tree contains 4.9 square feet of basal area. Consequently, it takes about 36 5" trees to make the same basal area of one 30" tree.

Density management, regardless of the measure used (e.g., basal area, trees per acre, etc.), helps managers consider not only the quantity of trees a site can support, but also the quality, or types of trees we want to grow. If you want to grow poles for the wood products market, it may be okay to grow many more trees on an acre, than if you want to grow large trees with large limbs and well-developed crowns (the type of forest structure so important to many old-growth species).

The upper management zone relates to the density of trees (basal area, trees per acre, etc.) a forest stand can support without significant mortality from bark beetles. With information about any forest stand, an upper management zone for that site can be calculated. The upper management zone is the density level at which trees begin to come under significant stress and can become susceptible to bark beetles and perhaps other insects and diseases.

Late and Old Structure (LOS) Stands

Maintaining and enhancing late and old structure (LOS) (primarily by reducing the risk of wildfire, insect and disease) is an important objective in this project, and is recommended in the WhyChus Watershed Analysis (USDA, 1998) and the Eastside Screens (USDA Forest Service, 1995). The ponderosa pine and mixed-conifer dry plant associations are fire-climax systems. These plant associations, which are the most common in the project area, are not well suited to support species that require dense, multi-layered forests. However, there are LOS / old growth associated species that prefer open, mature pine forests, such as white-headed woodpeckers, and these are the habitats that the Forest Service is focusing on improving and protecting in much of the fire climax forests in the SAFR project area.

White-headed woodpecker habitat

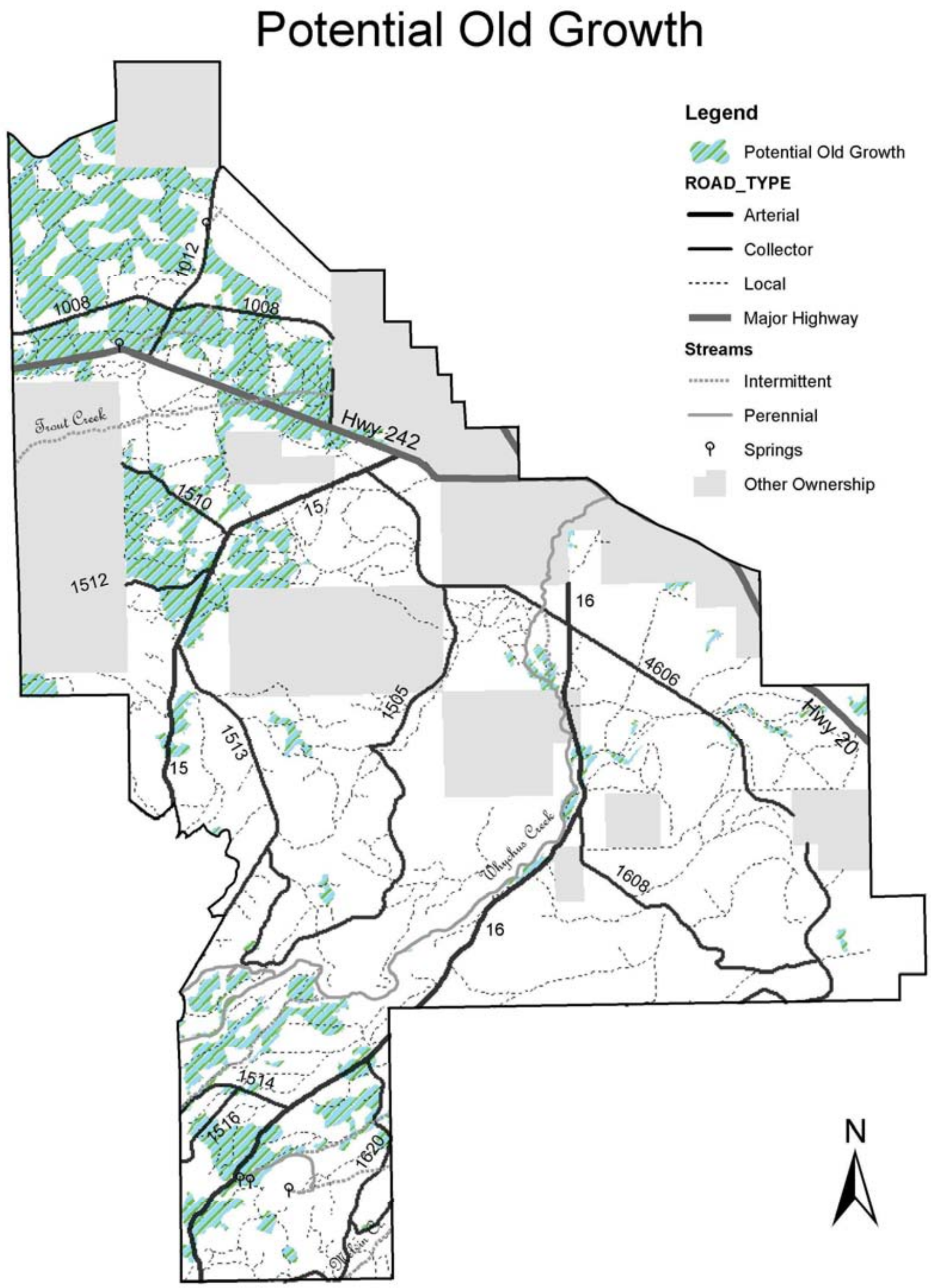
Within the SAFR project area approximately 4,350 acres (18% of the project area) were determined to be "possible LOS", based on the number of trees per acre 21 inches diameter and larger (1 of the 6 criteria used to determine old-growth / LOS stands; Hopkins et al, 1992). Possible LOS stands were identified using one or more of the following: photo interpretation, stand exams and field reconnaissance (not all possible LOS stands have been visited in the field, consequently, percentages may change slightly as LOS is field verified over time). Table 15 displays the percent of LOS in each plant association group for the project area and the relation to historic range of variability (HRV). Figure 6 displays the distribution of LOS in the project area.

Table 15: Possible LOS* by Plant Association Group.

Plant Association Group	LOS Structural Stage	Historic Range of Variability (HRV)	Current % of the PAG Area	Relation to HRV
Ponderosa Pine (Dry &Wet)	Multi-Stratum with Large Trees	0-7%	18%	Above
	Single-Stratum with Large Trees	25-60%	<1%	Below
	Total LOS	25-67%	18%	Below
Mixed Conifer (Dry &Wet) & Riparian	Multi-Stratum with Large Trees	8-15%	21%	Above
	Single-Stratum with Large Trees	18-38%	2%	Below
	Total LOS	26-53%	23%	Below

*Possible LOS for: Ponderosa Pine = 10 or more live trees/acre > 21" diameter; Mixed Conifer (dry and wet) and Riparian = 15 or more live trees/acres > 21" diameter

Figure 5: Potential LOS / Old Growth



All plant association groups (PAGs) in the SAFR project area have less total LOS than the historic range of variability (HRV). However, even though the total LOS is below HRV, the percentage of multi-stratum LOS is above HRV while single-stratum LOS is far below HRV.

Large old trees are the key structural components of old growth forests because of the time required for their development, their habitat functions as living trees, and because they contribute to the large snag and down wood component of these forests. However, altered successional patterns are working against the long-term survival of these large old trees. All growing sites have a fixed quantity of resources and growing space, and as inter-tree competition increases it is usually the large trees that die first (Dolph et. al. 1995, In: Fitzgerald et. al. 2000). It is thought that we may have only a few decades to deal with this situation, or we risk losing the large trees (Fitzgerald, 2002. personal. communication). Large trees would be lost at a faster rate at higher stand densities than at lower stand densities. On a stand-average basis, approximately 98% of the Late and Old Growth Structure (LOS) acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality.

Medium/large ponderosa pines (trees greater than 21" dbh) were rated for vigor based on the vigor classes developed by Keen (1943). Of the 607 trees rated, 58% were rated as being in fair to poor (51%) or poor (7%) condition and 42% were rated as being in good (7%) or good to fair (35%) condition. These results indicate that a majority of the large old ponderosa pine across the SAFR project area are in fair to poor condition indicating a general decline in the health of these trees. Without action it is predicted that loss of the large tree structure would continue. Given the relatively low numbers of trees 21 inches diameter or larger per acre compared to smaller trees, this number could be considered substantial.

Desired Future Condition

Forest health in over-dense stands is declining, resulting in an increasing risk of losing LOS habitat to wildfire, insects or disease. In addition, due to the extensive accumulation of fuels, there is a higher risk of losing the well-established old-growth ponderosa pine, which are resilient to low-intensity fires but can be lost in high-intensity fires, and which are considered a highlight of the forests in the SAFR project area. The desired future condition of the area would include variable densities of the largest and healthiest trees across the landscape based on site capability.

Thinning from Below

This treatment, also known as "low thinning", is "the removal of trees in the lower crown classes to favor those in the upper crown classes." (Helms, 1998). Thinning from below accomplishes several important management objectives including 1) reducing fire hazard and 2) improving forest health and tree growth. In general, the smallest trees at any particular location are the trees that will be removed and the largest, healthiest trees would be retained. Occasionally, a larger tree may be removed if the larger tree is in poor condition and a better smaller tree is present.

Thinning from below reduces fire hazard, and in turn, the risk of large catastrophic wildfire, by removing small diameter trees that create ladder fuels, which are capable of carrying fire from the ground fuels (e.g., woody material, forbs, grasses and shrubs) into the tree canopy. This thinning also reduces crown density and continuity to reduce the potential spread of crown fires. The resulting more open stand structure allows ground fire to move through the remaining larger tree stand, removing the build up of ground fuels without moving into the tree canopy. The remaining trees experience low levels of damage. Thinning from below improves forest health and tree growth by decreasing competition providing the remaining trees with increased moisture, nutrients and light.

Thinning from below begins the process of moving the landscape back toward the historic range of variability, where smaller trees were removed with frequent low intensity wildfire and large established trees remained on the landscape. Historically, the majority of this project area was dominated by ponderosa pine; consequently, ponderosa pine will be the preferred leave species across most of the project area. However, the objective will not be to eliminate other tree species, other species will be left for a variety of reasons. In this project area, ponderosa pine is the preferred species because it is the most resistant and resilient to wildfire, insects and disease.

The density of trees remaining after thinning would be variable between stands across the project area based on site capability. In general, the lowest densities would be on the lowest sites at the lower elevations in the eastern part of the project area and the highest densities would be on higher sites at the higher elevations in the western and southern portions of the project area. Densities would also be variable within stands by not treating some patches and by favoring the largest and healthiest trees available regardless of spacing.

Eastside Screens and Treatment of Late Old Structure (LOS)

The Eastside Screens contain standards stating that timber sale harvest is not permitted in late old structure when it is below the historic range of variability. The SAFR project area is below the historic range of variability for total late old structure (multi-strata & single strata together), however, multi strata late old structure is above the historic range of variability and single-strata is far below the historic range of variability (see section "Late and Old Structure Stands" above). The SAFR project area is also in the Whychus watershed and the ponderosa pine plant association group in this watershed is below the historic range of variability similarly to the SAFR project (USDA Forest Service, Glaze EA, 2008). The acreage of the ponderosa pine plant association group in the SAFR project area is approximately 29% of the total acreage for this association in the Whychus watershed.

The screens allow timber harvest activities to occur in late old structure stages that are within or above the historic range of variability to maintain or enhance late old structure, or to move a late old structural stage that is above the historic range of variability into the late old structural stage that is deficit (i.e., there can be no net loss of late old structure). The Glaze project proposes to move multi-strata late old structure to single-strata late old structure with no net loss of late old structure, utilizing timber harvest activities on approximately 2,749 acres or 63 percent of the potential old growth. No trees over 21 inches diameter would be removed except in instances for safety or temporary road construction. During temporary road use, the removal of trees 21" diameter or greater would only be used as a last resort and all other measures would be exhausted before considering the removal of a tree 21" diameter or greater.

No regeneration harvest is proposed in either action alternative. The proposed thinning treatments are designed to reduce tree density and improve growth of the residual trees, enhance forest health, or reduce potential morality resulting from inter-tree competition. Thinning would more quickly restore historic seral/structural stage conditions and improve growing conditions for larger trees than either no action or prescribed fire alone. Thinning contributes to the primary purposes of fuel treatment: decreasing the probability of crown fires, decreasing the severity of the impacts, enhancing effectiveness and safety, and reducing costs. While there may be short-term decreases in stand densities and while wildlife species dependent on higher density stands may experience reduced habitat, the longer-term maintenance of LOS into the future is desirable. After treatment, all 4,350 acres of LOS would remain LOS, but would have reduced canopy closures and stand densities. NO trees over 21 inches dbh would be removed except in instances for safety or temporary road construction.

Environmental Effects

Background

This analysis discloses the predicted effects of tree thinning and harvest on forest health and sustainability. The factors that are analyzed, and that influence forest health and sustainability are forest/stand structure (i.e., tree size), stand densities, species composition, and disturbance processes. Actions that can affect these factors are the type and amount of vegetation management (e.g. tree thinning and harvesting, prescribed burning, mowing and aspen restoration), and risk of extensive disturbances.

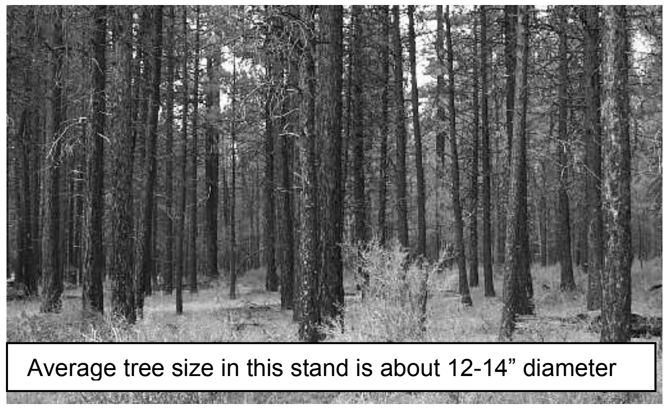
Stand Density: Stand density is a primary factor affecting growth and vigor of forest vegetation, and its resilience to disturbances. Different parts of the project area can support different stand densities, depending, in part, on available water, light and nutrients. For instance, forest stands on wetter, more productive sites can usually tolerate higher densities than stands on dry, low productivity sites. The Whychus Watershed Assessment (USDA 1998) states "maintaining stand densities at manageable levels is essential for promoting forest health and maintaining or creating large tree character and habitat in dry areas (pg. 58).

Ponderosa pine is more sensitive to high stand densities than other tree species in the project area. The longer a ponderosa pine remains in overcrowded conditions, the less it is likely to reach 21" or greater diameter. Stump analyses on the Sisters Ranger District revealed that large ponderosa pine trees initially had rapid growth rates (due to little competition) for the first 50 to 100 years and less growth over time as density increased and trees aged.

The "upper management zone" is the stand density threshold above which forest conditions and large tree health are likely to deteriorate (Cochran et al, 1994). Stands that are far above the upper management zone (the point at which tree mortality begins to occur due to competition) are more susceptible to severe disturbances than stands less densely stocked (see insert of upper management zone, Chapter 3).

Tree Size: Tree size (measured by the diameter of the trunk at 4.5 feet above the ground) is an indicator of the stage of development of old growth trees. An important structural element in the SAFR Project area forests are the large ponderosa pines. Highly valued, both socially and ecologically, there is concern about the potential loss of large trees across the project area. Proposed actions intend to improve the ability for existing large trees to survive, and to create conditions more favorable for the development of future large trees. One of the proposed actions is to thin dense forest stands to reduce the competition stress on remaining large trees, to improve the health and growth of smaller trees so that they may grow into the medium/large tree components sooner, and to reduce the high fuel levels and ladder fuels. Research shows (Tappenier et al. 1997, Hall 1998, and Hopkins 1998) that low densities are a requirement for development of large "old growth" trees with large branches. It appears that large branches (an important habitat component for several old growth dependent species) can only develop if the tree's bole is exposed to ample light for most of the tree's life. If existing densities are not reduced, it is predicted there would be delayed development of future large trees and a loss of existing large trees due primarily to competition related stress.

Size of Trees that could be Removed: The upper limit on the size of tree that can be removed is a Key Issue under this analysis. There is disagreement about the maximum size of trees that could be removed to meet project objectives. Some feel that only "smaller" trees (under about 12" diameter) should be removed, due to concerns about the perceived limited amount of trees larger than 12" in the project area, a concern about the loss of future old growth, and concern that most mid size trees must remain so that they can develop into the next generation of old growth. Common limits expressed are somewhere between 12" and 21" diameter.



Average tree size in this stand is about 12-14" diameter

The Sisters Ranger District has referred to trees 21" diameter or greater as "large" tree structure in local area assessments, based on the description from the Draft Old-Growth guidelines (Hopkins et al., 1992) and the Eastside Screens. The Deschutes National Forest Land and Resource Management Plan refers to trees 24" diameter + as large. Each of the Action Alternatives analyzes the predicted effects of removing different sizes of trees.

Old Growth Structure: Large old trees are the key structural components of old-growth forests both for their habitat functions as living trees, and because they contribute to the large snag and down wood component of these forests. Altered successional patterns are working against the long-term survival of these old-growth trees. All growing sites have a fixed quantity of resources and growing space, and as inter-tree competition increases it is usually the large trees that die first (Dolph et. al. 1995, In: Fitzergerald et. al. 2000). It is thought that we may have only a few decades to deal with this situation, or we risk losing the large trees (Fitzgerald, 2002. personal communication). Large trees would be lost at a faster rate at higher stand densities than at lower stand densities.

Recent studies have shown the ability of old growth trees to respond to reductions in density from thinning treatments, indicating an improvement in tree vigor and increased resistance to insects and pathogens. Latham and Tappeiner (2002) measured diameter growth increments of old-growth ponderosa pine, Douglas-fir, and sugar pine in the southern Cascades of SW Oregon. Ponderosa pine basal area growth was significantly greater in the treated stands than in the control stands. Fitzgerald and colleagues (2000) are testing the hypothesis that managed old-growth stands, where density and composition are maintained at historic levels, remain viable longer as old-growth habitat (Genesis Research and Demonstration Area). Stands were treated with thinning followed by underburning. Preliminary results, after 3 years of measurement, indicate that vigor of residual old-growth trees is increasing. A similar study has been initiated in the Whitehorse area of the Lolo National Forest (Hillis, et. al. 2001). The authors anticipate increased growth response of the residual old-growth trees, based on nearby research showing response of 800 year old pine to release from competition by fire.

Based on this research, it is assumed that reducing stand densities would help maintain existing large trees, and provide better conditions for the growth of future large trees.

For this project, possible LOS / old growth was measured as stands with sufficient number of trees 21” diameter or greater (in ponderosa pine it would be 13 trees or more per acre greater than 21” diameter, and in mixed-conifer it would be 15 trees per acre that size). No action alternatives would remove any trees 21” diameter or greater (East Side Screens). However, all action alternatives remove trees where densities or ladder fuels are high and can indirectly benefit remaining large trees by reducing risk and competition for nutrients and water.

There are several other characteristics of LOS / old growth stands (snags, down wood, multiple canopy layers, ground vegetation) that were not measured in this analysis. These other characteristics may be affected by actions that remove or potentially consume old growth elements (e.g., prescribed fire).

Species Composition

An objective identified in the Whychus Watershed Assessment is to keep species within a healthy range of variability depending on the plant association, specifically referring to the amount of fire intolerant species such as western juniper and white fir in ponderosa pine and mixed conifer plant associations, respectively. Species composition is a factor influencing the risk and stability of forests in the planning area. The mixed conifer plant associations were historically dominated by fire-climax ponderosa pine, which is more resistant to fire, disease, and insects than white fir (Hessburg et al., 1994). A reduction of western juniper and white fir in this project area can help move toward species composition more within the natural range of variability (Graham et al, 1999).

The effects of the alternatives on species composition are difficult to quantify, but in general, the greater the diameter of the trees cut, and the more thinning done (as opposed to use of prescribed fire), the greater the shift will be towards fire-tolerant/adapted ponderosa pine.

Shrubs: Shrub species are discussed under Wildlife, in relation to big game habitat.

Disturbance Processes

Disturbance size, intensity and patterns can be affected by the previous factors of forest structure, stand density and species composition, and relate to the sustainability of forest stands over the long-term. Disturbances are an important process in forest ecosystems because they may enhance nutrient cycles and promote diversity of habitat and species. However, the severity of disturbances tends to increase when forest conditions are outside the historic range of variability. Severe disturbances can result in the loss, amount, and quality of old-growth characteristics, such as large trees.

Factors that affect disturbance size, intensity and patterns include severe drought, stand densities, stand structure and species composition. Actions under the Alternatives that influence these factors are tree thinning, mowing, and prescribed burning. These actions are disturbances in themselves, and range in severity with thinning and prescribed burning being the most intensive and mowing the least. As with natural disturbances, these actions can both benefit (reduce competition, enhance nutrient cycling, create diversity and mosaics), and impact (compaction, loss of individual habitats, fragmentation) affected stands. However, all are considered less impactive than a severe wildfire or insect and disease epidemic. They also begin to move ecosystem processes back toward the natural range of variability.

The severity of impacts from future disturbances can be reduced, maintaining more resistant species (i.e., ponderosa pine) with prescribed fire, increasing the distribution of single or two storied-stands, maintaining vigor by thinning to lower densities, and making treatment units as large as possible (Brookes, et al., 1987; Wickman, 1992).

For instance, thinning can enhance vigor of ponderosa pine trees, which could aid them in resisting severe impacts from dwarf mistletoe, which is present in many of the stands within the project area and is expected to become a primary disturbance in these stands.

The primary biotic risk agents identified in the project area were bark beetles and dwarf mistletoe. Key measures of the effects of the alternatives on these agents are the following:

- Bark beetle risk reduction is measured in terms of the acres above upper management zone treated with density-reducing treatments (USDA 2000).
- Dwarf mistletoe risk reduction is measured in terms of the acres of mistletoe infected stands treated with thinning and/or larch restoration.

Prescribed underburning is not expected to have an effect on these risk factors because it does not typically have an appreciable effect on stand densities in the types of stands where it can be successfully employed (Covington et. al. 1997). With dwarf mistletoe, underburning would reduce the amount of mistletoe in the understory, but would not be an effective treatment to reduce infection and spread because the overstory would still be infected. It is assumed that reduced stand densities increase vigor and reduces stand susceptibility to bark beetles and dwarf mistletoe.

Alternative 1 (No Action) – Ecological Trends

Analysis Issue: Improvements to Forest Health Sustainability and Resiliency.

Measure #1: Effects of No Action on continued risk of losses to insects and diseases, especially the risk of continued loss of old-growth and mature pines to bark beetles.

Under Alternative 1, no thinning would occur in the project area. Stand densities will remain high and continue to increase in areas where they are already high. In areas where they may not already be high they will continue to increase, eventually reaching undesirable levels. On a stand-average basis, approximately 75% of the acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality. These high density acres will remain susceptible to bark beetle activity and the susceptibility will increase over time. High stand densities will result in the overall reduction in tree vigor among all size classes. A reduction in tree vigor will predispose those trees to the various insects and diseases that take advantage of low vigor/weakened trees (e.g., bark beetles and root diseases). The most significant effect of high stand densities will be the gradual loss of the existing historic large-tree component at a rate that is likely to be much faster than if stand densities had been reduced to more healthy levels.

Under the No Action alternative, the large tree component, as well as smaller trees, which represent future large trees, would exhibit low resistance to bark beetle attack, and higher risk of mortality from root diseases. With continued competition from understory trees, mortality within the large tree component would be expected to increase. Losses would be especially pronounced under drought conditions. Alternative 1 would result in the slow down of the recruitment of large trees due to the continued density-related decline in tree growth and vigor. Stands would continue to decline in growth and vigor due to increasing competition and reduced crown development. Risk to insects and disease would continue to intensify. Increased bark-beetle activity would be anticipated with the next drought cycle. Dwarf mistletoe infection would continue to increase in ponderosa pine in all size classes where this disease is present, primarily in the south half of the project area.

Measure #2: Effects of No Action on stand structure and species composition in relation to historic conditions.

No thinning or prescribed burning or mowing would occur within the project area under the no-action alternative. Stand structure and density under the no action alternative would continue to deviate from historical conditions in the following ways:

- Stands would continue to be dominated by small trees (<21 in. DBH).
- Stand structure of most stands would consist of dense, multi-storied canopies, resulting in large areas of contiguous ladder fuels.
- Dead fuel on the surface would continue to accumulate in the form of decadent brush, dead material from insect and disease mortality, limbs, and needles, adding to the fuels that have accumulated since the last burn cycle.

The shift in species composition towards fire intolerant species (western juniper and white fir) would continue with the following effects:

- There would be more fire-intolerant species (primarily western juniper and white fir) on the landscape, and there would be more ladder fuels from the fire-intolerant species in the understory
- There would be more shorter-lived trees (i.e., white fir)
- There would be more stress on overstory ponderosa pine
- There would be an increased risk of future bark beetle outbreaks, which increases the fire hazard over the landscape
- Conifers would continue to encroach upon natural meadows under No Action, and this rare habitat may continue to decline in acres.

Measure #3: Effects of No Action on Stand Structure/Species Composition and Its Relationship to Late and Old Structural (LOS) Habitat

No management actions to treat vegetation would occur under No Action. During this time, the following effects would accrue to LOS habitat, large trees (21"+ dbh), and pole and small-size stands (future LOS and large tree habitat).

Large, old ponderosa pine are the key structural components of LOS habitats in the project area because of the time required for their development, their habitat functions as living trees and because they contribute to the large snag and down wood component of this habitat. On a stand-average basis, approximately 98% of the LOS acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality. Under the No Action alternative loss of the large old ponderosa pine component would likely occur at an accelerated rate due to high stand densities. These large old trees would also be at higher risk of loss due to wildfire because of the high fire hazard across the project area. Given the relative low numbers of large trees per acre compared to the smaller trees this mortality could be considered substantial. Accelerated mortality of the older pines would contribute to the ongoing structure shift to smaller trees.

The growth and crown development of the smaller trees would also be affected by No Action. Trees in the smaller size classes (<21" dbh) would remain in high density conditions that are not conducive to good growth or crown development. Good growth is desired in these smaller size classes so that these trees will grow into the large size class sooner and contribute to future LOS sooner. Good crown development is desired so that smaller trees develop crowns that resemble crowns developed by historic old growth trees that grew under more open conditions. Keen (1943) describes the crowns of over-mature (i.e., old-growth) ponderosa pine as having large, heavy limbs that are often gnarled or crooked. Keen (1943) further described the crowns of vigorous (i.e., healthy) trees as being long (55% or more of total height), of average or wider width, crown density as being full and dense, with needles that are dense and thrifty and of average length or longer. The types of crowns developed by historic old-growth ponderosa pine did not occur under the high densities that the majority of the small trees in the SAFR project are growing under now.

Altered successional patterns are working against the long-term survival of these old-growth trees. All growing sites have a fixed quantity of resources and growing space, and as inter-tree competition increases it is usually the large trees that die first (Dolph et. al. 1995, In: Fitzergerald et. al. 2000). It is thought that we may have only a few decades to deal with this situation, or we risk losing the large trees (Fitzgerald 2002, pers. comm.).

There would be no new proposed activities under this alternative; consequently, there would be no cumulative effects. Effects of already approved activities to thin plantations and underburn in the Canal 16 and Underline project areas would be beneficial within the project area.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

Analysis Issue: Improvements to Forest Health Sustainability and Resiliency.

A total of 16,994 acres (includes 3,384 acres of plantations) or approximately 69% or the project area would be thinned, 15,307 acres (63% or the project area) would be prescribed burned and 16,047 acres (66% or the project area) would be masticated (e.g., mowed) to reduce tree and shrub density, increase average tree size and reduce fire-intolerant species. Thinning would be limited to trees <21" dbh.

Measure #1: Effects of Proposed Action on continued risk of losses to insects and diseases, especially the risk of continued loss of old-growth and mature pines to bark beetles.

Management practices aimed at maintaining vigorously growing stands can considerably reduce the potential impact of insect and disease agents and enhance forest health (Hessburg, et al 1994). Under Alternative 2 thinning treatments would reduce competition stress on larger, older ponderosa pine by thinning from below. High densities and western juniper can represent a considerable component of competition with the older overstory pines. Reducing the small tree component and western juniper around older pines would provide needed growing space to keep overstory trees growing at rates that would allow them to be resistant to bark beetles.

On a stand-average basis, approximately 75% of the acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality. Under Alternative 2, the percentage of the project area that is above the upper management zone is reduced to 30%.

Additionally, the use of stand averages to characterize stand densities can be misleading because the use of averages masks the fact that areas of stands where there is a significant component of trees greater than the thinning diameter limit (e.g., 12" or 21") that are above the upper management zone before treatment will remain above the upper management zone after treatment, even though the stand average is below the UMZ. A higher diameter limit will allow for more acres to be thinned to sustainable densities (i.e., below the upper management zone) than a smaller diameter limit. Consequently, a tree removal diameter limit of 21" dbh will allow for better stand density reduction than a tree removal diameter limit of 12", even in stands where the average stand density is below the UMZ.

Dwarf mistletoe in ponderosa pine is quite prevalent in the southern half of the SAFR project area. By thinning from below and favoring the least dwarf mistletoe infected trees, considerable progress can be made in reducing the incidence of this disease across the project area. Additionally, pruning of dwarf mistletoe infected trees within and adjacent to existing plantations will help reduce the future spread of this disease into plantations. Reducing the amount of dwarf mistletoe across the project area will help meet project objectives of reducing fire hazard and improving forest health and to maintain and grow large trees. Pruning treatments are described in more detail in the Proposed Treatments section under Plantation Treatments.

Measure #2: Effects of Proposed Action on stand structure and species composition in relation to historic conditions.

Stand structure and density under Alternative 2 would be moved towards historical conditions in the following ways:

- On treated acres, average diameter would be increased in all size classes up to 21” dbh, increasing the resistance of those acres to fire.
- Stand structure of most stands would still consist of multi-layered canopies, but the density and number of layers would be reduced and large areas of contiguous ladder fuels would be broken up and crown bulk densities would be reduced.
- Dead fuel on the surface in the form of decadent brush, dead material from insect and disease mortality, limbs, and needles, would be treated along with activity created fuels

The current trend, in some portions of the project area, in species composition towards fire intolerant species (western juniper and white fir) would be abated with the following effects:

- More fire- and disease-resistant species would occupy the landscape, and ladder fuels in the form of shade-tolerant trees in the understory would be reduced
- Less fire intolerant species (white fir and western juniper) would occupy the landscape
- There would be a reduction in competitive stress on overstory ponderosa pines

Measure #3: Effects of Proposed Action on Stand Structure/Species Composition and Its Relationship to Late and Old Structural (LOS) Habitat

This alternative would treat approximately 3,022 acres of LOS with thinning from below and associated thinning created fuels clean-up (2,764 acres), prescribed burning (2,983 acres) and mastication (2,980 acres). Thinned trees would be utilized to the greatest extent possible. There is uncertainty regarding future technology and markets for the disposal and utilization of the material generated by thinning, consequently, an objective of this project is to retain flexibility for the disposal of thinned material by commercial means.

All acres that were LOS before treatment would remain LOS after treatment. Thinning treatments would generally move multi-stratum LOS toward single-stratum LOS as thinning from below reduces canopy layers and canopy cover. Depending on the number of large (21”+ dbh) trees present, a portion of the treated LOS acres would continue to have a uneven-aged/sized structure. Where there are higher densities of large trees, fewer understory trees would be left and those areas would appear single-storied and where there are lower densities of large trees, more understory trees would be left and those areas would appear somewhat multi-storied, although not as much as before treatment.

Large, old trees are the key structural components of LOS habitat because of the time required for their development, their habitat functions as living trees, and because they contribute to the large snag and down wood component of these forests. Altered successional patterns are working against the long-term survival of these large old trees. All growing sites have a fixed quantity of resources- Alternative 2 would shift a portion of these resources to the large overstory pines with the objective of maintaining them on the landscape for the foreseeable future.

On a stand-average basis, approximately 98% of the LOS acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality. Under alternative 2, the percentage of the LOS that is above the upper management zone is reduced to 38%, as opposed to 63% under Alternative 3. Loss of the large tree component would continue to occur, but should be slowed on treated acres as trees respond to the increased growing space resulting from thinning from below. Given the relatively low numbers of 21"+ dbh trees per acre across the project area, this effect could be considered substantial.

An indirect effect of the proposed action is its effect on the growth and crown development of the smaller trees. Good growth and crown development would occur on residual smaller trees on 16,994 acres in all size classes below 21" dbh. By thinning up to 20.9" dbh, the trees closest to the large (i.e., 21"+ dbh) size class would move into the large size class sooner under Alternative 2 than under Alternative 3 where no trees between 12" and 20.9" dbh can be thinned. Consequently, large tree development can be accelerated better under Alternative 2 than Alternative 3.

Alternative 2 (Proposed Action) – Cumulative Effects

There are no reasonably foreseeable vegetation management projects planned within the SAFR project area; however, there are previously approved on-going projects within the SAFR project area including plantation thinning and underburning in the Canal 16 and Underline project areas. These on-going projects have been incorporated into the planning of the SAFR project, and the SAFR project would supercede these on-going projects, consequently, no negative cumulative effects from Alternative 2, combined with the on-going projects, would be expected other than what was analyzed in the effects for alternative 2.

There would be beneficial cumulative effects associated with the selection of Alternative 2. The on-going vegetation management projects and other vegetation management projects that have occurred on the District have created forest conditions that are more resistant to adverse effects of wildfire, drought, insects, and disease as well as enhancing recruitment of trees into the large-tree category by favoring growth of dominant and codominant trees. The selection of Alternative 2 would improve forest conditions and large-tree recruitment on an additional 16,994 acres achieving desired forest conditions over a larger landscape.

Alternative 3 – Direct and Indirect Effects

Analysis Issue: Improvements to Forest Health Sustainability and Resiliency.

A total of 16,994 acres (includes 3,384 acres of plantations) or approximately 69% or the project area would be thinned, 15,307 acres (63% or the project area) would be prescribed burned and 16,047 acres (66% or the project area) would be masticated (e.g., mowed) to reduce tree and shrub density, increase average tree size and reduce fire-intolerant species. Thinning would be limited to trees <12" dbh.

Measure #1: Effects of Alternative 3 on continued risk of losses to insects and diseases, especially the risk of continued loss of old-growth and mature pines to bark beetles.

Thinning from below, regardless of the upper diameter limit, will reduce stand densities and thus improve conditions for tree and stand health and vigor. However, a limit on the size of trees that can be thinned will have a consequence on the effectiveness of the thinning to improve conditions for tree and stand health and vigor. Across a landscape or project area and within most stands, there can be a variety of size classes present and when a diameter limit is set then thinning is most effective where the majority of the trees are less than the diameter limit and the density of the trees above the diameter limit is at or below the desired level.

On a stand-average basis, approximately 75% of the acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality. Under Alternative 3, the percentage of the project area that is above the upper management zone is reduced to 41%.

Additionally, the use of stand averages to characterize stand densities can be a little misleading because the use of averages masks the fact that areas of stands where there is a significant component of trees greater than the thinning diameter limit (e.g., 12" or 21") that are above the upper management zone before treatment will remain above the upper management zone after treatment, even though the stand average is below the UMZ. A higher diameter limit will allow for more acres to be thinned to sustainable densities (i.e., below the upper management zone) than a smaller diameter limit. Consequently, Alternative 2, with a diameter limit of 21" dbh will allow for better stand density reduction within stands than Alternative 3, even in stands where the average stand density is below the UMZ under Alternative 3.

Dwarf mistletoe in ponderosa pine is quite prevalent in the southern half of the SAFR project area. Reducing the amount of dwarf mistletoe across the project area, will help meet project objectives of reducing fire hazard and improving forest health and to maintain and grow large trees. By thinning from below and favoring the least dwarf mistletoe infected trees, considerable progress can be made in reducing the incidence of this disease across the project area. However, having a diameter limit of 12" dbh, above which no trees can be thinned, limits the ability to significantly reduce dwarf mistletoe. Additionally, pruning of dwarf mistletoe infected trees within and adjacent to existing plantations will help reduce the future spread of this disease into plantations and both action Alternatives (2 and 3) are the same in this regard.

Measure #2: Effects of Alternative 3 on stand structure and species composition in relation to historic conditions.

Stand structure and density under Alternative 3 would be moved somewhat towards historical conditions; however, no trees between 12" dbh and 21" dbh could be thinned. On acres where there are a significant number of trees greater than 12" dbh, there would be no opportunities to thin these areas and they would remain at higher densities and the growth and crown development of the trees in these areas would not improve, consequently, the trees in these area would not move into the larger size classes at an accelerated rate that thinning would allow.

The current trend, in some portions of the project area, in species composition towards fire intolerant species (primarily western juniper and white fir) would be abated, especially in the size classes less than 12” dbh. However, species composition between 12” dbh and 21” dbh would not change.

Measure #3: Effects of Proposed Action on Stand Structure/Species Composition and Its Relationship to Late and Old Structural (LOS) Habitat

This alternative would treat the same number of LOS acres as Alternative 2 (approximately 3,022 acres of LOS with thinning from below and associated thinning created fuels clean-up (2,764 acres), prescribed burning (2,983 acres) and mastication (2,980 acres)); with the only difference being that no trees between 12” dbh and 20.9” dbh would be thinned under Alternative 3. As under Alternative 2, thinned trees would be utilized to the greatest extent possible under Alternative 3 given the same uncertainty regarding future technology and markets for the disposal and utilization of the material generated by thinning.

All acres that were LOS before treatment would remain LOS after treatment. Thinning treatments would generally move multi-stratum LOS toward single-stratum LOS as thinning from below reduces canopy layers and canopy cover. However, because of the 12” dbh limit on thinning under Alternative 3 more acres would remain multi-storied compared to Alternative 2.

Large, old trees are the key structural components of LOS habitat because of the time required for their development, their habitat functions as living trees, and because they contribute to the large snag and down wood component of these forests. Altered successional patterns are working against the long-term survival of these large old trees. All growing sites have a fixed quantity of resources- Alternative 3 would shift a portion of these resources to the large overstory pines with the objective of maintaining them on the landscape for the foreseeable future. However, under Alternative 3, this would not happen as well, on as many acres, as Alternative 2 because of the 12” dbh thinning limit under Alternative 3.

On a stand-average basis, approximately 98% of the LOS acres in the project area are above the upper management zone and considered at risk for bark beetle (mountain and western pine beetle) mortality. Under Alternative 3, the percentage of the LOS that is above the upper management zone is reduced to 63%, as opposed to 38% under Alternative 2. Loss of the large tree component should be slowed on treated acres but not as well as under Alternative 2.

An indirect effect of Alternative 3 is its effect on the growth and crown development of the smaller trees. Good growth and crown development would occur on 16,994 acres in all size classes below 12” dbh. Alternative 3 only thins to 12” dbh, consequently, good growth and crown development will not occur wherever acres are overstocked in trees greater than 12” dbh and in these areas, trees will not be promoted into the larger size classes sooner and they will continue to experience poor crown development. Consequently, Alternative 3 does not promote good growth and good crown development as well as Alternative 2. Additionally, under Alternative 3, size classes between 12” and 21” dbh that are closest to moving into the large size class (i.e., 21” + dbh) would not be thinned, growth would not be improved and the trees in these size classes would not move into the larger size class sooner than under the no-action alternative (1).

Alternative 3 – Cumulative Effects

There are no reasonably foreseeable projects planned within the SAFR project area, however, there are previously approved on-going projects within the SAFR project area including plantation thinning and underburning in the Canal 16 and Underline project areas. These on-going projects have been incorporated into the planning of the SAFR project, and the SAFR project would supercede these on-going projects, consequently, no cumulative effects from Alternative 3, combined with the on-going projects, would be expected other than what was analyzed in the effects for alternative 3.

There would be beneficial cumulative effects associated with the selection of Alternative 3. The on-going vegetation management projects and other vegetation management projects that have occurred on the District have created forest conditions that are more resistant to adverse effects of wildfire, drought, insects, and disease as well as enhancing recruitment of trees into the large-tree category by favoring growth of dominant and codominant trees.

Fire Hazard Risk Reduction

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Fire Hazard Risk Reduction Report. Reference information is contained in the full specialist report.

Introduction

Fire is a disturbance process that historically played an important role in shaping the landscape of the SAFR planning area. Under current conditions, fuel loads are high and there is a moderate to high risk of large scale, high severity wildfire (GSA CWPP 2006). As forest stands become denser, and trees die from competition and stress, fuel levels and fire hazards are predicted to increase over most of the project area.

Affected Environment

Historically fires have been a major influence in shaping these landscapes. Fredrick Colville's 1898 report, “Forest Growth and Sheep Grazing in the Cascade Mountains of Oregon”, reveals that forest composition was quite different a century ago. He described the general forest as “the yellow pine forest, … [in which] the principal species is …*Pinus ponderosa*. The individual trees stand well apart and there is plenty of sunshine between them.” Colville also recognized the role of fire. “The scant grass and underbrush do not make a destructive burn”. These conditions are consistent the Fire Regime I, Condition Class 1 under which fire burned at low intensity with a frequency of between 2-30 years.

Fire Regimes

The Fire Regime describes the historic role that fire played in an ecosystem. Each plant community has a unique Fire Regime based on our understanding of historic conditions and description of the role fire played in an ecosystem (Agree, 1993). The historic Fire Regime identifies potential fire effects, historic size, frequency and intensity of fire within vegetation types.

Approximately 90% of the area is classified as Fire Regime 1 where fires historically occurred on an average frequency of 8-12 years with low severity in pine. About 8% of the project area is in Fire Regime 3 where the fire return interval in the dry mixed conifer was 25 -50 years and typically resulted in mixed severity to the stands (Bork, 1985, In: Cochran and Hopkins, 1990). The balance of the area is a mixture of meadow, riparian, non-forest and Juniper Woodland.

How are "Fire Regimes Defined"?

A fire regime is a general classification of the role fire would play across a natural landscape in the absence of modern human mechanical intervention, but including the influence of aboriginal burning. Coarse scale definitions for natural (historical) fire regimes have been developed by Hardy et al. (2001) and Schmidt et al. (2002) and interpreted for fire and fuels management by Hann and Bunnell (2001). The five natural (historical) fire regimes are classified based on average number of years between fires (fire frequency) combined with the severity (amount of mortality) of the fire on the dominant overstory vegetation. As scale of application becomes finer these five general classes may be defined with more detail, or any one class may be split into finer classes, but the hierarchy to the coarse scale definitions should be retained.

I. I0-35 years, Low severity.
Typical climax plant communities include ponderosa pine, eastside/dry Douglas-fir, pine-oak woodlands, Jeffery pine on serpentine soils, oak woodlands, and very dry white fir. Large stand-replacing fire can occur under certain weather conditions, but are rare events (i.e. every 200+ years).

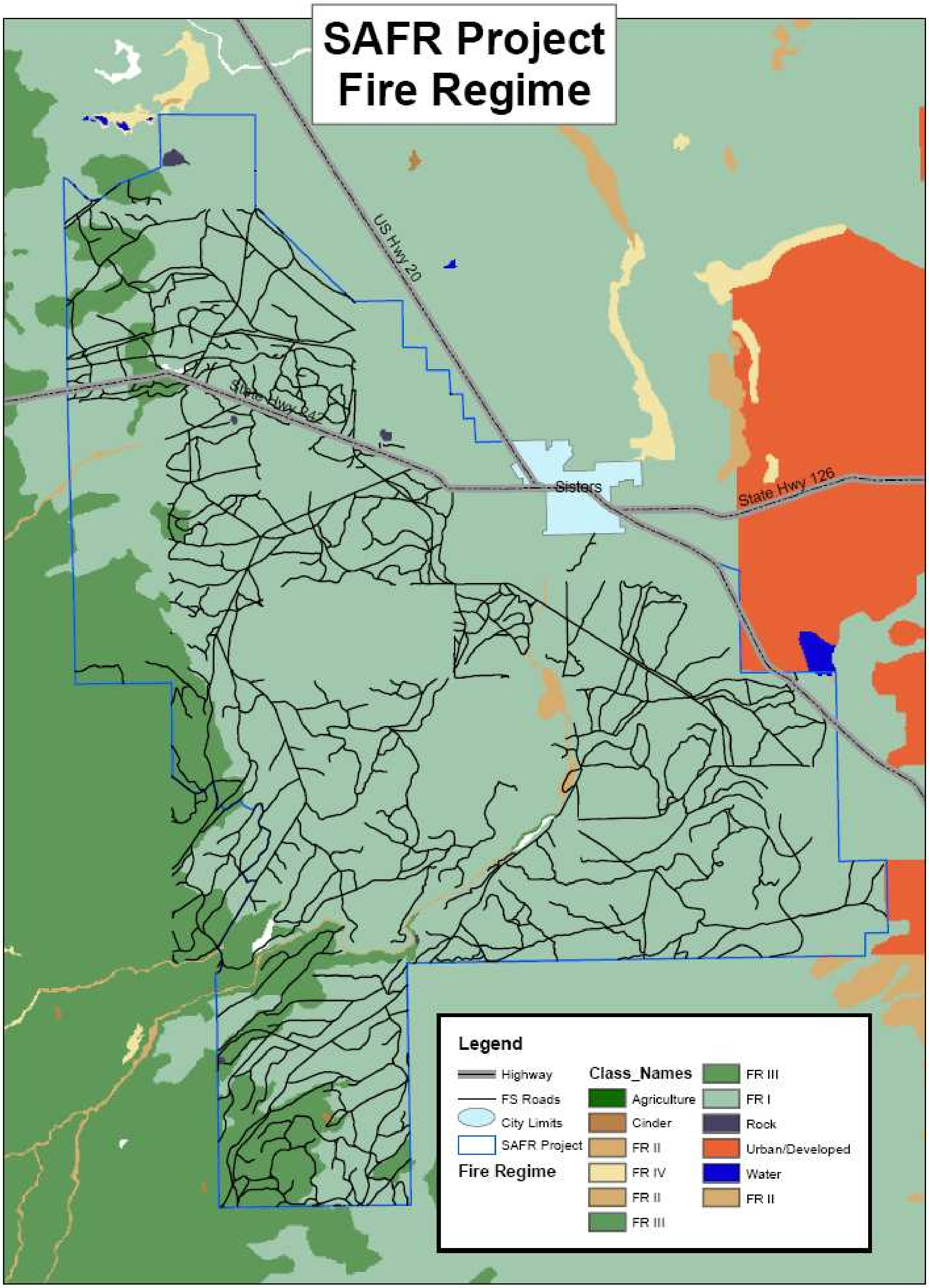
II. 0-35 years, Stand-replacing, non-forest
Includes true grasslands (Columbia basin, Palouse, etc.) and savannahs with typical return intervals of less than 10 years; mesic sagebrush communities with typical return intervals of 25-35 years and occasionally up to 50 years, and mountain shrub communities (bitterbrush, snowberry, ninebark, ceanothus, Oregon chaparral, etc.) with typical return intervals of 10-25 years. Fire severity is generally high to moderate. Grasslands and mountain shrub communities are not completely killed, but usually only top-killed and resprout.

III. 35-100+ years, Mixed severity
This regime usually results in heterogeneous landscapes. Large, stand-replacing fires may occur but are usually rare events. Such stand-replacing fires may "reset" large areas (10,000-100,000 acres) but subsequent mixed intensity fires are important for creating the landscape heterogeneity. Within these landscapes a mix of stand ages and size classes are important characteristics; generally the landscape is not dominated by one or two age classes.

IV. 35-100+ years, Stand-replacing
Seral communities that arise from or are maintained by stand-replacement fires, such as lodgepole pine, aspen, western larch, and western white pine, often are important components in this fire regime. Dry sagebrush communities also fall within this fire regime. Natural ignitions within this regime that result in large fires may be relatively rare, particularly in the Cascades north of 45 degrees latitude.

V. >200 years, Stand-replacing
This fire regime occurs at the environmental extremes where natural ignitions are very rare or virtually non-existent or environmental conditions rarely result in large fires. Sites tend to be very cold, very hot, very wet, very dry or some combination of these conditions.

Figure 6: Fire Regimes within planning area



Existing Condition

Condition Class

The Condition Class is the classification of the amount of departure for vegetation/fuel conditions from a reference condition for each Fire Regime (Hann and Bunnell 2001). Coarse-scale Condition Classes have been defined and mapped by Hardy et al. (2001) and Schmidt et al. (2001). They include three Condition Classes for each fire regime. The classification is based on a relative measure describing the degree of departure from the historical natural fire regime, or reference condition. This departure results in changes to one (or more) of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (e.g. insect and diseased mortality, grazing, and drought). There are no wildland vegetation and fuel conditions or wildland fire situations that do not fit within one of the three classes.

A combination of Fire Regimes and Condition Classes are used to describe the existing condition of the landscape. Fire Regime Condition Class (FRCC) is an interagency, standardized tool for determining the degree of departure from reference condition vegetation, fuels and disturbance regimes. As vegetative treatments are implemented they will collectively improve vegetation/fuel conditions and move the project area toward a lower condition class.

Fire regimes are identified based on plant association mapping done by the Deschutes National Forest (Table 16). Condition class is determined utilizing a method developed by the Central Oregon Fire Learning Network (The Nature Conservancy, 2006). Results indicate that 77 % (a significant portion) of the project area is currently in Condition Class 2 and 3. Landscapes in Condition Class 2 and 3 represent areas that are altered from their historical range. Areas in these Condition Classes have a moderate to significant risk of loosing key ecosystem components when a fire occurs.

Table 16: Fire regimes and conditions classes in the SAFR Project Area.

Fire Regime	Percent of Area	Departure from Reference Condition	Condition Class
I	90	40% Moderate	2 &3
III	8	37% Moderate	2 &3

How are "Condition Classes" Defined

The three defined Fire Regime Condition Classes are based on low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the central tendency of the natural (historical) regime (Hann and Bunnell 2001, Hardy et al. 2001, Schmidt et al. 2002). The central tendency is a composite estimate of vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances. Low departure is considered to be within the natural (historical) range of variability, while moderate and high departures are outside. A simplified description of the Fire Regime Condition Classes and associated potential risks follow:

Fire Regime Condition Class 1: Areas in Condition Class 1 are within historical ranges of variability for vegetation characters. The historic vegetation composition and structure are intact. Most stands are open with trees well spaced and ground fuels consist of grass forbs with minimal accumulation of woody material. Thus, fire behavior effects and the risk of losing key ecosystem components from the occurrence of a fire are relatively low.

Fire Regime Condition Class 2: These areas have been moderately altered from their historical range of variability by decreased fire frequency or other associated disturbances. Portions of the stands are over stocked by smaller diameter trees and brush. A moderate risk of losing key ecosystem components would be expected on these lands.

Fire Regime Condition Class 3: These lands have been significantly altered from their historical regimes and have missed numerous fire return interval. Stands typically are over stocked with trees, have continuous ladder fuels from the ground into the canopy with brush in the understory. The risk of losing key ecosystem components from fire is high.

Historic Fires in and Adjacent to the Project Area

Between 1987 and 2006 there were 101 fires less than 25 acres. Most of these fires were contained at less than 1/10 of an acre; however, several were as large as one acre and one grew to 12 acres (Table 17). Two thirds of the fires were man caused and the remaining 1/3 were caused by lighting. During this period 98% of the fires were controlled by initial attack fire resources during the first burning period.

Table 17: Man and lighting caused fires occurring between 1987 and 2001.

Year	Man Caused Fires	Lightning Fires	Total Fires	Total Acres
1987	2	2	4	0.9
1988	5	0	5	1.1
1989	5	2	7	13.6
1990	3	9	12	2.7
1991	2	2	4	5.4
1992	2	6	8	2.3
1993	3	1	4	0.5
1994	6	4	10	3.1
1995	2	0	2	0.2
1996	6	1	7	1.3
1997	4	0	4	0.5
1998	7	1	8	0.8
1999	4	0	4	0.7
2000	11	0	11	3.1
2001	3	8	11	1.4
Total	**65**	**36**	**101**	**38**

Between 1900 and 2006 there were ten large (>25 acres) fires recorded in the project area and another seven large fires in close proximity (Table 18). Fire patterns indicate that in most cases the fires were long and narrow wind driven fires and in most of the fires the destructive effects occurred during a single 4 to 6 hour burning period. For example, in 1991 the Cow Camp Fire burned a 276 acre strip over 2 miles long and less than ½ mile wide in one afternoon in July. If the wind had been blowing from the west instead of from the northwest a number of homes in the Remuda Road area may have burned.
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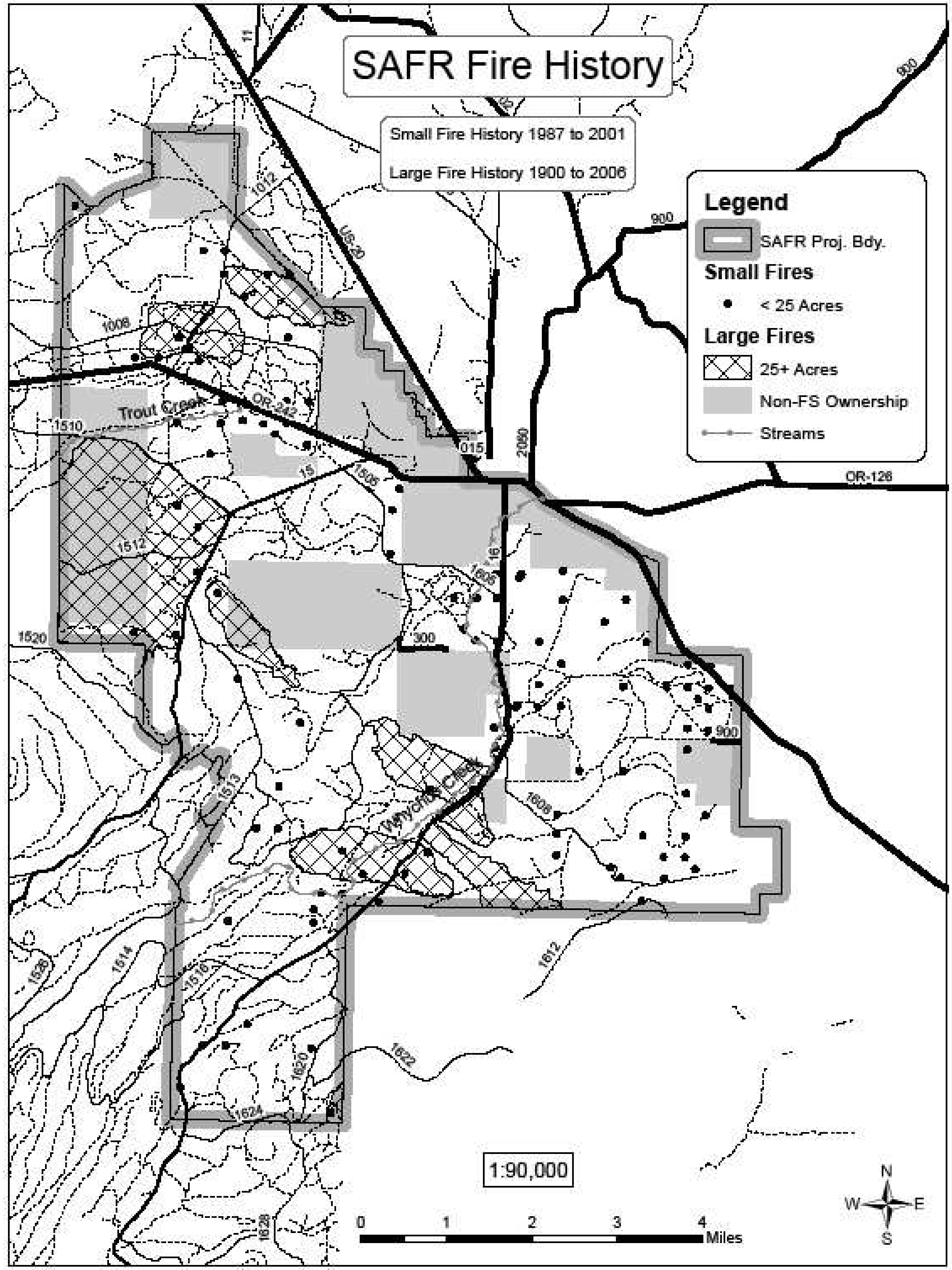
Table 18: Large fires occurring between 1900 and 2006.

Fire Name	Year	Total Acres
Cold Springs #1	1919	226
Cold Springs #2	1919	193
Petterson Mill	1941	577
Melvin Butte	1947	691
Squaw Creek	1959	609
Wier Grade	1969	585
Tollgate	1979	339
Delicious	1990	2041
Cow Camp	1991	278
Black Crater	2006	9407
Total		**14,946**

Figure 7: Small and large fire history within the SAFR planning area.



Recent fires

The recent wildland fires on the Sisters Ranger District have increased the public's awareness of fire hazard in and around the Wildland Urban Interface (WUI). In 1992 the residents of the Juniper Acres, Sno-Cap Vista and Squaw Creek Canyon Subdivisions experienced a fire that started on private land near the eastern side of the district. The fire quickly crowned into the tree canopy and consumed 1,106 acres as it ran almost four miles to the east in one afternoon, destroying 6 homes before sunset. In 2002 the Eyerly Fire burned 23,573 acres and destroyed 18 residences. A month later the wind driven Cache Mountain Fire burned into Black Butte Ranch destroying 2 homes.

In 2003 the 3,589 acre Link Fire ignited on the northwest portion of Cache Mountain resulting in the evacuation of summer camps, camp grounds, and businesses in the Suttle Lake recreation area. Then while smoke could still be seen on Cache Mountain another set of fires started in August. The Bear and Booth Fires burned together resulting in the 94,281 acre B&B Complex. This large fire destroyed numerous buildings at the Round Lake Camp, resulted in the evacuation of Camp Sherman twice, shut down Oregon HWY 20 and caused significant economic loss to the community of Sisters, resorts and recreation facilities through out the area.

Even more recently in 2006 the Black Crater Fire and the Lake George Fire burned 9,407 and 5,534 acres, respectively. Both of these fires started in the wilderness and over a period of days experienced intense crowning in the canopy with rapid rates of spread as they burned from the west in an easterly direction. While no structures were lost in either of the fires, the Black Crater Fire did result in the evacuation of several subdivisions in the project area including Crossroads, Tollgate, Edgington, and almost the town of Sisters.

The recent increase of large and destructive fire in the past several years (Figure 8) is the result of the current vegetation condition across the landscape that is increasingly dominated by brush ladder fuels and closed canopies. The combination of timber harvest, fire suppression policy, and insect and disease infestations (along with the resulting mortality) over the past 100 years changed forest conditions. There have been more acres burned by wildfire on the Sisters Ranger District in the last five years than in the previous 100 years, indicating a change in the historic vegetation condition.

Risk Assessment Findings: Greater Sisters Country Community Wildfire Protection Plan (GSA CWPP)

In general, all of the lands within the identified communities are classified as having medium-high to extreme risk based on fire ignition rates between 1994 and 2003. Plain View Estates, Aspen Lakes, and Forked Horn Estates Area have medium to high risk because they are located on the southern and eastern perimeters of the WUI. Outside of the communities at risk, most of the Forest Service lands to the west, south and north are rated as high hazard. The majority of these lands are located west of the identified at risk communities, and toward the crest of the Cascades Mountains. There are also pockets of high/extreme and extreme hazard areas throughout the project area.

Values identified in the GSA CWPP include residences and businesses within the communities at risk as well as ecological, cultural, and recreational values on National Forest lands. The Fire Protection District within the GSA CCPP fire district protects all of the 14 identified at risk communities except the northern portion of Whychus Creek Canyon Estates. Over two dozen structures outside the boundaries of the fire protection districts are rated as higher risk due to their lack of fire protection.

A combination of risk, hazard, values protected, structural vulnerability, and protection capability were used to calculate a risk assessment score for each community (Table 19). Scores over 170 are considered extreme risk. Results illustrate the importance of focusing efforts to reduce hazardous fuels in and around these communities at risk.

Table 19: Calculated risk assessment score based on GSA CWPP analysis.

Community	Average Score	Risk Assessment Rating
Tollgate	193	Extreme
Crossroads	191	Extreme
Panoramic View Estates	187	Extreme
Camp Sherman	183	Extreme
Sage Meadows	179	Extreme
Sisters Area	178	Extreme
Indian Ford Meadows	172	Extreme
Whychus Creek Canyon Estates	169	High
Black Butte	168	High
Cascade Meadows	154	High
Forked Horn Estates	137	High
Suttle Lake	133	Medium-High
Plainview Estates and Area	132	Medium-High
Aspen Lakes	116	Medium-High

Air quality

The LRMP, as amended by the Eastside Screens, specifies fuels and fire management activities to protect wildlife habitat, riparian habitat, air quality, public property, health and safety while reducing fuels and fire risk. This is accomplished by following Forest wide individual management area standards and guidelines that initiate long term actions to prevent wildfire and reintroduce the use of low intensity prescribed fire to move towards the desired future conditions for each management area.

The 1990 Clean Air Act (CAA) is an amended federal law first passed in 1970. Under this law, the Environmental Protection Agency (EPA) protects and enhances the quality of the nation's air resources by setting limits on how much of a pollutant (particulate matter) can be in the air based on scientific studies that have established a link between the particulate matter and public health. The Oregon Clean Air Act Implementation Plan considers local geography and industry to further define how the provisions of the CAA would be implemented through the Oregon Smoke Management Plan. This plan includes regional monitoring and regulation of pollutants less than 10 and 2.5 micrometers (PM 10 and PM 2.5) in size.

The Forest Service is required by law to follow the directions of the State Forester in conducting prescribed burning in order to achieve strict compliance with all aspects of the CAA by working in conjunction with the Oregon Department of Forestry (ODF) to adhere to the Oregon Smoke Management Plan. One of the requirements of the plan is to minimize smoke intrusions into designated areas (i.e. Bend) and Class 1 Airsheds to avoid adversely affecting air quality. The closest Class 1 airshed is the Three Sisters Wilderness approximately 10 to 20 air miles west and northwest of the project area.

Impacts related to air quality include visibility of smoke and potential health affects of small air bourn particles. In addition, there is a need to meet standards for air quality in adjacent Class I Airsheds Three Sisters Wilderness. Since prevailing winds within the project area are out of the west and away from the wilderness, prescribed burning is not expected to result in an incursion into the Class I Airshed more than 5% of the prescribed burning time.

Drift smoke from a prescribed fire or wildfire would affect recreationists by reducing visibility and views of the surrounding forest and mountains. Visibility could be reduced from the normal 20 miles or more to less than 3 to 5 miles. This impact could last from a few hours to several days for prescribed fire, to weeks or months for wildfires. Smoke intrusion into Class I airsheds from prescribed fires would be mitigated either by avoidance or through dispersion.

Negative effects on air quality resulting from a wildfire are expected to be far greater than that resulting from prescribed burning. Analysis of potential air quality impacts in Oregon, Washington and Idaho found that wildfire impacts would be significantly greater in magnitude than prescribed burning impacts over the same area (Hugg et al., 1995; USDA, USDI, Draft EIS Interior Columbia Basin Ecosystem Management Project, 2000). This analysis concluded that wildfires reduced visibility substantially more than prescribed burning (though effects from prescribed burning may be more frequent). This was due to wildfires typically consuming more fuel per acre burned than prescribed fires. This analysis also concluded that predicted concentrations or particulate matter for prescribed fires would by substantially lower than for wildfires due to: 1) higher fuel moisture levels during management ignited prescribed fire, 2) better smoke dispersion conditions during prescribed fires in the spring and fall, than typical conditions during summer wildfires, and 3) prescribed fires are dispersed across the landscape spatially and temporally, rather than concentrated in a few locations.

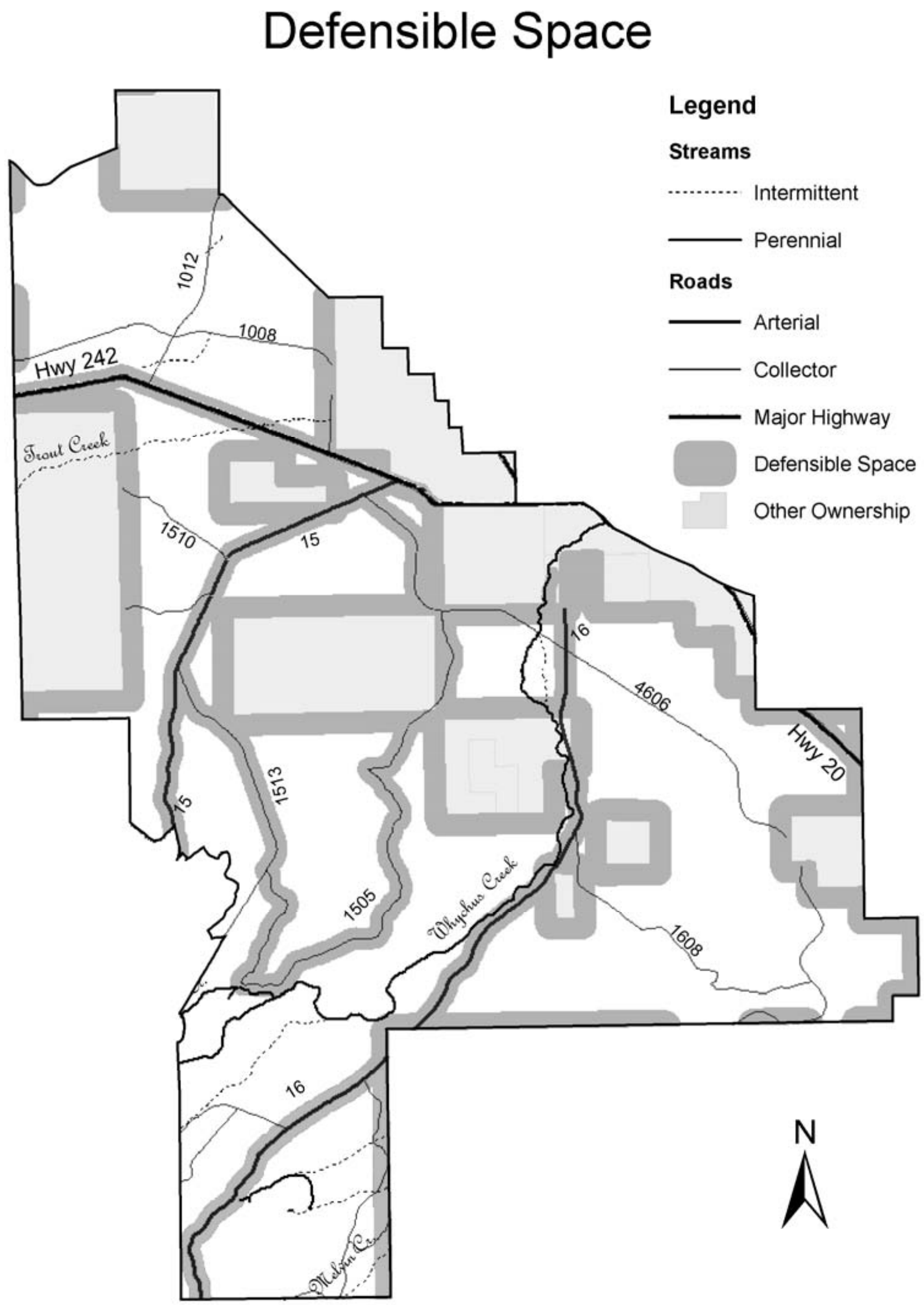
Desired Future Condition

From a fuels perspective a mosaic of landscape treatments would be strategically placed and managed to reduce fire behavior potential, facilitate the suppression of wildfires, protect valuable resources, and allow the re-introduction of fire as a disturbance process. This will help to reduce the risk of wildfire impacting nearby communities. In addition, areas that provide for defensible space adjacent to private lands and along identified escape and access corridors will help with reducing risk (Figure 9).

The desired future structure of treated stands includes a canopy bulk density and a fuel continuity of the forest canopy that does not sustain a crown fire under severe fire conditions. Shrub cover would be maintained at a height that would reduce the potential for crown fire initiation. To mitigate the potential for crown fire initiation trees within stands should have a height to live crown that is well above the shrub component.

The Deschutes National Forest Plan prohibits treating all of the project area for fire and fuels hazard reduction at one time. Defining a percentage of the project area that should be treated to reduce fire and fuels is problematic due to the shortcomings and variables involved in weather, stand condition, location of EA units, modeling and research. Based on these variables, expected fire behavior, and professional judgment; it was determined that the percentage of the project area that should be in the low fire behavior category should be greater than 50 percent over both the short (5 to 10 year) and long term (10 to 20 year) timeframes.

Figure 8: Proposed defensible space treatments within the SAFR planning area.



Environmental Effects

Wildfire susceptibility is defined and discussed in terms of the hazard and the risk of a wildfire as it relates to fuel types and arrangements. ***Hazard*** relates to the availability of fuels to sustain the fire (Maffie et al. 1996) and the amount of loading, arrangement and continuity of fuels through the area. The changes that occur in the loading, arrangement or continuity of the fuels will change the predicted fire behavior and associated fire effects. ***Risk*** of fire occurrences relates to the probability that an ignition could occur under conditions that will result in a wildfire.

Values at risk include public and firefighter safety, property and developments, and important or rare late successional resources (including both species and habitats). The condition of forest stands has a direct impact to safety and protection. High fuel levels and multiple layers of fuels (e.g. shrubs, dense branches, and tree crowns) increase the probability of an extreme wildfire, increase the risk of a wildfire getting larger, increase the difficulty and danger in controlling a fire, and increase the danger to the public and firefighters.

Between 1987 and 2001, 101 small fires started in the project area. Two thirds of the fires were human caused and the remaining 1/3 were caused by lightning. During this period the ratio of person caused to lightning stayed approximately the same. However the average number of fires per year in the project area has almost doubled since 2000. Not only is there a risk of a fire starting within the project area, there is also a risk of a fire starting on private lands and moving onto adjacent public lands.

Evidence from recent studies of wildfires and personnel observations of both prescribed fire and wildfire on the Sisters Ranger District stress the importance of treating the entire fuels profile, from surface fuels to crown fuels. Omi and Martinson (2002) found significant correlations between stand conditions and wildfire severity. Height to live crowns had the strongest correlation to fire severity, and stand density and basal area were also important factors. Studying the 1994 Wenatchee fires, Agee (1996) found that thinned stands which were below a critical crown bulk density did not sustain a crown fire. He concluded that forest structure can be manipulated to reduce severity of fire events. This was found to be particularly true in lower elevation forests with historically low severity fire regimes.

Silvicultural treatments in combination with other fuel treatments can reduce wildfire hazard by reducing fuel loads and ladder fuels, and by breaking up the continuity of fuels (Omi 1997, Omi and Martinson 2002). Graham et al. (2004) concluded that thinning treatments that are followed by reduction of surface fuels can significantly limit fire spread under wildfire conditions. The treatments under the action alternatives would treat the entire fuels profile (surface fuels, ladder fuels, crown fuels) and would be followed by treatments of fuels generated from operations (logging slash, etc.).

Environmental effects are based on the following assumptions:

- Reduction in the number of canopy layers in the stand reduces fire severity. This parameter relates directly to crown bulk density and crown base height, which are two of the three primary determinants of fire behavior (Omi 1997, Grahm et al, 1999).
- An increase in average tree diameter of the stand reduces fire severity. Larger trees have thicker bark and are more resistant to flame scorch from surface fuels. The more acres that are thinned, the greater the average diameter of remaining trees.
- Silvicultural treatments will shift stand composition towards fire resistant species.
- Treatment of surface fuels generated from silvicultural treatments will prevent an increase in fire severity. All vegetation treatments would be followed by fuels treatment, so this element is equal among the alternatives.
- Treatment of natural surface fuels (brush, and trees 3 inch diameter and less) will reduce fire severity.
- Population growth and increased use of National Forest lands will result in the potential of more person caused fire starts.
- Lightning will remain a potential source of ignitions
- As the mountain pine beetle epidemic continues in the forest to the west there will continue to be a risk of a large fire spreading into and through the project area.
- The regions weather patterns could continue to be dry with above average temperatures.

The effects of the alternatives are displayed for several measures that help to describe their effects on project objectives:

Measure #1 – Reduce the risk of high intensity fire to the public and firefighters for reasons of safety. The measure is the amount of area (acres) with conditions that would support active crown fire or flame lengths greater than 4 feet.

Measure #2 – Improve forest health, sustainability, and resiliency and promote development of old growth forest stands and large trees by reducing the uncharacteristically high levels of competing live vegetation and reintroducing the more natural role of low intensity ground fire. The measure is the percent departure from reference condition or improving condition class.

Measure #3 – Reduce the risk of high intensity wildfires to nearby communities, private properties, and special natural places. The measure is burn probability combined with fire intensity.

Measure #4 – The negative effect to air quality which would likely result from a wildfire. The measure is the amount of smoke and the tones of particulate matter.

Fire Modeling

The South Central Oregon/Northeastern California (SO) Variant of the Forest Vegetation Simulator (FVS) and the Fire and Fuels Extension (FFE) model were used to simulate thinning and fuel treatments for the forest strata within the project area. The fire effects of No Action and the Action Alternatives were based on a projected fire in 2011 using the Potential Fire report. Data for running the model came from the stand exams, both actual and imputed from adjacent stands.

Limitations

The stand exam data imputed by Most Similar Neighbor (MSN) is an approximation of actual conditions. Given the uncertainty of any modeling exercise, the results are best used to compare the relative effects of the alternatives, rather than as an indicator of absolute effects.

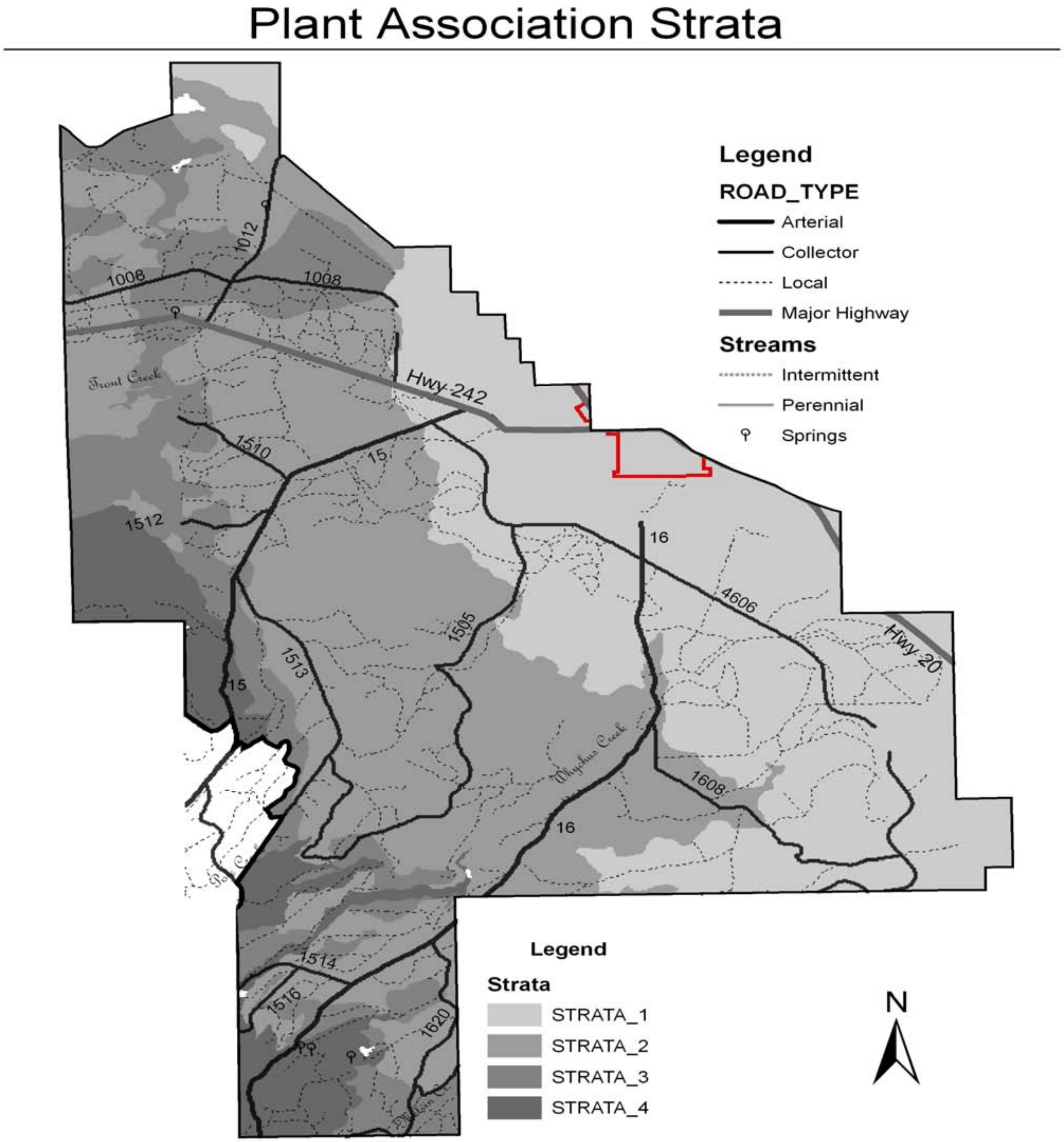
Forest Inventory

Forested vegetation within the project area was broken into four strata based on the plant association and site index (Table 20). Strata 1 represents ponderosa pine stands that are dominated with bitterbrush and grass in the understory. Strata 2 and 3 were combined for analysis and are dominated by ponderosa pine in the overstory and have a mix of manzanita and snow brush in the understory. Strata 4 are in the upper elevations to the west and are represented with mixed conifer species. For a complete discussion of the upper management zone (UMZ) and thinning stand density index (SDI) see the section on “Forest Health Sustainability and Resiliencey.”

Table 20: Forest Strata in SAFR Project Area used in fuels model.

Stratum	Plant Associations	Site Index	Upper Management Zone (UMZ)	Thinning Stand Density Index (SDI)
1	Ponderosa pine/sage brush/bitterbrush	73	135	108
2	Ponderosa pine/bitterbrush/snowbrush	81	164	131
3	Ponderosa pine/manzanita	84	175	140
4	Mixed conifer	86	183	146

Figure 9: Plant Association Strata in the SAFR Project Area



Weather Assumptions

Severe fires were modeled at the 97th percentile weather and fuel moisture conditions. Meteorological and fuels conditions for predicting effects from a severe wildfire in ponderosa pine and mixed conifer are shown in Table 21.

Table 21: Percentile Weather Compiled for SAFR Project

Percentile	Temp DB	Temp Max	RH 1300	RH Min	1 Hr	10 Hr	100 Hr	1000 Hr	Herb	Woody	Duff	Wind	Gusts
97%	96	99	11	9	2.0	3.2	7.0	8.9	44.2	67.9	20.7	11.0	35
95%	94	97	13	11	2.2	3.3	7.4	9.1	46.6	64.9	29.5	10.0	30
90%	91	94	14	12	2.4	3.7	8.0	9.7	53.0	74.4	47.5	8.0	25
83%	89	91	17	14	2.8	4.1	8.7	10.2	56.7	78.9	62.6	7.5	20
75%	86	89	19	16	3.1	4.5	9.4	10.8	60.7	83.1	76.5	6.0	15
70%	85	88	20	17	3.3	4.7	9.8	11.0	63.9	85.1	85.8	6.0	15

(Average Winds were adjusted based on actual winds associated with the Cache Creek, Cache Mountain, Link Creek and B&B Fires.)

Wind is the most dynamic variable in the prediction of fire behavior. A review of weather data associated with the Eyerly and Cache Mountain wildfires on the Sisters Ranger District in 2002 indicated that the difference between average winds and peak winds recorded at the COLGATE RAWS station were significant (Table 22). Fire Family Plus does not calculate percentile weather for gusts or peak winds. Average hourly wind speed of 5 mph and higher was sorted and compared to the recorded wind gusts associated with the same time frame. Based on the data set during the month of July wind gusts averaged 2.7 times higher then the average hourly wind speed. Even short periods of high winds can produce extreme fire behavior resulting in torching, crowning and long range spotting. The following wind speeds were used to predict potential fire behavior outputs for FVS-FFE simulations.

Table 22: Average winds and peak winds recorded at the COLGATE RAWS station.

Percentile	Average Wind	Wind Gusts
97%	11.0	35
95%	10.0	30
90%	8.0	25
83%	7.5	20
75%	6.0	15
70%	6.0	15

Methods

Growth of trees was adjusted for local conditions through the site index data collected on stand exams. The No Action and the Action Alternatives were simulated for 30 years.

The purpose in running the model was to compare the effects of the No Action and Action Alternatives on canopy base height, fire behavior and resulting mortality from a potential fire occurring in 2011 under severe weather conditions. The Action Alternatives were modeled by thinning to an SDI representing 80 percent of the UMZ, pile burning activity slash, and underburning. Two separate proposed action simulations were done, one with for Alternative 2 on all species and one for Alternative 3 on all species. Fuel loadings were initialized from photo series data determined to represent the different strata.

Initial fuel models (Anderson 1982) were input based on local experience and fuel model data collected on the stand exams. Post-treatment fuel models were input based on the expected change resulting from removal of trees, slash, and brush. Table 20 lists the fuel models used and the percentage weights assigned to them for No Action Alternative and Alternatives 2 and 3.

Flame Length

A landscape approach was employed to address risk of loss from wildfire. The FlamMap model was used to calculate a relative burn probability and fire intensity (flame length) under each alternative. Conditions for a problem fire were used for the analysis.

A problem fire is one which burns under conditions that result in a threat to resource values within or adjacent to the project area. Problem fire conditions are typically at or above what would normally be considered extreme fire conditions. Typically wildfires burn from west to east in the SAFR area. Prevailing winds are westerly, varying from NW to SW. Wind speeds as shown above may gust up to 30 – 40 miles per hour. Weather and fuel moistures for a problem fire were identified as 97th percentile condition as described earlier.

To better reflect the risk of a wildfire an area larger than the SAFR project was used for this analysis so that effects from ignitions outside the project area could be accounted for. An area of about 56,000 acres which best reflects the zone of influence was analyzed which included the SAFR project area. See Alternative 2 and 3 for a comparison of the change in flame length due to the action alternatives.

The next step to analyze the effects of the alternatives on this measure is to determine burn probability. As above, 97th percentile conditions were assumed for weather and fuels. The same wind speed and direction was used. Model inputs included 2,000 random fire ignitions, and fire duration of 6 hours.

Table 23: Fuel models and weights used in FFE modeling

Stratum	No Action		Action Alternatives	
	Fuel Model	% Weight	Fuel Model	% Weight
1	9	25	9	20
	6	75	8	80
2/3	9	35	9	30
	6	65	8	70
4	9	90	9	40
	6	10	8	60

Indicators from FVS-FFE Analysis

The following indicators from the FVS-FFE analysis were used to compare the alternatives:

1. Canopy base height is the distance from the surface of the ground to the lower branches and relates to the probability of a surface fire spreading into the canopy.
2. Crown density is the amount of needles and small branch wood in the crowns of a tree and contributes to the spread of a fire from tree to tree.
3. Fire type is an indicator of fire behavior and results when the combination of weather and vegetation is conducive to the spread of the fire. The fire types are; active crowning, passive crowning, conditional surface and surface fires.
4. Mortality is associated with fire type and fire severity.

Alternative 1 (No Action) – Ecological Trends

Measure #1 – Reduce the risk of high intensity fire to the public and firefighters for reasons of safety. The measure is the amount of area (acres) with conditions that would support active crown fire or flame lengths greater than 4 feet.

The FlamMap model was initially used to determine the predicted acres burned by fire type under Alternative 1 (No Action). The results are shown in Table 24 and Figure 11.

Table 24: Predicted acres burned under Alternative 1 (No Action) by fire type with a 30mph wind speed.

Fire Type	Alternative 1 No Action (acres)
No Burn	3109
Surface Fire	7232
Passive Crowning	44708
Active Crowning	1320
Analysis run with a 30 mph wind from the NW	

In order to focus on the crown fire aspect another run of the FlamMap model was done with a 50 mph wind speed. Based on historic weather records a wind speed of 50 mph is unlikely to occur in the SAFR area (Tables 21 and 22). However, a wind speed of 50 mph was chosen for the analysis in order to focus on the potential for active crown fire behavior. The results are shown below in Table 25 and in Figure 12.

Table 25: Predicted acres burned under Alternative 1 (No Action) by fire type with a 50mph wind speed.

Fire Type	Alternative 1 No Action (acres)
No Burn	3109
Surface Fire	7095
Passive Crowning	11044
Active Crowning	35121
Analysis run with a 50 mph wind from the NW	

Under the No Action Alternative the risk of surface fire is higher than that which would result from the action alternatives. See Alternative 2 and 3 for a comparison of the change in surface fire due to the action alternatives.

Figure 10: Fire Type, Alternative 1, 30 mph wind

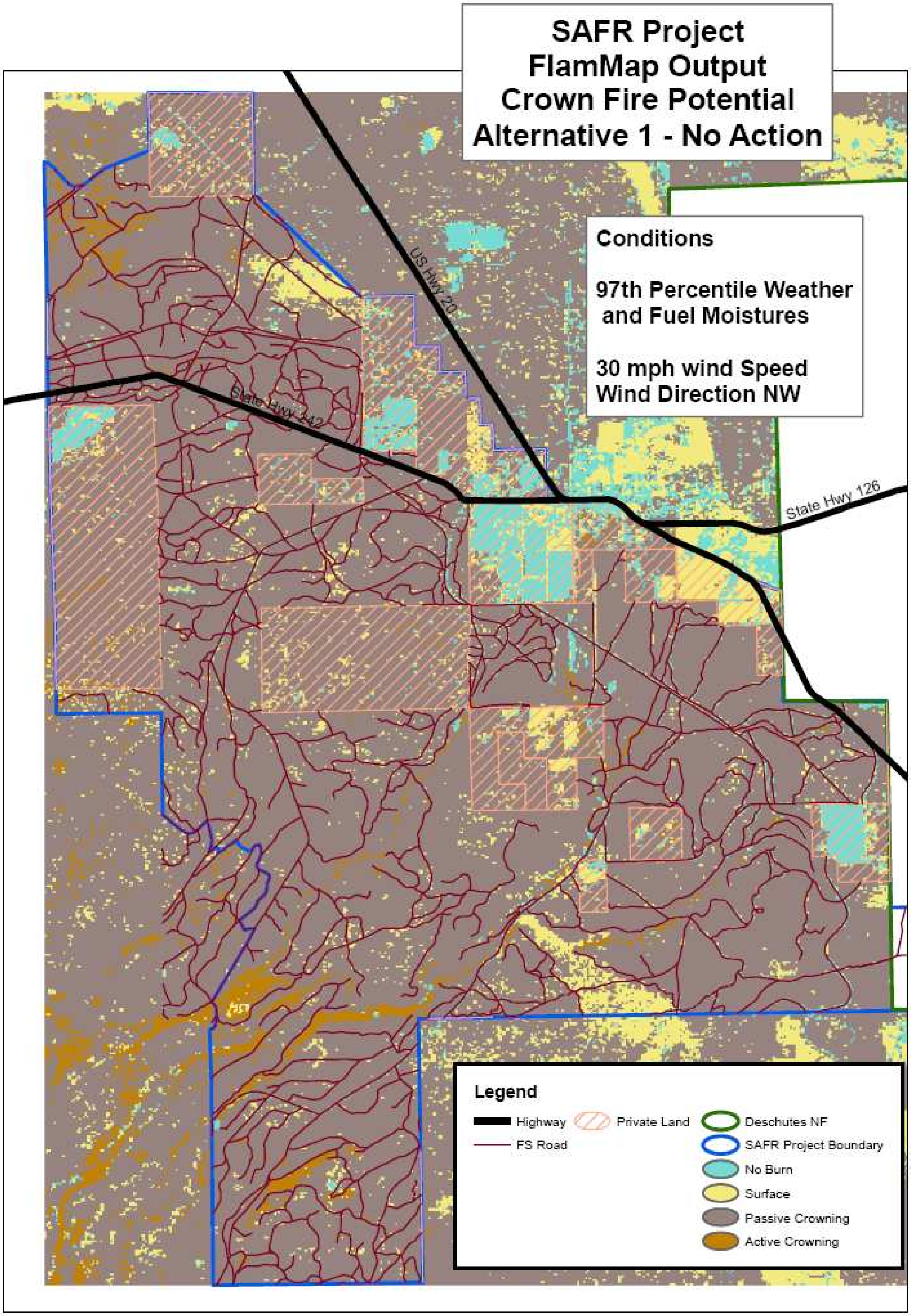
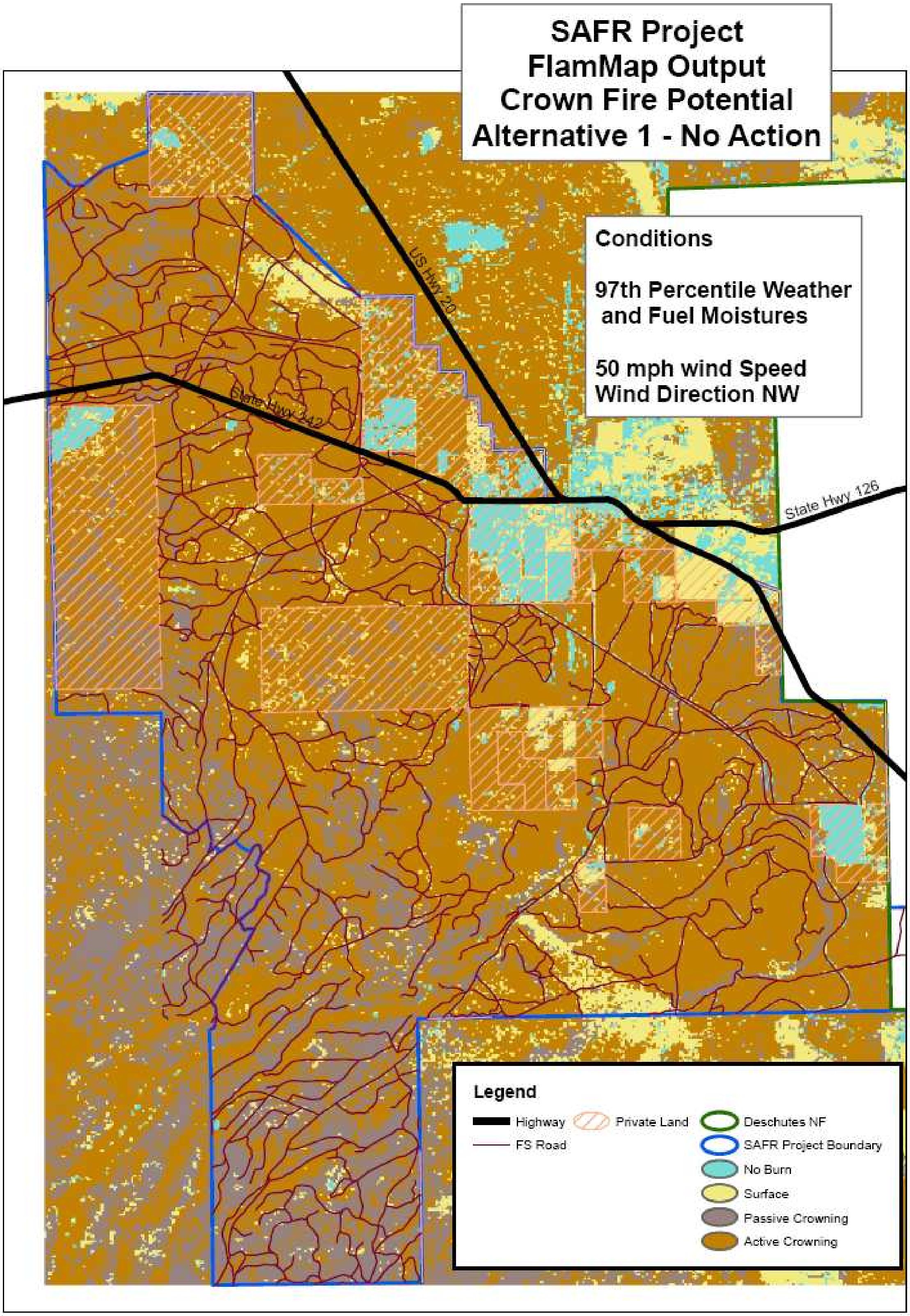


Figure 11: Fire Type, Alternative 1, 50 mph wind



There is a scientific foundation that treatments of fuels and vegetation can affect potential fire behavior and thereby reduce the risk of high intensity fire (Graham 2004).

Thinning treatments create a potential short-term increase in hazard in exchange for a long-term reduction in hazard. Although the threat of high-intensity fire is greatly reduced by thinning, the slash created by thinning is a potential hazard until it is treated. High fuel moisture in green slash makes it unavailable to burn, unless a wildfire occurs under extreme conditions. After the slash has dried out and turned red, it is available to burn. Should a wildfire occur during this time, the additional heat generated by the increased fuel load has the potential to cause undesired effects to the surrounding stand, soils, and other resources. This hazard is mitigated by either lopping (cutting) the slash to reduce the height of the fuel bed under 24 inches, or by piling the slash; both treatments reduce fire intensity. In units that have been lopped, after 2 or 3 years the slash gets further compacted by winter snows and can be burned with a low-intensity underburn without causing undesired fire effects. This delay also allows for the redistribution of nutrients from the slash back into the soil.

Thinning treatments reduce canopy cover and may result in increased wind speeds, lower humidity and lower fuel moistures for a given time and place compared to the no action alternative. This can result in lower fine fuel moisture in grasses and pine needles. Lowering moisture in the fine fuel will facilitate the spread of low-intensity surface fire which will in turn maintain low levels of surface fuels and ladder fuels and decrease the probability of crown fire.

Measure #2 – Improve forest health, sustainability, and resiliency and promote development of old growth forest stands and large trees by reducing the uncharacteristically high levels of competing live vegetation and reintroducing the more natural role of low intensity ground fire. The measure is the percent departure from reference condition or improving condition class.

Table 26 displays the percentage of area currently in different seral/structural strata. The primary measure of the effects of the alternatives on this measure is departure from reference conditions which determines condition class. Departure percent is more sensitive to the changes that result from the proposed actions than condition class. Condition class is derived from the departure percent value. See Alternative 2 and 3 for a comparison of the change in departure from reference conditions due to the action alternatives.

Table 26: Fire regime and seral/structural strata under Alternative 1 (No Action).

Fire Regime and Seral/Structural Strata	Alternative 1 Percent
Fire Regime I	
Strata	
Early (A)	19
Mid-Closed (B)	35

Mid-Open (C)	31
Late-Open (D)	6
Late-Closed (E)	9
Percent Departure	40
Condition Class	2
Fire Regime III Strata	
Early (A)	15
Mid-Closed (B)	13
Mid-Open (C)	54
Late-Open (D)	11
Late-Closed (E)	6
Percent Departure	37
Condition Class	2

Measure #3 – Reduce the risk of high intensity wildfires to nearby communities, private properties, and special natural places. The measure is burn probability combined with fire intensity.

To display the effects of the alternatives flame length potential was determined using the FlamMap model (Figures 13, 14 and Table 27). Flame length was chosen since it represents a good indicator of fire intensity. High intensity fire would be flame lengths greater than 4 feet.

Table 27: Predicted acres producing different flame lengths under Alternative 1 (No Action).

Alternative and Conditions	**Acres by Flame Length** **<2 feet**	**2-4 feet**	**4-8 feet**	**>8 feet**
Alternative 1				
30 mph wind	3290	69	638	52,372
50 mph wind	3134	36	2612	46,093

See Alternative 2 and 3 for a comparison of the change in burn probability due to the action alternatives.

Figure 12: Flame Length Alt. 1 30 mph Wind

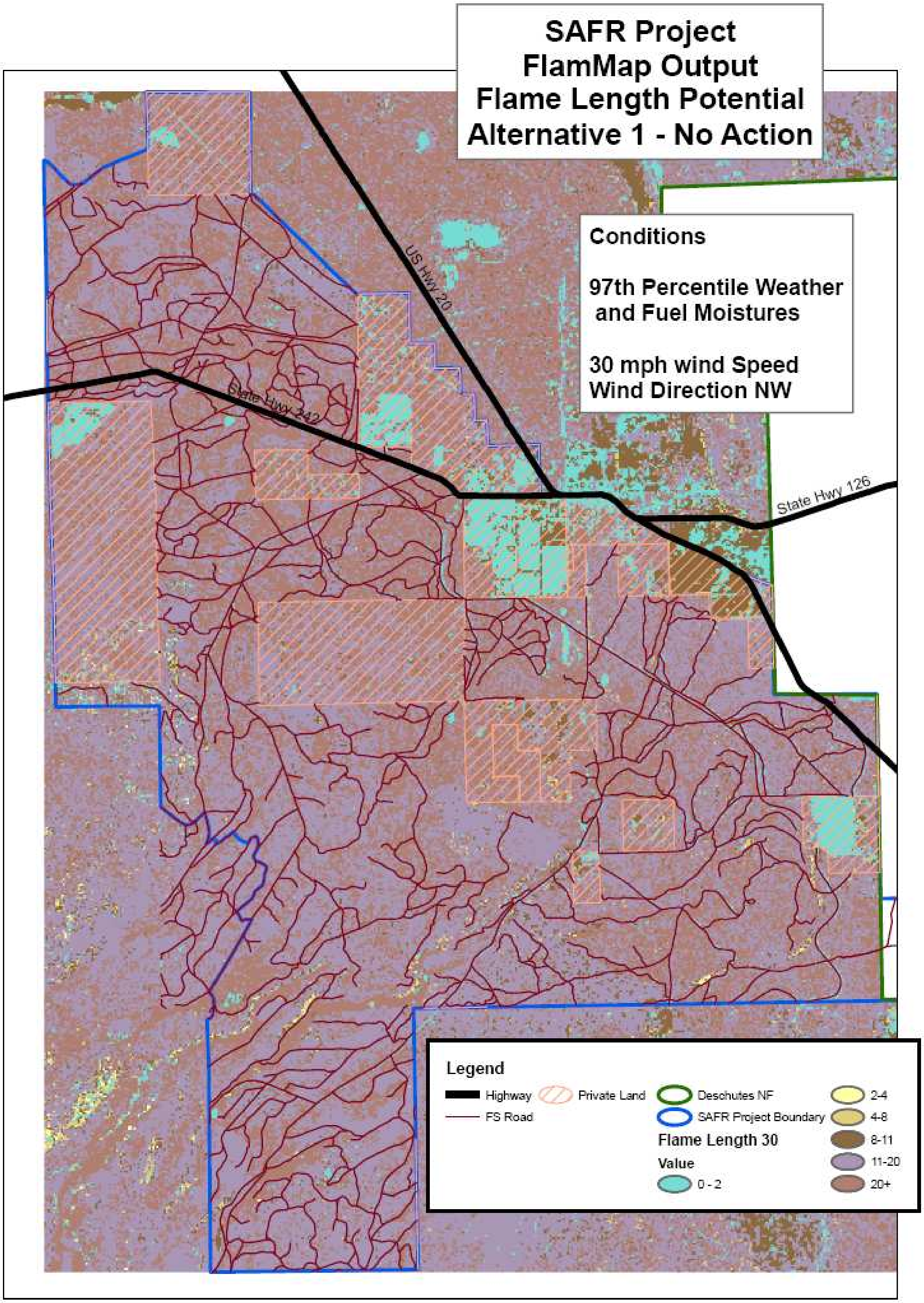
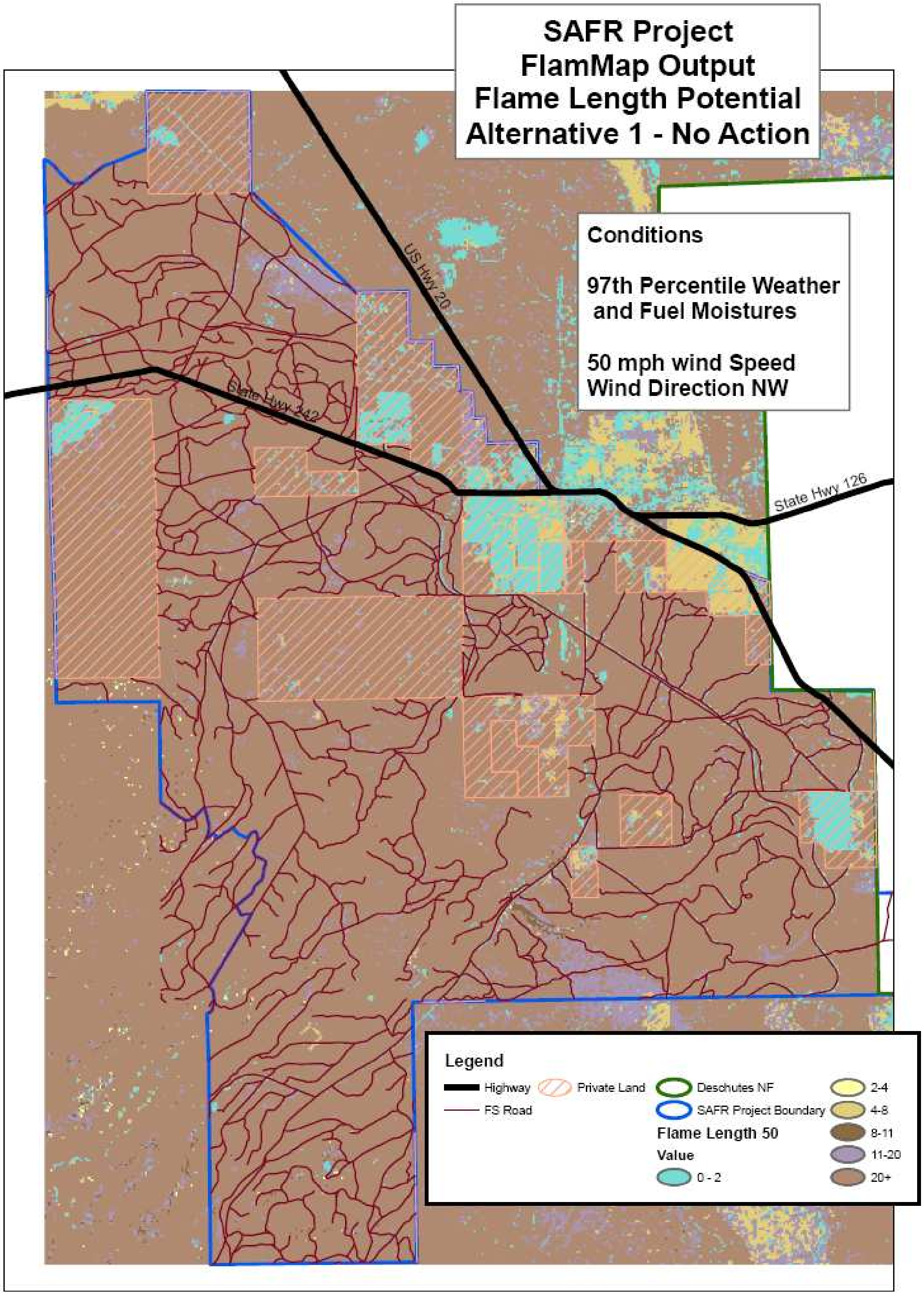


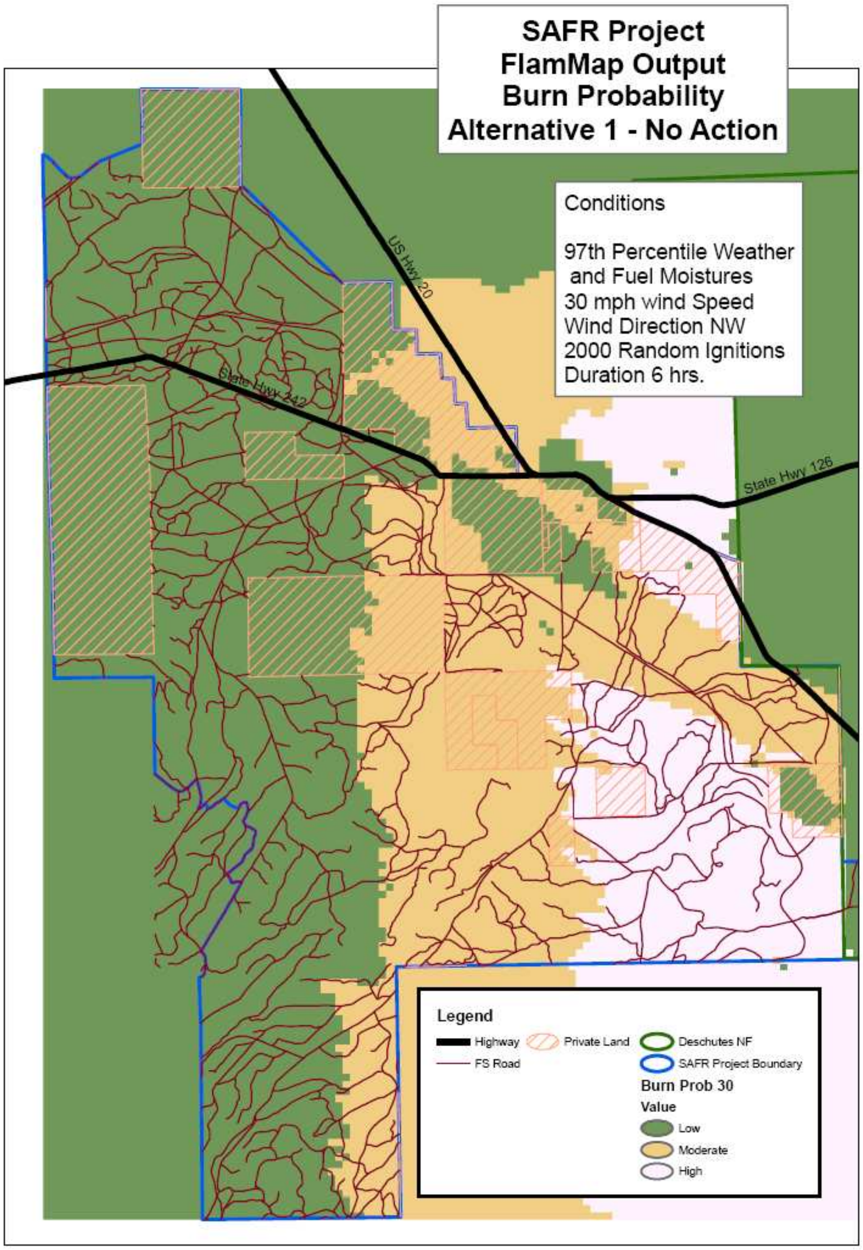
Figure 13: Flame Length Alt. 1 50 mph Wind



Burn Probabilities

Burn probabilities values were classified into 3 categories Low, Moderate and High. Under Alternative 1 (No Action) there is a high percentage of area that supports high intensity fire and has a high burn probability (Figure 15).

Figure 14: Alternative 1, Burn Probabilities



Measure #4 – The negative effect to air quality which would likely result from a wildfire. The measure is the amount of smoke and the tones of particulate matter.

Under Alternative 1, the effects on air quality would occur when high quantities of PM 2.5 and PM 10 are released when inevitable wildfire comes through the project area. These quantities released are much higher than what would be released under prescribed fire conditions. This can be attributed to the fact that summer wildfire conditions are usually windier, hotter and drier and consume a greater amount of down woody material, litter, duff, bark and foliage components during both ground and crown fire events. During a high intensity wildfire, smoke emissions of particulate matter of PM 2.5 and PM 10 could range from 500 lbs to 2,000 lbs or more per acre. This is at least 10 times the effects of mowing and prescribed underburning of the same acre. Where down woody fuels have accumulated and/or stands are dense particulate matter production of PM 2.5 and 10 may exceed these estimates.

Smoke from wildfires within the project area would impact the town of Sisters as well as other nearby communities because it would likely occur under conditions not conductive to smoke dispersion. It is highly likely that air quality within the Three Sisters Wilderness, a Class 1 Airshed, would be adversely affected. Dust from a denuded wildfire area within the WUI could be a major air quality concern, at least until grasses and forbs become reestablished following one to two growing seasons.

The cumulative effects on air quality would be to have much higher quantities of PM 2.5 and PM 10 released when wildfire occurs within the project area due to the higher burn intensities and increasing fuels accumulation that would occur over time. The amount of acres of vegetation management and fuels reduction activities accomplished within Central Oregon via timber harvest has steadily declined over the last 10 years. The continued deferral of treatment within the WUI would only exacerbate the negative effects on air quality, when a wildfire does occur.

Alternative 2 and 3 – Direct and Indirect Effects

Measure #1 – Reduce the risk of high intensity fire to the public and firefighters for reasons of safety. The measure is the amount of area (acres) with conditions that would support active crown fire or flame lengths greater than 4 feet.

With a wind speed of 30 mph, the amount of surface fire is reduced by 13,000 acres under both Alternatives 2 and 3 (Table 28). This effect results from the treatments proposed under Alternatives 2 and 3 which reduce surface fuels and remove ladder fuels which carry fire from the surface up into tree crowns.

Table 28: The effects of the alternatives on fire type, including active crown fire, are displayed in the table below, and in Figures 15 and 16.

Fire Type	**Alternative**		
	Alt. 1	**Alt. 2**	**Alt. 3**
No Burn	3109	3109	3109
Surface Fire	7232	20502	20502
Passive Crowning	44708	31708	31708
Active Crowning	1320	1049	1049
Analysis run with a 30 mph wind from the NW			

Conditions supporting active crown fire are not widespread in any of the alternatives at this wind speed, primarily because there is not enough crown mass to carry a fire from tree crown to tree crown. This can be addressed by looking at the average crown bulk density and crowning index over the project area by alternative. These are calculated outputs from the FVS-FFE stand model (Table 29).

Table 29: Crown bulk density as a measure of the forest canopy and crowning index indicators of wind speed necessary to carry an active crown fire.

Crown Fire Indicator	**Alternative**		
	Alt. 1	**Alt. 2**	**Alt. 3**
Average Crown Bulk Density (kg/m3)	.056	.035	.04
Average Crowning Index (mph)	36	51	48

As shown in the table above a wind speed of at least 36 mph is needed to result in active crown fire under existing conditions. The analysis above was done with a 30 mph wind, insufficient for active crowning.

With a 50 mph wind active crowning is the most common fire type found within the analysis area (Table 30). However, within the SAFR Project Area active crowning is reduced substantially under Alternatives 2 and 3.

Table 30: FlamMap model of active crowning with a 50 mph wind speed.

Fire Type	**Alternative**		
	Alt. 1	**Alt. 2**	**Alt. 3**
No Burn	3109	3109	3109
Surface Fire	7095	17236	17236
Passive Crowning	11044	8839	8839
Active Crowning	35121	27184	27184
Analysis run with a 50 mph wind from the NW			

The FlamMap model results for both Alternatives 2 and 3 are identical primarily due to their similar effects on reduction of surface and ladder fuels. The primary difference between Alternatives 2 and 3 is indicated by the crown bulk density and crowning index displayed above.

Figure 15: Fire Type, Alternatives 2 and 3, 30 mph wind

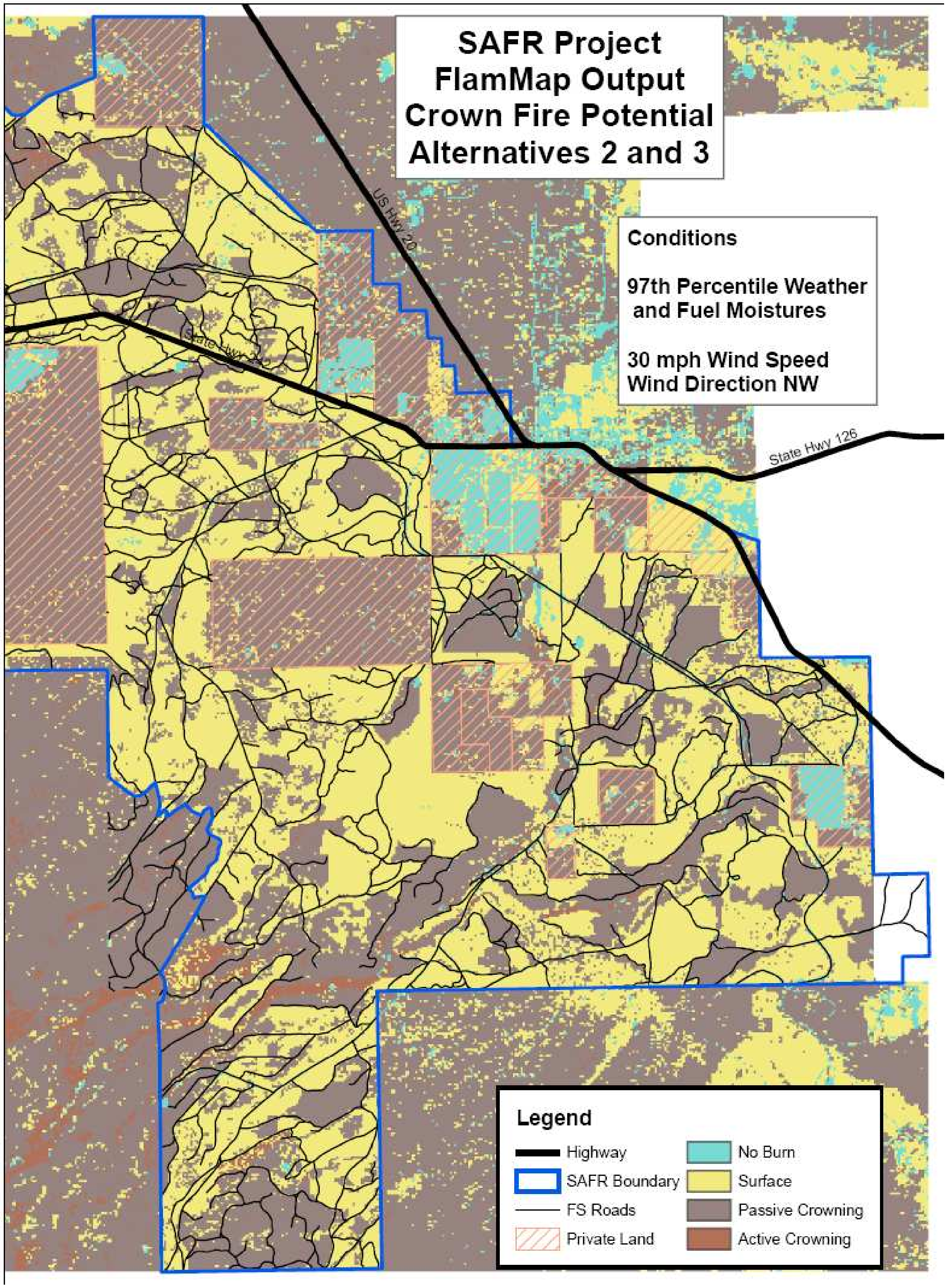
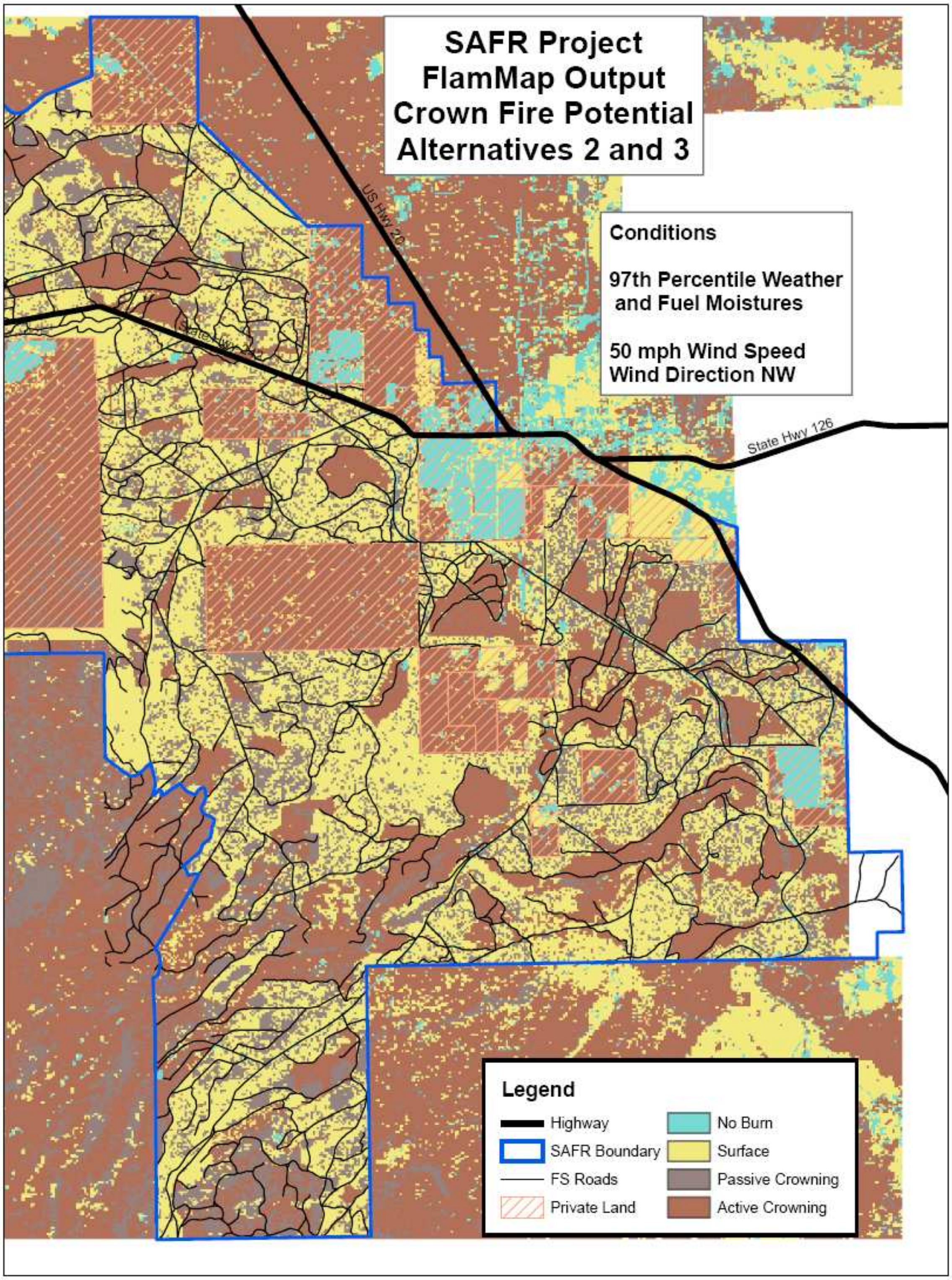


Figure 16: Fire Type, Alternatives 2 and 3, 50 mph wind



Measure #2 – Improve forest health, sustainability, and resiliency and promote development of old growth forest stands and large trees by reducing the uncharacteristically high levels of competing live vegetation and reintroducing the more natural role of low intensity ground fire. The measure is the percent departure from reference condition or improving condition class.

In Fire Regime I the amount of Mid-Closed strata is reduced and shifted to the Mid-Open strata for both Alternatives 2 and 3 (Table 31). The shift is slightly more evident in Alternative 2 than Alternative 3 because in Alternative 2 trees up to 21 inches in diameter can be removed. The same shift from closed to open strata is evident in the Late Seral stages. Again due to the treatment proposed in Alternatives 2 and 3.

None of the alternatives result in enough improvement to in seral/structural class composition to reach Condition Class 1, however there is improvement for both Alternatives 2 and 3 as shown in the table above. The improvement is captured as a reduction in the percent departure. Condition Class 1 is defined as ≤ 33% departure from reference conditions.

Reaching and maintaining amounts of seral/structural stages closer to reference conditions would result in increased sustainability considering the inherent disturbance processes associated with these Fire Regimes.

Table 31: Change in fire regime and seral/structural strata by Alternative.

Fire Regime and Seral/Structural Strata	Alternative 1 Percent	Alternative 2 Percent	Alternative 3 Percent	Reference Condition (%)
Fire Regime I Strata				
Early (A)	19	19	19	25
Mid-Closed (B)	35	12	14	5
Mid-Open (C)	31	53	51	25
Late-Open (D)	6	12	11	40
Late-Closed (E)	9	3	4	5
Percent Departure	40	36	36	
Condition Class	2	2	2	
Fire Regime III Strata				
Early (A)	15	18	18	15
Mid-Closed (B)	13	8	9	1
Mid-Open (C)	54	53	53	30
Late-Open (D)	11	16	15	40
Late-Closed (E)	6	4	5	14
Percent Departure	37	34	34	
Condition Class	2	2	2	

Measure #3 – Reduce the risk of high intensity wildfires to nearby communities, private properties, and special natural places. The measure is burn probability combined with fire intensity.

Flame Length

Flame lengths less than 4 feet could be suppressed safely using direct suppression tactics with hand crews. Generally fires with flame lengths greater than 4 feet require heavier mechanized suppression equipment or indirect tactics which may increase hazards to firefighters and the public.

Table 32: Displays the effects of the alternatives on flame length within the analysis area.

Alternative and Conditions	Acres by Flame Length			
	<2 feet	2-4 feet	4-8 feet	>8 feet
Alternative 1				
30 mph wind	3290	69	638	52,372
50 mph wind	3134	36	2612	46,093
Alternative 2				
30 mph wind	17,487	307	2043	36,532
50 mph wind	20,094	5362	1783	29,131
Alternative 3				
30 mph wind	17,487	307	2043	36,532
50 mph wind	20,094	5362	1783	29,131

The differences in flame length supported by each alternative are largely determined by the fuel model assignment as shown in Table 28 above. In Alternatives 2 and 3 treatment of fuels would be accomplished changing the fuel model from a 6 (shrub dominated) to 8 and 9 (timber litter dominated). Fuel models resulting from Alternatives 2 and 3 are identical, thus having the same effects on flame length (Figures 18 and 19).

Figure 17: Flame Length Alts. 2 and 3 30 mph Wind

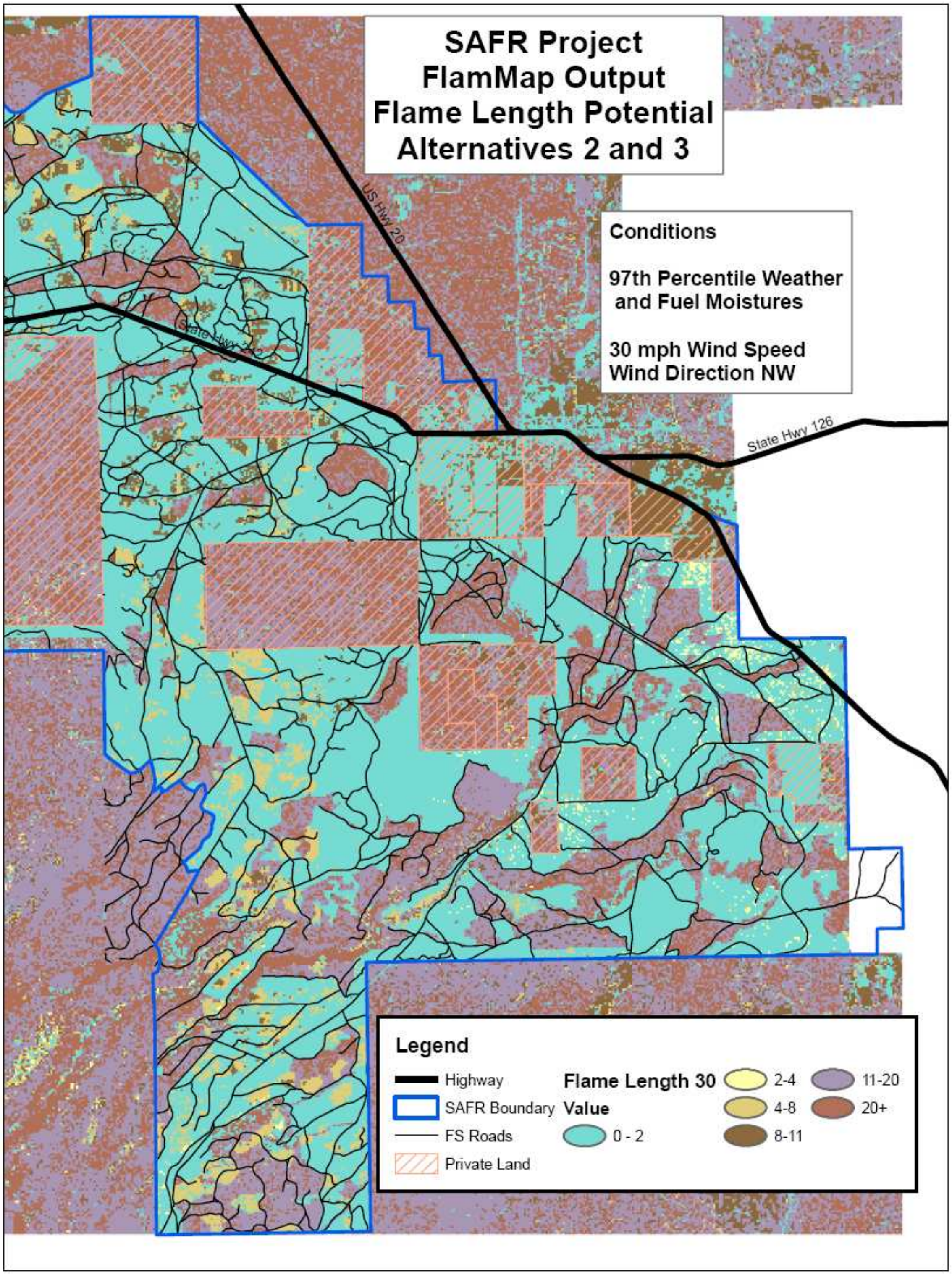
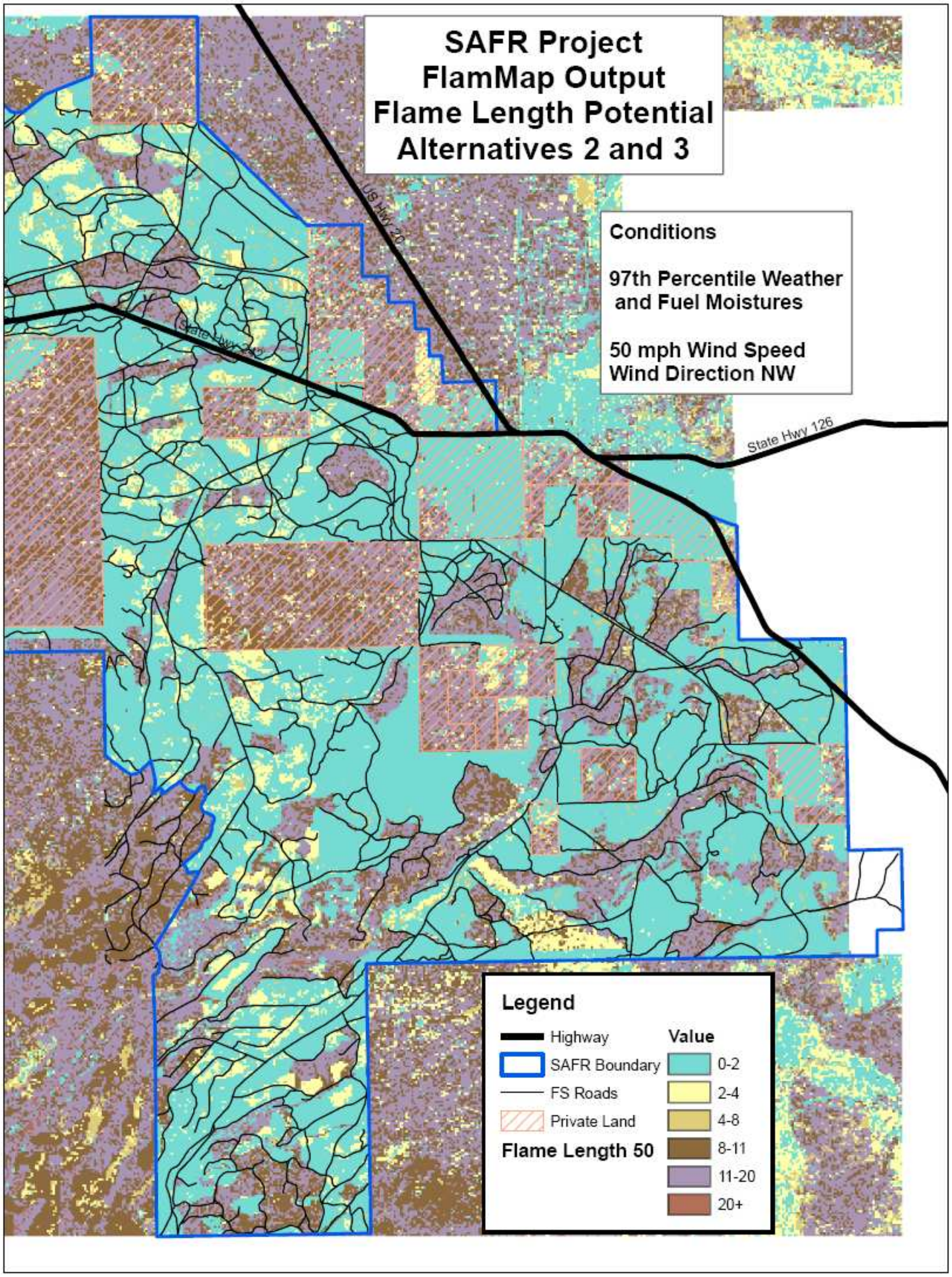
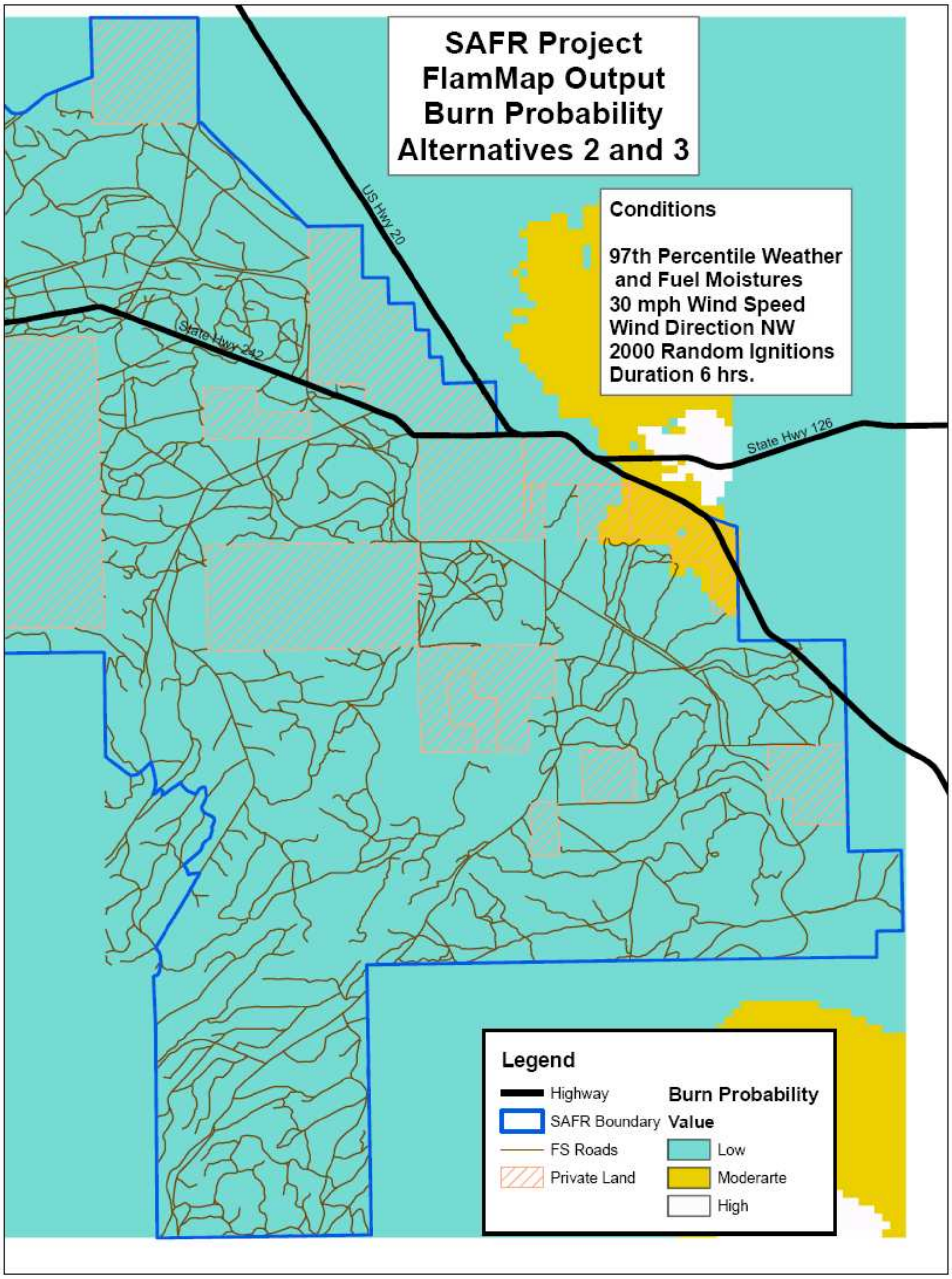


Figure 18: Flame Length Alts. 2 and 3, 50 mph Wind



Burn Probabilities
Burn probabilities values were classified into 3 categories Low, Moderate and High. Figure 20 displays burn probabilities for the alternatives.

Figure 19: Alternatives 2 and 3, Burn Probabilities



The burn probabilities and flame length outputs were combined to calculate a Risk of Loss value. Flame lengths greater than 4 feet were determined to be of sufficient intensity to cause unacceptable levels of mortality in forest stands and create hazardous conditions for firefighters and the public. Risk of Loss categories are defined as:

Low Risk of Loss = Flame lengths less than 4 feet, any burn probability
Moderate Risk of Loss = Flame lengths of 4-8 feet, low and moderate burn probability

High Risk of Loss = Flame lengths of 4-8 feet, high burn probability and
Flame lengths >8 feet, any burn probability.

Table 33: Alternatives effects on Risk of Loss.

Alternative	Acres by Risk of Loss Low	 Moderate	 High
Alternative 1	3359	638	52,003
Alternatives 2 and 3	17,794	2043	36,163

Figures 21 and 22 display a spatial representation of Risk of Loss by Alternative.

Both figures display major fire travel routes to help understand the way FlamMap models fire spread. The fire routes represent pathways that a fire would take through the landscape based on the conditions under which the model is run. The fire routes shown use the same ignition points, wind speed and direction and fire duration for each of the alternatives. The fire travel routes are much longer for Alternative 1 compared to Alternatives 2 and 3 which illustrates that conditions under Alternative 1 are much more conducive to rapid fire spread than Alternatives 2 and 3.

Under Alternative 1 there is a high percentage of area that supports high intensity fire and has a high burn probability, resulting in a high amount of area that has a high risk of loss. Alternatives 2 and 3, by treating surface fuels reduce fire intensity and fire spread thereby increasing the area at a low risk of loss in the analysis are by 14,435 acres.

Figure 20: Risk of Loss, Alternative 1

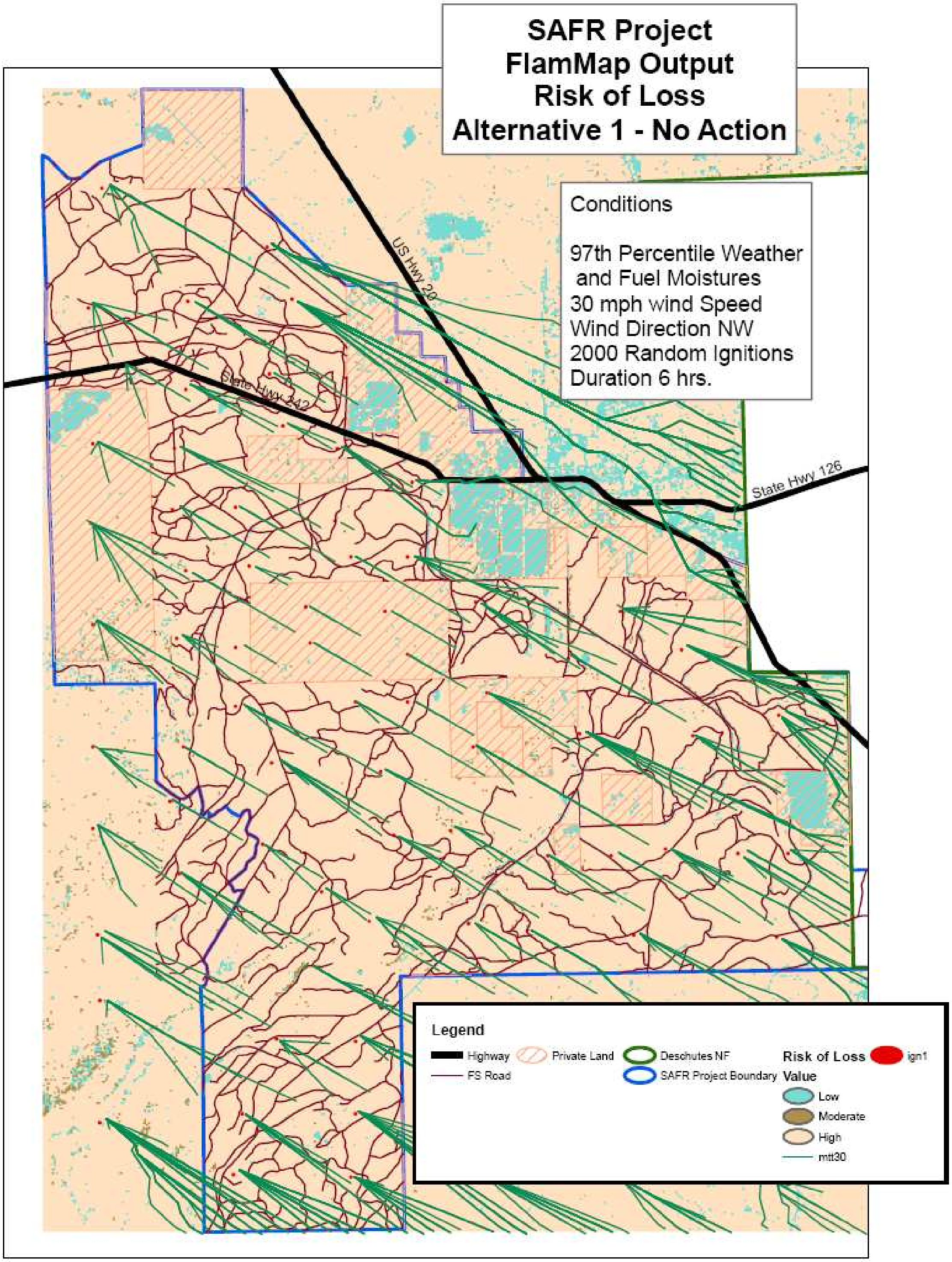
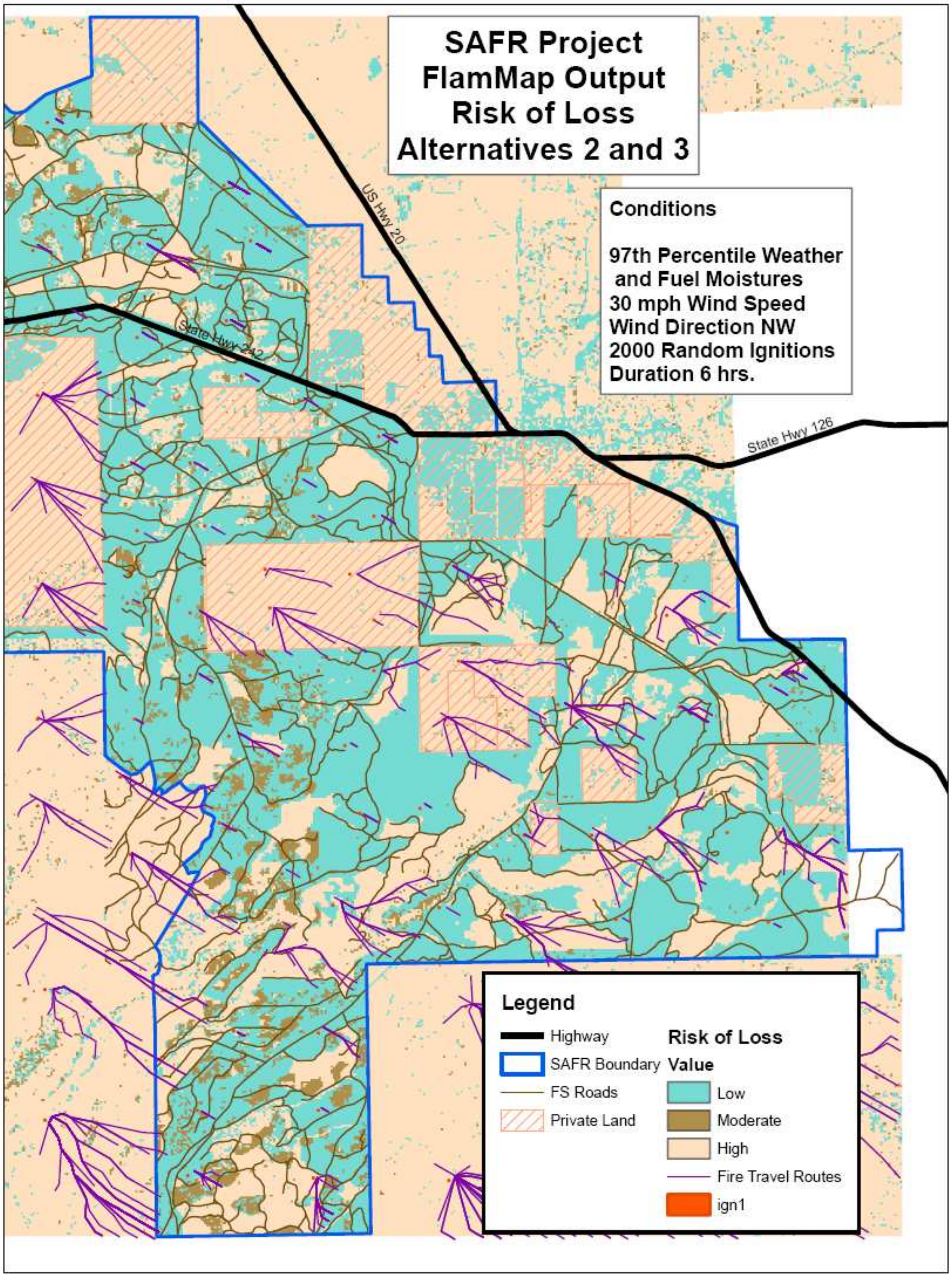


Figure 21: Risk of Loss, Alternatives 2 & 3



Measure #4 – The negative effect to air quality which would likely result from a wildfire. The measure is the amount of smoke and the tones of particulate matter.

Smoke emissions connected with Alternative 2 and 3 are of concern due to the project areas proximity to Sisters, other near by communities, and the Three Sisters Wilderness. Under Alternative 2, air quality would be affected primarily by smoke produced during prescribed underburning and pile burning activates. Through the use of mowing prior to burning, emissions could be reduced. For example, 500 acres of mowing and underburning produce approximately six tons of PM 10 versus 16 tons when burning without mowing.

Burning would be conducted in compliance with National Ambient Air Quality Standards and under the Oregon Smoke Management Plan regulations and restrictions to track smoke produced and monitor emissions. Burning would only be conducted when prevailing and predicted wind patterns would result in negligible effects to the town of Sisters and near by communities.

Cumulative Effects on Fire Behavior Potential

The analysis boundary for fire behavior is approximately 56,000 acres of private and public lands.

The analysis area has a high occurrence of both lightning and human caused fires that are scattered across all ownership boundaries. This risk combined with the accumulations of surface, ladder, and crown fuels increases the potential for a large, high intensity wildfire to occur and spread across ownership boundaries.

The Deschutes National Forest, Oregon Department of Forestry and private land owners are coordinating fuel reduction efforts through the Greater Sisters Country Community Wildfire Protection Plan to tie in treatment areas within and adjacent to the SAFR project area to increase reductions in fire intensity and spread potential. Sound biological fuel reduction treatments would create defensible space and increase effectiveness of fire suppression actions.

Alternative 1(No Action) - Ecological Trends

Limited vegetation management, aggressive wildfire suppression, and insect and disease mortality would continue the trend of fuel loadings accumulating in the form of dead and down trees, small diameter trees growing into the overstory, and dense crown conditions. These conditions would continue to the potential for a ground fire to transition to a crown fire. Heavy accumulations of surface fuels and/or crown fires would continue to increase the potential for spotting to occur.

These conditions would continue to limit fire fighting effectiveness, increase risk to private property and homes, firefighter and public safety, and increase the risk of damaging impacts to natural resource values within the SAFR area.

Alternatives 2 and 3

The combined continued fuel reduction efforts of all ownerships would reduce the potential for a large, high intensity wildfire to spread through the area. Fuel reduction efforts would reduce potential crown fire and flame lengths, improve effectiveness of firefighting actions, and improve safety for the public and firefighters.

Cumulative effects of Alternatives 2 and 3 are similar. The same number of acres are treated and treatment types are the same. The diameter cut limit in Alternative 3 of 12 inches dbh is limited in effect on fire behavior, and only makes a measurable difference when wind speeds are at very high levels.

Implementing either Alternatives 2 or 3 would reduce the potential for a large, high intensity wildfire to spread from Deschutes National Forest onto private lands by reducing flame lengths, crown fire and spotting potential.

Cumulative Effects on Fire Regime and Condition Class

Alternative 1(No Action) – Ecological Trends

Fire regimes identified as being in condition class 2 would convert to a condition class 3 over the next 20 to 30 years. Regimes identified as being in a condition class 3 would continue to be at high risk. Fire Regime I and 3 areas identified as condition class 1 would develop into condition class 2 within 20 to 50 years.

Movement towards historic or reference conditions in disturbance patterns across the landscape would be delayed for approximately 20 to 30 years, or until a stand replacement event occurs.

Heavy concentrations of dead standing and down trees and multi-strata structure and tree densities would continue to be at risk to intense, stand replacing fire events, which could result in the loss of late and old structure, wildlife habitat cover, and consumption of large woody material and structure in riparian areas.

Alternatives 2 and 3

Cumulative effects in Alternatives 2 and 3 are similar, the main difference being that Alternative 3 leaves a denser overstory of trees greater than 12 inches dbh. In 20 to 30 years this may result in higher crown bulk densities, dependant on crown development, and a potential for increased crown fire.

Forest vegetation treatments proposed in both alternatives reduce dense stand conditions and reduce ladder fuels resulting in reduced potential for surface fires moving into tree crowns. This would result in Fire Regimes I and III moving from condition class 2 to conditions class 1.

Mechanical treatments would allow for more opportunities to use prescribed fire in the future. Mechanical treatments would reduce the amount of smoke emissions generated during prescribed fire burning by reducing the amount of fuels available for combustion.

Maintaining fire return intervals within Fire Regimes I and III would help move existing vegetation condition in terms of species composition, structural stages, and disturbance patterns towards historic/reference conditions.

Cumulative Effects on Air Quality

The cumulative effect on air quality from prescribed burning included with Alternative 2 and 3 is zero. A study of the cumulative effect of emissions in the Central Oregon area shows that slash burning contributes less than 0.5 percent (0.34 percent) of the PM 10 and less than 1 percent (0.64 percent) of the carbon monoxide in Central Oregon. Burning would be conducted to ensure that there would be no cumulative effects on air quality. In areas where restoration of historic fire regimes is planned, prescribed fire would likely need to occur.

Wildlife

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Biological Evaluation and Wildlife Report. Numerous wildlife species occur within the planning area. This section provides a description of the types of species and their habitat requirements. Effects of implementing this project on different species and their habitats are also analyzed. Reference information is contained in the full specialist report.

Affected Environment

Threatened, Endangered, and Federal Candidate Species

Those species thought to occur presently or historically on the Deschutes National Forest include the northern bald eagle (*Haliaeetus leucocephalus*), northern spotted owl (*Strix occidentalis*), Canada Lynx (*Lynx canadensis*), Pacific fisher (*Martes pennanti*), and the Oregon spotted frog (*Rana pretiosa*). Habitat for the northern spotted owl, Canada lynx, and Oregon spotted frog do not occur within the SAFR project area. These species will not be discussed within the EA, see the Wildlife Biological Evaluation for the SAFR project for the rationale.

Existing Condition

Threatened, Endangered, and Federal Candidate Species

Northern Bald Eagle, Federal Threatened, Management Indicator Species
Bald eagles are permanent residents of Oregon. Essential habitat elements for the recovery and eventual delisting of the northern bald eagle are nest sites, communal night roosts, foraging areas, and perch sites. On the Deschutes National Forest, ponderosa pine and Douglas-fir trees averaging 32 inch+ dbh with large, open limb structure are preferred for nesting. Nests consist of bulky stick platforms built in the super-canopy of such trees, or less frequently on cliffs. They are typically constructed within one mile of appropriate foraging habitat, which includes rivers and large (typically 90 surface acres or greater) lakes and reservoirs. Bald eagles are sit-and-wait predators, which predominantly capture prey from perches over water; ideal perches are large trees and snags within 330 ft. (100 m) of water (Anthony et al. 1995). Prey items include fish, waterfowl and other birds, small mammals, and carrion (Stalmaster, 1987). Most of the large lakes, reservoirs, and rivers on the Sisters Ranger District provide suitable habitat for bald eagles.

The Pacific Bald Eagle Recovery Plan (USDI 1986) designated recovery zones for each state and the Sisters Ranger District is within the High Cascades Zone. The Recovery Plan population goal for the High Cascades is 33 territories and the Habitat Management goal is 47 territories. Surveys conducted in 2005 confirmed the presence of 64 occupied territories of 69 territories located in the High Cascades Zone (Isaacs and Anthony 2006). Bald eagle use has been documented within the planning area. The planning area contains the Cloverdale bald eagle pair. The pair has a known nest site and winter roost. The pair uses Watson Reservoir (owned by Three Sisters Irrigation District) as their primary foraging area although there are several other foraging areas that have been identified. Table 34 shows the nest history of the pair.

Table 34: Nesting History of the Cloverdale Bald Eagle Pair

Year	Status	Year	Status
1986	2 Young	1997	Occupied, Failed
1987	2 Young	1998	Occupied, Failed
1988	1 Young	1999	Occupied, Outcome Unknown
1989	2 Young	2000	1 Young
1990	1 Young	2001	2 Young
1991	2 Young	2002	2 Young
1992	Failed	2003	2 Young
1993	2 Young	2004	2 Young
1994	2 Young	2005	2 Young
1995	Occupied, Failed	2006	2 Young
1996	Occupied, Failed		

The Cloverdale Bald Eagle Management Area (BEMA) is located in the project area. The BEMA is 666 acres in size. Currently, the BEMA averages 5 trees over 21 inches dbh per acre. Many of the future nest, roost, or perch trees are suppressed and therefore have limited large limb structure. Competition for nutrients and water makes these trees more susceptible to insects and disease. In addition, the larger trees that are within densely stocked stands are more susceptible to wildfire due to increased fuel loadings and ladder fuels from 100 years of fire suppression.

Evaluation criteria
Large tree habitat for the bald eagles is the most limiting factor within the Cloverdale BEMA in the short and long term. Protection of existing large trees is important, but it is essential to accelerate the development of large trees with structures (large limbs) capable of supporting future bald eagle nesting, roosting, and perching.

The following evaluation criteria will be used to evaluate the effects of planned activities and provide a comparison between alternatives:

- Total number of acres of treatments (thinning, mowing, and burning) within the Cloverdale Bald Eagle Management Area (BEMA).

Pacific Fisher, Federal Candidate, Region 6 Sensitive
Fisher populations are considered to be extremely low in Oregon, Washington, and parts of the Rocky Mountains. They occur in landscapes dominated by late-successional and mature forests. Fishers have been found to use riparian areas disproportionately to what exists. On the Westside of the Cascades, fishers tend to be associated with low to mid-elevational forests dominated by late-successional and old growth Douglas-fir and western hemlock. However, on the eastside of the Cascades, they occur at higher elevations in association with true fir and mixed conifer forests. They tend to prefer areas with high canopy closure and late and old structural forests with relatively low snow accumulations. Critical features of fisher habitat include physical structure of the forest and prey associated with forest structure. Structure includes vertical and horizontal complexity created by a diversity of tree sizes and shapes, light gaps, down woody material, and layers of overhead cover. Major prey species include small to medium sized mammals, birds, and carrion. Porcupines are the best known prey species but fisher will also prey on snowshoe hare, squirrels, mice and shrews. (Powell and Zielinski 1994)

There are only two known populations of fisher in Oregon, one on the Rogue River National Forest and the other in southwestern Oregon along the Oregon-California border. Limited potential habitat exists on the west edge of the project area within the late and old structural mixed conifer wet plant association that, due to the fishers high canopy closure preferences.

Formal surveys have not been conducted in the project area. However, surveys were conducted in the winters of 1997/1998 (Dec. through March) and 1999 (Febr. through April) according to the protocol outlined in Ruggerio et al. (1994). These consisted of Trailmaster baited camera set-ups located along the wilderness boundary. Two of the stations were located within 5 miles of the southern extent of the project area. There were no fishers located during the surveys.

Environmental Consequences

Northern Bald Eagle, Federal Threatened, Management Indicator Species
Alternative 1 – Ecological Trends
There are no known direct effects associated with the no action alternative. Many of the large trees that provide potential nest, perch, and roost sites are surrounded by dense patches of smaller trees with and understory of brush. Competition for nutrients and water makes these trees more susceptible to insects and disease. In addition the larger trees that are within densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from 100 years of fire suppression. Under the no action alternative, large trees will continue to be at an increased risk to insect, disease, and wildfire.

Currently, there are a limited number of large trees available for alternate nest and potential roost sites located within allocated bald eagle habitat. Much of the future eagle habitat (larger trees) is within overstocked stands, which will increase the amount of time to develop future habitat (the desired size and height). Many of the future large trees have been growing in dense pockets, which create large trees with small branches. Therefore, many of the future large trees may lack the structure needed to support heavy nests eagles create.

The no action alternative *"May Affect, but is not likely Adversely Affect"* bald eagles or their habitat in the short and long term due to large trees continuing to be at an increased risk to insect, disease, and wildfire and the length of time the trees will take to get to the desired size and height. In addition trees growing tightly spaced may lack the larger branch structure needed to hold the heavy nest structures eagles create.

Pacific Fisher, Federal Candidate, Region 6 Sensitive
Alternative 1 – Ecological Trends
No direct effects will occur with this alternative. Existing suitable habitat is limited (approximately 68 acres) and fragmented. In addition some stands show signs of increased mortality, decreasing the quality of habitat currently existing. In the mixed conifer increased stand densities due to fire suppression is allowing white fir to out compete or put added stress on existing large Douglas fir and large ponderosa pine which is resulting in these large trees dying at an accelerated rate. No treatment within these stands will only allow habitat conditions to exist in the short term. Increased fragmentation due to further degradation of habitat may reduce the habitat quality for this area.

There is an increased risk of loss of the remaining suitable habitat by a stand replacing fire event or further degradation by insects and disease. If such an event were to occur, it would prolong the development of suitable habitat within the project area and may destroy critical habitat components like large snags and down woody material. Some snags and down woody material would be created with these events, but the loss of canopy would lead to reduced acres of suitable habitat.

Implementation of the no action alternative would have "*No Effect*" on the fisher, due to the minimal amount of potential habitat occurring within the project area.

Northern Bald Eagle, Federal Threatened, Management Indicator Species
Alternatives 2 and 3
Direct/Indirect Effects: There will be no known direct effects to the Cloverdale bald eagle pair, due to seasonal restrictions for the nest site and winter roost. However, disturbance may occur to foraging eagles during treatments which may result in altering their foraging patterns. Approximately 523 (79%) acres of allocated eagle habitat will receive treatment. Green trees 21 inches and greater (potential roost, nest, and perch trees) will not be removed. Generally, all large snags will be avoided, but there is the potential for incidental loss during operations. OSHA regulations/requirements direct removal of snags that pose hazards to operations.

Thinning within the bald eagle allocation will reduce ladder fuels associated with large trees, reducing the risk of loss to the remaining large trees. Removal of understory in overstocked stands will reduce competition for nutrients and water, decreasing the susceptibility to insects and disease, which was noted by Cochran and Barret (1999a) as an important benefit to thinning.

Replacement large trees are also a concern, many of the future eagle trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size and height. Thinning stands will reduce competition, increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees.

Many of the future large trees have been growing in dense pockets, which will create large trees with small branches. Therefore, future large trees may lack the structure that is needed to support nest structures that eagles create. Cochran and Barret (1999b) determined that crown widths were significantly greater in the absence of understory vegetation. Using the assumption that larger crown widths equate to larger branch structures, the study shows open grown trees with limited understory will have larger branches than large trees in densely stocked stands. Therefore, thinning treatments will increase branch sizes creating trees with the structure to support future eagle nest sites.

Proposed mastication and burning treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuels treatments will reduce fire risk and competition between established trees, increasing stand resiliency to wildfire.

Negative effects of treatments may result in large snags being removed for safety. Disturbance may also occur to foraging eagles during treatments, altering their foraging locations or behavior.

The action alternatives *"May Affect, but are not likely to Adversely Affect"* bald eagles or their habitat in the short term due to thinning, mastication, and burning occurring within eagle habitat. The SAFR project is consistent with Deschutes LRMP (USDA 1990) and the Project Design Criteria Compliance Checklist from the Joint Aquatic and Terrestrial Programmatic Biological Assessment for Federal Lands within the Deschutes Basin (USDA 2006). The project will effect eagles short term, however treatments within eagle habitat are expected to benefit eagles in the long term.

Pacific Fisher, Federal Candidate, Region 6 Sensitive
Alternatives 2 and 3
Direct/Indirect Impacts: There are approximately 68 acres of potential habitat that is late and old structural mixed conifer wet. Of that approximately 2 acres are identified for thinning and prescribed fire, which will result in a decrease in structure and canopy closure. Removal of this material will decrease canopy cover in the stand. Several studies have shown that fishers disproportionately use habitat with high canopy cover and avoid areas with low canopy cover (Arthur et al. 1989; Coulter 1966; Jones and Garton 1994; Kelly 1977; Powell 1977; Raphael 1984; Rosenberg and Raphael 1986; and Thomasma et al. 1991, 1994). Prescribed fire will also decrease the level of available down woody material, which results in a decrease in potential foraging and denning sites. Approximately 66 acres (97%) of potential habitat will remain untreated.

Approximately 87 acres (9%) of the riparian habitat conservation areas (RHCA's) are proposed for treatment. These treatments occur in lower elevations where the riparian areas tend to be very narrow and canopy cover is at higher levels, so potential habitat is limited. In addition areas identified for treatment in the RHCA's lack horizontal and vertical structure needed for fisher habitat

Implementation of Alternative 2 or 3 would have "*No Effect*" on the fisher, due to the minimal amount of potential habitat occurring within the project area.

Northern Bald Eagle, Federal Threatened, Management Indicator Species
Cumulative Effects: Bald Eagle Management Areas and essential eagle habitat along the Metolius River and Lake Billy Chinook located on the Sisters Ranger District will be used to discuss cumulative effects to bald eagles. Essential eagle habitat along the Metolius River is down stream of Canyon Creek to Lake Billy Chinook. Danger trees are routinely removed from recreation facilities and major travel routes. An estimated 1,090 acres of 21,810 acres (5%) of potential eagle habitat could potentially have danger trees removed around developed campgrounds and along main roads. Continued loss of large snag habitat in and immediately adjacent to recreation facilities and major travel routes due to safety reasons limits available nesting and perching sites along suitable water bodies (e.g., Suttle Lake, Metolius River, and Lake Billy Chinook). Most hazard trees

removed do not occur directly on the shoreline in most cases but do occur within the riparian reserve. Large snag habitat outside designated recreation areas is important to retain since most, if not all, large snag habitat will eventually be lost in the recreation sites over time. Because of the high level of use these areas receive, it is unlikely they would be utilized for nesting.

Several sections of private land occur near potential habitat, which are not managed for eagle habitat. It is assumed that any habitat provided by these parcels is incidental and may not be long term. Other private lands occurring along the Metolius River and Lake Billy Chinook consist of small communities or resort facilities. Large tree development may be consistent with their goals and objectives but retention of large snag habitat is not for safety reasons.

Past harvest activities and wildfires resulted in the removal of large trees and snags. This coupled with the loss of large snag habitat due to safety reasons has reduced the available nesting, roosting, and perching habitat for eagles (approximately 1,990 acres of harvest since 1980 and 8,740 acres of wildfire since 1980). However, recent vegetation management projects like the Metolius Basin Forest Vegetation Management project designed treatments along the Metolius River to facilitate the development of large tree structure and reduce the risk to existing large trees and snags. Some management activities, primarily understory thinning within the Suttle Lake BEMA was completed (Coil Fiber timber sale) to help maintain existing bald eagle habitat and promote future suitable habitat for the Suttle Lake nest site. However, all treatments had not been accomplished prior to the B&B Fire, primarily around the nest tree due to seasonal restrictions for breeding.

Restoration projects on Brush Creek, Canyon Creek, and Jack Creek improved habitat for bull trout. In addition, many culverts were replaced under BAER to minimize impacts to important waterways. These projects have the potential to increase fish production, providing the bald eagle with a more abundant food source.

Road decommissioning has been proposed within potential eagle habitat across the district, reducing the potential disturbance to existing nest, enhancing habitat connectivity and increasing the potential to develop more suitable habitat.

Overall, nesting, roosting, and perching habitat has declined or been impacted in some way (approximately 43%) but existing and potential habitat still remains outside of managed facilities and away from major travel routes. The quality of habitat has changed due to the wildfires and will continue to change inside and out of the fire areas. The future of eagle use in burned nesting territories on Suttle Lake and Lake Billy Chinook will be determined with continued monitoring. Bald eagle populations are expected to remain stable across the district. The currently active nest sites are expected to remain active territories especially with associated road closures, stand density reduction activities, and associated healthy fisheries.

Pacific Fisher, Federal Candidate, Region 6 Sensitive
Cumulative Impacts: Activities proposed for the SAFR project will not incrementally add to cumulative effects as there are no direct or indirect effects associated with the project for this species.

Affected Environment

Regional Forester's Sensitive Species

Regional Forester's Sensitive Species

The Regional Forester's Sensitive Species List was updated in July of 2004 to include species for which population viability was a concern. Species identified as sensitive species on the Deschutes National Forest include: American peregrine falcon, bufflehead, harlequin duck, horned grebe, red-necked grebe, tricolored blackbird, western sage grouse, yellow rail, California wolverine, pygmy rabbit, and the Crater Lake tightcoil. After a review of the records, habitat requirements, and existing habitat components, it was determined that the following sensitive animal species have potential habitat in the SAFR planning area.

Harlequin Duck	(*Histrionicus histrionicus*)
California Wolverine	(*Gulo gulo leuteus*)
Crater Lake Tightcoil	(*Pristiloma articum crateris*)

The American peregrine falcon, bufflehead, horned grebe, pygmy rabbit, red-necked grebe, tricolored blackbird, western sage grouse, and yellow rail are all sensitive species that are known to occur or may potentially occur on the Deschutes National Forest. However, there is no suitable habitat for any of these species within the SAFR project area. Species with no habitat have been given a determination of "No Impact" with implementation of any of the alternatives.

Existing Condition

Harlequin Duck, Region 6 Sensitive
Harlequin ducks breed along relatively low-gradient, slower-flowing reaches of mountain streams in forested areas. It is easily disturbed and seeks out the most remote streams for breeding. It uses swift waters and rapids during other seasons. They feed primarily on aquatic insects and their larvae, which are found on stream bottoms. (Cassirer and Groves 1989).

No harlequin duck sitings have been documented in the project area. However, Whychus Creek has been identified as having potential suitable breeding habitat (USDA 2004).

California Wolverine, Region 6 Sensitive, Management Indicator Species
Wilderness or remote country where human activity is limited appears essential to the maintenance of viable wolverine populations. Habitat use is probably dictated largely by

food availability; wolverines are primarily scavengers, but also depend on a variety of prey items. High elevation alpine wilderness areas appear to be preferred in summer, which tends to effectively separate wolverines and humans. In winter, they tend to den in the ground under snow or in rocky ledges or talus slopes (Ingram 1973; Banci 1994). However, Copeland (1996) found they tended to prefer montane coniferous forest habitats during the winter. Wolverines make little use of young, thick timber and clear-cuts (Hornocker and Hash 1981). Wolverines were documented using burn areas in Idaho (Copeland 1996) from immediately after the fire to up to several years after the event, and they seemed to be following ungulate herds.

Magoun and Copeland (1998) described two types of dens: natal and maternal. Natal dens are used during parturition and occur more commonly in subalpine cirque basins associated with boulder talus slopes. Maternal dens are used subsequent to natal dens and before weaning and consist of a complex of dens associated with boulders or fallen trees. Magoun and Copeland (1998) believe that a critical feature of wolverine denning habitat is the dependability of deep snow to persist through the denning period (Febr. – May at least 1 m deep). Deep snow offers thermoregulatory advantages to kits. Boulders and fallen trees are incorporated into dens if available and covered with deep snow. These provide the needed subnivean cavities. Dens without boulders or trees are found at higher elevations in drifted hard-packed snow. There are no areas that have the potential to provide denning habitat within the project area. The Mt. Jefferson and Mt. Washington wilderness areas have the greatest potential for providing denning habitat scattered along the Cascade crest. It is assumed that wolverines may travel through and or forage infrequently at lower elevations on the district and utilize higher elevations for most of their needs.

Wolverines appear to be extremely wide-ranging and unaffected by geographic barriers such as mountain ranges, rivers, reservoirs, highways, or valleys. For these reasons, Hornocker and Hash (1981) concluded that wolverine populations should be treated as regional rather than local. However, Edelman and Copeland (1999) suggest that wolverine populations move along corridors of mountainous habitats and that features such as the Columbia River Gorge and shrub-steppe habitats serve as barriers to dispersal. They also conclude that sightings occurring across the arid mountains of Central Oregon may suggest a movement corridor from the Cascade Mountains to the Wallowa Mountains.

Two aerial flights were conducted in the Three Sisters, Mt. Washington, and Mt. Jefferson wilderness areas and adjacent roadless areas during the winter/spring of 1998 and 1999 by an interagency group consisting of several National Forests, ODFW, and PNW Experiment Station. Nothing was detected during the two flights. Baited camera systems were placed near the wilderness boundary from 1997 through 1999 to try and detect wolverine presence. Wolverines were not detected using this method. No other surveys have been conducted for this species.

Several historic sightings have been documented in on the Sisters Ranger District. One sighting occurred near Suttle Lake, while the remainder of sightings occurred within the Mt. Jefferson and Mt. Washington wilderness areas.

The project is comprised of low elevation ponderosa pine forests that receives high amounts of recreational use and are considered marginal habitat for wolverines.

Road densities were calculated using the original SAFR boundary. The boundary was later changed and 1.39 square miles of the original proposed boundary are not included in current SAFR boundary (Figure 23). The original project area is fragmented with open road densities averaging 6.15 miles/sq. mile from April 1 through November 30 and 5.30 miles/sq. mile from December 1 through March 31 due to a winter range seasonal closure.

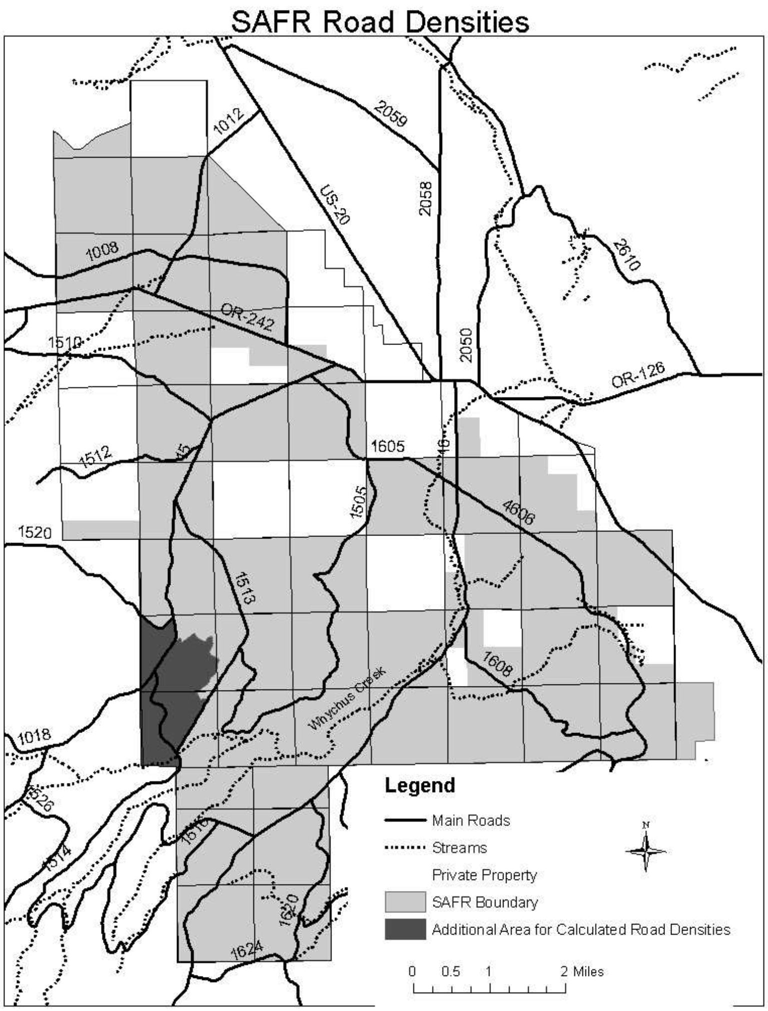


Figure 22. Road Density Calculations for the SAFR project.

Crater Lake Tightcoil, Region 6 Sensitive, Survey and Manage
One terrestrial mollusk, the Crater Lake Tightcoil (*Pristiloma arcticum crateris*), is a Sensitive Species on the Deschutes National Forest. This species is considered to be rare

and identification of specimens is difficult because of its small size and cryptic habits. Expert identification is required.

"The Crater Lake Tightcoil may be found in perennially wet situations in mature conifer forests, among rushes, mosses and other surface vegetation or under rocks and woody debris within 10 m. of open water in wetlands, springs, seeps and riparian areas, generally in areas which remain under snow for long periods during the winter. Riparian habitats in the Eastern Oregon Cascades may be limited to the extent of permanent surface moisture, which is often less than 10 m. from open water" (Duncan et al. 2003).

Surveys have not been conducted for this species within the project area.

Environmental Consequences

Harlequin Duck, Region 6 Sensitive
Alternative 1 – Ecological Trends
There are no known direct impacts associated with the no action alternative. The no action alternative would increase the risk of a wildfire event due to increased stand densities in the uplands, which would allow fire to spread from the uplands down into the riparian vegetation. The result would be a loss of shrubby riparian vegetation, down woody material, and snags, decreasing potential nesting sites within the project area. It may also lead to increased sedimentation, which would decrease foraging opportunities by filling interstitial spaces reducing caddisfly levels. Barring a fire event, stand densities would continue to increase which may shade out some riparian vegetation, also decreasing potential nesting sites. Down woody material and snags would continue to increase over time and caddisfly levels should remain constant.

Recreation use levels are expected to increase, which may result in increased compaction to potential habitat. With increased recreation to the area, habitat loss of ground vegetation due to disturbance is a concern.

The no action alternative will have *"No Impact"* to harlequin ducks or their habitat due.

California Wolverine, Region 6 Sensitive, Management Indicator Species
Alternative 1 – Ecological Trends
There are no known impacts associated with the no action alternative. Transportation systems would remain the same. Within the project area recreation pressure continues to increase, as well as OHV use. Currently the habitat in the project area is marginal and may decline in quality with additional amounts of human disturbance related to recreation. The amount of wolverine use in the area is expected to be low to non-existent because the project area contains only marginal habitat due to high road densities, recreational use, and the lack of denning habitat.

Wolverines are thought to be infrequent visitors to the project area. The no action alternatives would have *"No Impact"* to the wolverine.

Crater Lake Tightcoil, Region 6 Sensitive, Survey and Manage
Alternative 1 – Ecological Trends
The no action alternative would result in an increased risk of loss of individuals and habitat from a wildfire event due to increased stand densities in the uplands, which would allow fire to spread from the uplands down into the riparian vegetation. This would result in the loss of shrubby riparian vegetation, down woody material, and snags, which would decrease the potential habitat within the project area. It may also lead to increased sedimentation, which would also decrease habitat. Barring a fire event, stand densities would continue to increase which should benefit habitat.

Recreation use levels are expected to increase, which may result in increased compaction to potential habitat. With increased recreation to the area, habitat loss of ground vegetation due to disturbance is a concern.

There is *"No Impact"* associated with the no action alternative for the Crater Lake tightcoil.

Harlequin Duck, Region 6 Sensitive
Alternatives 2 and 3
Direct/Indirect Impacts: No known nesting occurs within the project area. There are no proposed treatments within 30 feet of Whychus Creek and there are limited acres (87 acres) proposed for treatment within the Whychus RHCA.

Treatments outside of potential habitat include thinning, mastication, and burning. The proposed action would reduce the risk of wildfire in treated areas. In addition treated areas could reduce the size of fires that may occur. Reducing the risk of fire would result in the following for harlequin duck habitat:

- Reduce potential large scale loss of riparian vegetation, down woody material, and snags from wildfire, which would maintain potential nesting sites within the project area.
- Reduce the risk of effects of sediment deposit on caddisfly habitat, by lowering the risk of stand replacement fire.

In the RHCA's barring a fire event, stand densities would continue to increase which may shade out some riparian vegetation, also decreasing potential nesting sites. However, down woody material and snags would continue to increase over time and caddisfly levels should remain constant.

The proposed actions will have *"No Impact"* to harlequin ducks or their habitat due to very limited treatments occurring within the Whychus Creek Riparian Habitat Conservation Area (RHCA).

California Wolverine, Region 6 Sensitive, Management Indicator Species
Alternatives 2 and 3

Direct/Indirect Impacts: There are no known direct impacts associated with either of the alternatives. Transportation systems would remain the same. Currently the habitat in the project area is marginal and may decline in quality with additional amounts of human disturbance related to recreation. The amount of wolverine use in the area is expected to be low to non-existent because the project area contains only marginal habitat due to high road densities, recreational use, and the lack of denning habitat.

Wolverines are thought to be infrequent visitors to the project area. Activities proposed in any of the action alternatives would not alter prey availability or use of the area by wolverine. Implementation of the action alternatives would have *"No Impact"* to the wolverine.

Crater Lake Tightcoil, Region 6 Sensitive, Survey and Manage
Alternatives 2 and 3
Direct/Indirect Impacts: There are no known occupied sites within the project area. However, surveys were not conducted. There are no proposed treatments within 30 feet of a perennial water body; therefore no potential habitat will be treated.

Treatments areas, outside of potential habitat, include thinning, mastication, and burning which will result in a reduction of risk from wildfire in areas treated, as well as risk of large scale wildfire across the project.

In the riparian reserves barring a fire event, stand densities would continue to increase which may shade out some riparian vegetation, also decreasing potential habitat. However, down woody material and snags would continue to increase, which provide Crater Lake tightcoil habitat.

The SAFR project will have *"No Impact"* to the Crater Lake tightcoil or their habitat, due to no treatments occurring within suitable habitat.

Harlequin Duck, Region 6 Sensitive
Cumulative Impacts: Activities proposed for the SAFR project will not incrementally add to cumulative impacts as there are no direct or indirect impacts associated with the project for harlequin ducks.

California Wolverine, Region 6 Sensitive, Management Indicator Species
Cumulative Impacts: Activities proposed for the SAFR project will not incrementally add to cumulative impacts as there are no direct or indirect impacts associated with the project for California wolverines.

Crater Lake Tightcoil, Region 6 Sensitive, Survey and Manage
Cumulative Impacts: Activities proposed for the SAFR project will not incrementally add to cumulative impacts as there are no direct or indirect impacts associated with the project for Crater Lake tightcoils.

Affected Environment

Management Indicator Species (MIS)

The Deschutes National Forest Land and Resource Management Plan (LRMP) (USDA 1990) identified a group of wildlife species as management indicator species (MIS). These species were selected because they represent other species with similar habitat requirements. Those species selected for the Deschutes National Forest include the bald eagle, northern spotted owl, golden eagle, red-tailed hawk, osprey, northern goshawk, Cooper's hawk, sharp-shinned hawk, great gray owl, great blue heron, cavity nesters (Lewis woodpecker, white headed woodpecker, pygmy nuthatch, Williamson's sapsucker, pileated woodpecker, and flammulated owl), waterfowl, peregrine falcon, California wolverine, elk, mule deer, American marten, western big-eared bat (Townsend's big-eared bat), species associated with logs and down woody debris, and species with special or unique habitats.

The following MIS species are discussed in the Threatened, Endangered, or Sensitive Species sections: northern bald eagle, northern spotted owl, peregrine falcon, and California wolverine.

The great grey owl, a management indicator species, is known to occur on the Deschutes National Forest. The great gray owl is usually associated with meadows in conjunction with late or old structural habitats. No suitable great grey habitat (i.e. meadows) occurs within the SAFR project area. Therefore, the SAFR project is consistent with the standards and guidelines for great grey owls located in the Deschutes LRMP (1990).

The western big-eared bat (Townsend's big-eared bat), a management indicator species is also known to occur on the Deschutes National Forest. Western big eared bats forage on moths and insects and utilize special habitats for roosting, reproduction, and over wintering on the Deschutes National Forest. In the spring and summer, females form maternity colonies in mines, caves, or buildings. During the winter Townsend's big-eared bats utilize caves and abandoned mines as hibernacula's (Kunz and Martin 1982). There are no known mines, caves, or buildings located within the project area. Therefore, the SAFR project is consistent with the standards and guidelines for western big-eared bats located in the Deschutes LRMP (1990).

Habitats

In addition, habitats and wildlife species that were identified in the Regional Forester's Forest Plan Amendment #2 (1995) are addressed. Forest Plan Amendment #2 is commonly referred to as the Eastside Screens. The northern goshawk, Late and Old structural stands, connectivity, snags, and down wood are addressed in the Eastside Screens.

Other Species

Additional species of concern include birds of conservation concern (USFWS 2002) and landbirds (Altman 2000), which include chipping sparrow, Brewer's sparrows, olive-sided flycatcher, brown creeper, and hermit thrush.

Existing Condition

Cooper's and Sharp-shinned Hawks
The Cooper's and sharp-shinned hawks are considered MIS species in the LRMP. They often use dense cover in which to hunt and nest. Cooper's hawks tend to select nest sites in dense second growth of mixed conifer or ponderosa pine stands (Jackman and Scott 1975). Moore and Henney (1983) noted that this species would routinely utilize mistletoe brooms as nesting sites. Sharp-shinned hawks utilize thickets in mixed conifer and deciduous woods. Generally, nesting habitat has been grouped into 3 types by Reynolds (1976): young, even-aged conifer stands with single-layered canopies; mature, old-growth stands of mixed conifer with multi-layered canopies; and dense stands of aspen.

No known nests have been located to date inside the project area. However, no formalized surveys have occurred for these two species in the planning area. During northern goshawk surveys it is common to get responses from Cooper's and sharp-shinned hawks. Surveys were conducted for goshawks during the 2005 and 2006 field seasons. There were no Cooper's or sharp-shinned hawks observed during the 2005 surveys. During the 2006 field season one sharp-shinned hawk was detected and Cooper's hawks were observed at seven calling stations. See the SAFR Wildlife Report for Non-TES for specific details.

There is approximately 488 acres (2%) of the project area is considered suitable habitat for these two forest hawk species. Guidelines used for computing Cooper's and sharp-shinned hawk habitat included stands with at least 60 percent canopy cover and above based on the following:

Within the LRMP the definition of Cooper's habitat is:
- Mean canopy cover of 60 percent or greater.
- Tree density of at least 365 trees per acre.
- Stand age 50 to 80 years old.

While the LRMP definition for Sharp-shinned habitat is:
- Mean canopy cover of 65 percent or greater.
- Tree density of at least 475 trees per acre.
- Stand age 40 to 60 years old.

Evaluation Criteria

1. The amount of potential habitat as described above impacted by treatment activities.

Great Blue Heron

The great blue heron is one of the most wide-ranging waterbirds in Oregon (Marshall et al. 2003). Highly adaptable, it is found along estuaries, streams, marshes and lakes throughout the state. Nest locations are determined by their proximity to suitable foraging habitat. Great blue herons nest in colonies within shrubs, trees and river channel markers where there is little disturbance (Marshall et al. 2003). Tree species that herons routinely nest in include ponderosa pine, Douglas fir, and black cottonwood. While the average diameter of nest trees is 54 inches and the average height is 79 feet, they use a wide range of sizes from 18 to 72 inches in diameter and 43 to 120 feet tall (Marshall et al. 2003). They hunt shallow waters of lakes and streams, wet or dry meadows feeding on fish, amphibians, aquatic invertebrates, reptiles, mammals and birds. They are very sensitive to disturbance, especially during the nesting season. (Jackman and Scott 1975).

Nesting and foraging habitat in the project is primarily located along Whychus Creek and within Pole Creek Swamp and their associated riparian habitats.

No surveys were conducted and there are no known colonies/rookeries in the SAFR project area.

Golden Eagle

Golden eagles may be found nesting in shrub steppe, grassland, juniper, and open ponderosa pine or mixed conifer habitats. They will utilize mature trees or ledges along cliffs and rims (Issacs and Opp 1991). Nest trees in Oregon tend to be large live ponderosa pine with sturdy open branches and a dbh of at least 30 inches. Preferred foraging areas tend to be areas with an open shrub component (Marshall et al 2003).

There is one historic golden eagle nest site within the project area. The last time the nest was active was 2002. Subsequently the nest tree has died and the historic nest has fallen to the ground. Terry Bryan, Wildlife Biologist, conducted a survey during the summer of 2005 and was not able to locate a new nest site. There have been sightings of at least one golden eagle in a field adjacent to the project area, and adjacent to the historic nest. This field was used for foraging when the nest was active. There is a possibility that the pair is now nesting on private land.

Currently there are 133 acres of potential golden eagle habitat adjacent to the large field (within ¼ mile) golden eagles have been seen foraging in.

Evaluation criteria

Large tree habitat for golden eagles is the most limiting factor within the project area in the short and long term. Development of large tree structure capable of supporting future golden eagle nesting, roosting and perching is important to achieve as quickly as possible.

The following evaluation criteria will be used to evaluate the effects of planned activities and provide a comparison between alternatives:

- Total number of acres of thinning, mowing, and burning within golden eagle habitat.

Northern Goshawk

The northern goshawk is associated with mature and late-successional forests. All mature and late-successional habitats are considered potential nesting habitat and earlier forested seral stages are considered potential foraging habitat. Moist mixed conifer and moist ponderosa pine late-successional areas are preferred habitats, although forest structure appears to be the more limiting factor to goshawk habitat rather than stand composition (i.e. tree species). Preferred nest stands have a minimum of 40% canopy closure; and the nest sites within these stands have >60% canopy closure (Reynolds et al. 1991).

Goshawk habitat was determined by looking primarily at two factors – total canopy closure and size class of existing trees. This information was gathered from stand exam data where available. If it was not available from stand exams, photo interpretation data was used. Goshawk habitat was considered to exist in all PAGs with no requirements on species composition. Parameters identified in Table 35 were used to delineate goshawk habitat.

Table 35: Parameters used to Delineate Goshawk Habitat within the SAFR Project.

Habitat	Canopy Closure	Tree Size Class
Nesting	>60%	> 9 inches dbh
Foraging	>40%	> 9 inches dbh

Existing goshawk habitat occurs within the project area (Table 36), however it is scattered.

Table 36: Existing Goshawk Habitat located on USFS administered lands within the SAFR planning area.

Habitat Type	Foraging Habitat	Nesting Habitat	Total Project Area
Acres	1,103 acres	232 acres	25,372 acres

There are currently 232 acres of nesting and 1,103 acres of foraging habitat for goshawk in the project. The ponderosa pine plant association dominates the project area (approximately 90%) and historically very few of those acres met the parameters described in Table 36. Most of the ponderosa pine plant association was described as stands composed of mature ponderosa pine and ponderosa pine regeneration in relatively even-age groups, with minor amounts of Douglas-fir and white fir in the overstory and many areas with grass understories (USDA 1998).

There are two historic goshawk nest sites within the project area: Black Pine Spring and Meredith. See Table 37 for nesting history.

Table 37 Northern Goshawk Nesting History within the SAFR Project Area.

Year	Black Pine Springs	Meredith
1991	Nest Located	N/A
1992	No Visits	N/A
1993	2 Young	N/A
1994	Called No Response	1 Young, Year the Nest was Located
1995	Female Sitting on Nest Fledglings Not Confirmed	Called No Response
1996	No Visits	No Visits
1997	No Visits	No Visits
1998	No Visits	No Visits
1999	No Visits	No Visits
2000	2 Young	No Visits
2001	No Visits	No Visits
2002	Adult Heard Nesting Not Confirmed	No Visits
2003	Adult Found Dead at Base of Nest Tree	No Visits
2004	No Visits	2 Adults Detected near Historic Nest, Nesting Unconfirmed
2005	Called No Response	Called No Response
2006	Called No Response	Called No Response

Although neither of the goshawk pairs were found active during surveys in 2005 and 2006 they still meet the Eastside Screens definition of historical. Therefore a 30 acre nesting habitat area and 400 acre post fledgling area (PFA) were established as outlined by the Eastside Screens. Figure 24 identifies stands that will be nest cores and PFA's for these goshawk sites.

In 2005 and 2006 potential goshawk habitat was surveyed to Region 6 protocol within the SAFR project. There were no goshawks detected during the 2005 surveys. During the 2006 calling season one goshawk was located near Pole Creek Swamp on July 12. Two subsequent follow ups were unsuccessful at locating the goshawk or a nest site.

Evaluation Criteria

The following measures will be used to evaluate the impacts of the planned activities:

- The amount of potential nesting and foraging habitat as described above impacted by fuels reduction activities.
- Acres of stands within identified post-fledgling areas that are treated.

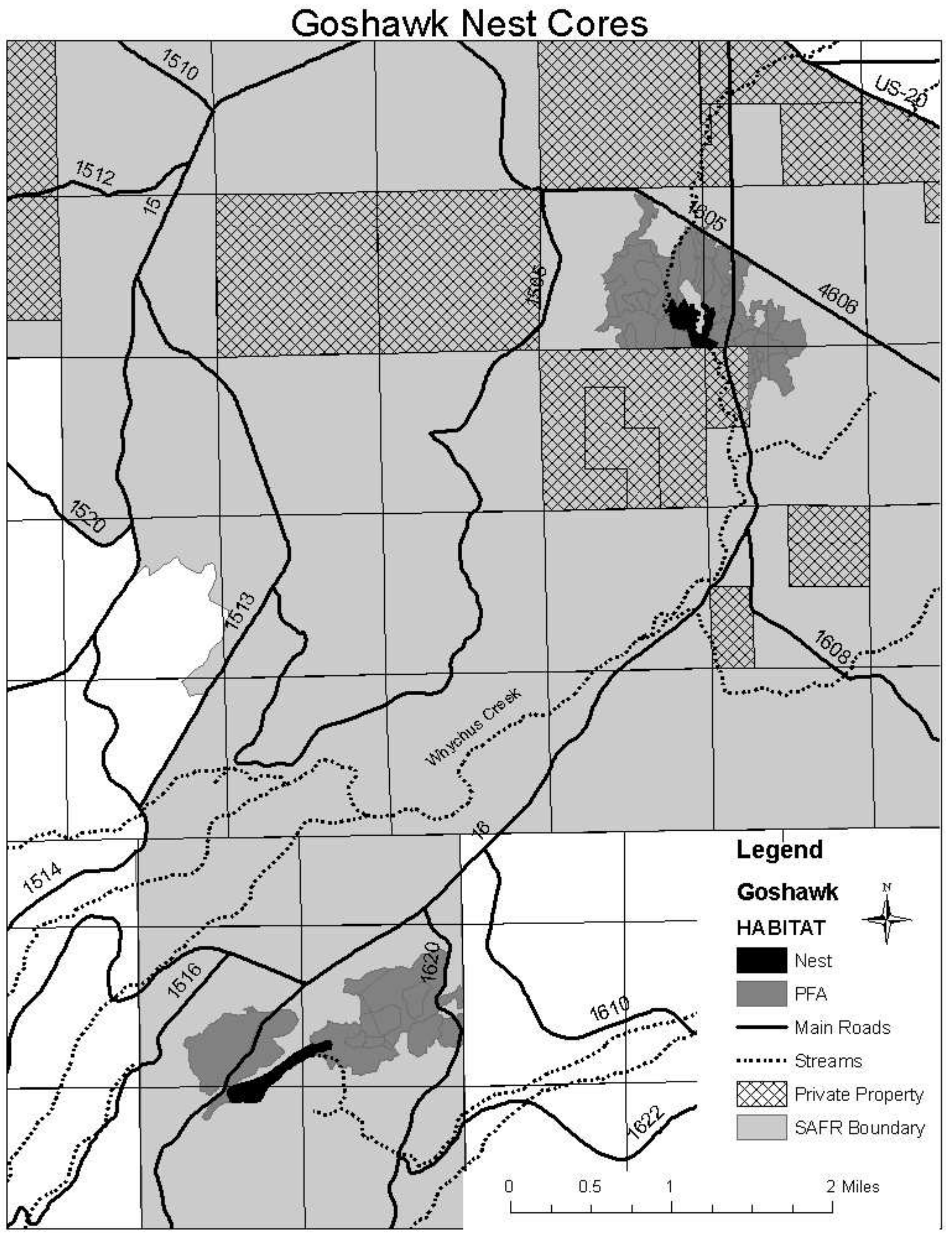


Figure 23. Sisters Area Fuels Reduction Project Northern Goshawk Nest Cores.

Osprey

Osprey are specialized for catching fish. They nest near lakes and rivers in the tops of large snags or they may use artificial platforms if available. Their main prey is live fish – slow-moving species that swim near the surface. However, they may also take other vertebrate species (birds, reptiles, and small mammals) but this represents only a very small proportion of their diet (Csuti et. al 1997).

Currently there are no known osprey nests located within the project area. However, there have been sightings of osprey close to Watson Reservoir [owned by Three Sisters Irrigation District] (District Files) in the project area.

Red-tailed Hawk

The red-tailed hawk is found throughout Oregon in every habitat and at every elevation, although scarce in dense forests (Marshall et al. 2003). They are perch hunters (trees, utility poles, etc.) and inhabit mixed country of open areas interspersed with woods (agricultural areas, grasslands, woodlands, meadows). They roost in thick conifers and nest in large conifer snags often in the tallest tree on the edge of the timber (Jackman and Scott 1975). They feed mainly on small to medium prey including ground squirrels, cottontails, voles, pocket gophers, snakes (Marshall et al. 2003) but may also take larger mammals (skunks), birds, reptiles, and insects (Jackman and Scott 1975).

Past harvest activities had produced habitat conditions favorable for red-tailed hawks by clearing stands adjacent to mature and late successional stands. This provided open areas for foraging adjacent to potential roosting and nesting habitat. Numerous sightings have occurred throughout the watershed however, no known nests have been documented. During 2005 and 2006 northern goshawk surveys red-tail hawks responded at thirteen locations. See the SAFR Wildlife Report for Non-TES for specific details.

Waterfowl

Open lakes, ponds, streams, rivers, and wet/dry meadows provide foraging habitat for most waterfowl species. Some species utilize large snags for nesting, while others utilize open grassy areas near the water's edge. Most waterfowl diets consist primarily of vegetation although some aquatic invertebrates (caddisflies, crustaceans, and mollusks) may be consumed. (Csuti et. al 1997).

There are very limited reports of waterfowl using the project area, although a pair of Canada geese were reported within the project area (district files). Potential habitat exists primarily along Whychus Creek.

American Marten

The American marten is associated with mixed conifer and high elevation hemlock/lodgepole pine late-successional habitats, and is a focal species for climax habitats. Marten habitat generally involves a dense-canopy (greater than 40% canopy cover) and supports significant amounts of large down logs (≥20"dbh at rest sites and > 30"dbh at den sites, 8-20/acre) and snags (2-3/acre) ≥20"dbh. Moist forests where marten are usually found have down woody material densities as high as 39 pieces per acre with 40% of the pieces >20"dbh. Raphael and Jones (1997) found that martens use snags and logs with intermediate levels of decay with greatest use in the larger (30 inches in diameter or larger) size classes when available. Especially significant are riparian areas, ridgetops, and areas where high concentrations of down logs and snags occur (Ruggiero et al. 1994). Natal dens are largely found in trees, logs, and rocks (Ruggiero et. al. 1994). Martens mainly eat forest rodent species (e.g. squirrels) or riparian rodent species (e.g. voles). Complex physical structure, especially near the ground, helps provide foraging/hunting areas and shelter from weather and predators (Buskirk and Powell 1994 as cited in Ruggiero et. al. 1994). Canopy cover plays a greater role in winter where marten select for higher canopy cover during snow periods than snow-free periods.

Marten probably avoid the ponderosa pine and mixed conifer dry PAGs due to the more open nature of the stands and their tendency to avoid openings (Ruggerio et al. 1994). These stands also lack complex horizontal structure typically found in more mesic forest conditions and along riparian reserves.

Systematic surveys have not been completed for the project area. Surveys were completed in 1993 and 1994 for the Broken Rim Timber Sale located approximately 1.5 miles to the south of the project area. Aluminum track plates were set in cubby boxes and baited with raw chicken with strawberry preserves. Surveys were also conducted in the winters of 1997/1998 (Dec. through March) according to the protocol outlined in Ruggerio et al. (1994). These consisted of Trailmaster camera set-ups baited with deer carcasses located along the wilderness boundary. Two of the stations were located within 5 miles of the southern extent of the project area. During the surveys 18 marten were located. See the SAFR Wildlife Report for Non-TES for specific details.

Approximately 486 acres (2%) of the project area is considered suitable for marten habitat. The small amount of potential habitat occurs on the west edge of the project area in the mixed conifer stands and along the riparian areas of Whychus Creek. Guidelines used for computing marten habitat included mixed conifer and riparian PAGs above 3400' in elevation having at least 40% canopy closure. Below this elevation, stands become dominated by ponderosa pine and are more typical of dry sites. These areas do not typically produce the canopy cover or downed wood levels needed by marten.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities to the marten:

- Marten habitat impacted by project activities.

Elk

The SAFR project area is not located within a Key Elk Area and there are no LRMP standards and guidelines associated with the SAFR project. However, there is approximately 5,804 acres of biological winter elk habitat within the project area that was identified during the Integrated Fuels Strategy process (USDA 1998).

Thermal cover for elk is identified as 10 acres of trees that are at least 40 ft tall and a canopy closure of 40% and elk hiding cover as areas at least 6 acres in size that are capable of hiding 90% of an adult animal from human view at a distance of 200 ft (USDA 1990). Table 38 shows the existing amount of thermal and hiding cover for elk within identified biological winter range.

Table 38: Elk habitat acres on Forest Service Administered Lands within the SAFR Project Area within biological elk winter range.

Elk Habitat Type	Quality of Habitat	Acres of Habitat
Thermal Cover	40 + Canopy Cover	38 acres
	30-39 Canopy Cover	234 acres
	25-29 Canopy Cover	134 acres
	20-24 Canopy Cover	851 acres
Hiding Cover	Hiding Cover that doesn't meet Thermal Definition	1,277 acres
	Acres of Cover	**2,534 acres**
Thermal cover data equals the percent canopy cover of trees 9 inches dbh or greater. All plantations were considered hiding cover. In addition areas that had 200 trees per acre or greater in the 1 to 8 inch category were considered hiding cover.		

Road Densities
Road densities were calculated for the elk biological winter range. There is a winter road closure in affect within the Tumalo Deer Winter Range, so open road density varies within the elk winter range (Table 39). During the winter road closures the open road density is 0.70 miles per square mile.

Table 39: SAFR project area road densities within elk habitat.

Allocation	Open road density from April 1 through Nov. 31	Open road density from Dec. 1 through March 31
Biological (Winter)	5.71 miles/miles^2	0.70 miles/miles^2

Evaluation Criteria
The following measures will be used to evaluate the impacts of the SAFR project on elk.

- Acres of cover treated in elk winter range.
- Acres of mastication and or burned habitat that should increase grass and forbs production.

Mule Deer
The SAFR project area consists of approximately 7,439 acres of Management Area 7 (MA-7)-Deer Habitat (LRMP). The goal of MA-7 is to manage vegetation to provide optimum habitat conditions on deer winter and transition ranges while still providing some wood products, visual quality, and recreation opportunities. Herbaceous vegetation is to be managed to provide a vigorous forage base with a variety of forage species. Within MA-7 cover and forage areas should be in close proximity to each other for optimum use by big game, with cover making up 40% of the land area.

The project area also consists of biological deer winter range (7,386 acres). Biological deer habitat (i.e. winter, transition, and summer range) was developed during the Integrated Fuels Strategy process (USDA 1998) in concert with Oregon Department of Fish and Wildlife (ODFW) and consists of winter, transition, and summer range. It is not considered an allocation in the Deschutes LRMP, however, it is recognized by ODFW as an important area for mule deer. See Table 40 for a breakdown of deer habitat.

Table 40: Deer habitat acres within Forest Service Administered Lands within the SAFR Project Area.

Deer Habitat Type	Acres
Management Area 7	7,439 acres
Biological Winter Range	7,386 acres
Biological Summer Range	3,560 acres
Biological Transition Range	14,411 acres

Ecological types were mapped for the project area using information on soil types and the potential natural vegetation. The potential natural vegetation may differ from the existing vegetation, however the ecotype has the potential to produce the climax vegetation if disturbance events were to occur naturally. Three ecotypes were developed for the SAFR project deer winter range. They are as follows: pine-juniper/sagebrush-bitterbrush/fescue, pine/bitterbrush/fescue, and pine/bitterbrush-manzanita /fescue. Each area shows differences in site productivity, fire risks, expected shrub recovery times and seral stages, and conversion potential to less desirable species.

Pine-juniper/sagebrush-bitterbrush/fescue (Ecological Type 1)

- Cover Potential – Low potential for growing thermal and hiding cover.
- Forage Potential – Without disturbance understory consists of a mixture of sagebrush and bitterbrush. With repeated disturbance understory typically converts to Idaho fescue and forbs with little or no brush. Disturbance followed by a recovery period in this ecotype appears to favor rabbit brush over sagebrush.

Pine/bitterbrush/fescue (Ecological Type 2)

- Cover Potential – Moderate potential for growing thermal and hiding cover.
- Forage Potential – This is the most productive ecotype for bitterbrush production and without disturbance the understory vegetation consist of mainly bitterbrush. With repeated disturbance understory typically converts to Idaho fescue and forbs with little or no brush. Areas with dense tree canopy can also limit the amount of bitter brush in the understory.

Pine/bitterbrush-manzanita/fescue (Ecological Type 3)

- Cover Potential – High potential for growing thermal and hiding cover.
- Forage Potential – Without disturbance the understory vegetation consist of manzanita and bitterbrush. With repeated disturbance understory typically converts to Idaho fescue and forbs with little or no brush.

Table 41 shows a breakdown of the three dominant ecotypes by deer habitat.

Table 41: Acres by Ecotype for Deer Habitat within Forest Service Administered Lands.

Deer Habitat	Ecological Type	Acres within SAFR
MA-7	1	3,666
	2	6
	3	2,703
Biological Winter Range	1	4,347
	2	0
	3	2,568

Cover

Table 42 shows a breakdown of existing cover by deer habitat type. Thermal cover was broken into various size classes and canopy cover percentages to show the quality of thermal cover within the project.

Table 42: Current amount of thermal and hiding cover within the SAFR project.

Cover Type	Thermal Cover Quality (DBH and Canopy Closure)	Acres within MA-7	Acres outside of MA-7	Acres within Bio. Winter Range On USFS Administered Lands
Thermal	9 inch DBH at least 40% CC	55	N/A**	34
	9 inch DBH 30-39% CC	278	N/A**	285
	5 inch DBH at least 40% CC	212	N/A**	80
	5 inch DBH 30-39% CC	699	N/A**	665
	9 inch DBH 25-29% CC	120	N/A**	147
	5 inch DBH 25-29% CC	1,138	N/A**	807
	9 inch DBH 20-24% CC	879	N/A**	840
	5 inch DBH 20-24% CC	1,207	N/A**	1,106
Hiding	Hiding Cover that doesn't meet Thermal Definition	1,118	12,564	1,526
	Total	**5,706**	**12,564**	**5,490**
** Note- Outside MA-7 Hiding Cover Meets the Definition of Thermal Cover.				
All plantations were considered hiding cover. Areas that had 200 trees per acre or greater in the 1 to 8 inch category were considered hiding cover. In addition areas that had 25% cover or greater in brush at least 3 ½ feet tall were considered hiding cover.				

Forage

Bitterbrush is a major component of the potential natural vegetation, which is an important food source for deer during the winter months. Providing high quality winter forage in adequate quantity and distribution to meet nutritional demands of wintering mule deer and adequate shrub structure and patch size to maintain quality habitat for shrub associated species is a primary objective of the SAFR project.

Management direction regarding shrubs is provided by the LRMP. The goal of the LRMP in Management Area 7, Deer Habitat, is to manage vegetation to provide optimum habitat conditions. The objective is to manage vegetation to provide optimum habitat considering the inherent productivity of the land. Recommendations for the management of shrubs are also provided by the Integrated Natural Fuels Management Strategy (IFMS 1998). The IFMS identified interim management goals of managing shrubs in shrub dominated landscapes (Deer Habitat) to have 33% of shrubs in an early seral condition, 33% in a mid seral condition, and 33% in a late seral condition. Early seral condition areas have bitterbrush in the seedling and young-adult age classes. Mid seral condition areas have bitterbrush in the adult, adult-mature, and mature age classes. Late seral condition areas have bitterbrush in the mature-decadent and decadent age classes. Mixed seral condition areas have a combination of young, adult, mature, and decadent age classes of bitterbrush. Currently 53% of MA-7 is within the late seral condition (Table 43).

Table 43: Shrub seral condition within MA-7 and Biological Winter Range.

Deer Habitat	Seral Condition	Acres (Percent)
MA-7	Early	1,034 (14%)
	Mid	1,825 (24%)
	Mixed	642 (9%)
	Late	3,989 (53%)
Biological Winter Range	Early	334 (5%)
	Mid	1,652 (22%)
	Mixed	723 (10%)
	Late	4,214 (57%)
	Unknown	466 (6%)

Road Densities
Road densities were calculated using the original SAFR boundary. The boundary was later changed and 1.39 square miles of the original proposed boundary are not included in current SAFR boundary (Figure 25). Target open road density for the LRMP Standards and Guidelines is 2.5 miles per square mile unless specified in management area direction. The total open road densities within the SAFR project are 4.25 miles per square mile December 1 through March 31 (Table 44) due to the Tumalo Winter Range Closure.

Table 44: SAFR project area road densities within deer habitat.

Deer Habitat	Road density (includes inactivated roads associated with Tumalo Mule Deer Winter Range Closure)	Open road density April 1 through Nov. 30	Open road density Dec. 1 through March 31
MA-7 Deer Habitat	5.25miles/miles^2	3.92 miles/miles^2	1.85 miles/miles^2
Project Area Excluding MA-7	6.50miles/miles^2	5.86 miles/miles^2	5.63 miles/miles^2
Total	**6.13 miles/miles^2**	**5.29 miles/miles^2**	**4.25 miles/miles^2**
Biological (Winter)	5.72 miles/miles^2	4.24 miles/miles^2	0.74 miles/miles^2

Target open road densities as described within MA-7 LRMP Standards and Guidelines densities, will average 1.0 to 2.5 miles per square mile in each implementation unit. For the SAFR project the implementation unit will be all MA-7 within the SAFR project boundary. The existing open road densities within SAFR MA-7 are within LRMP Standards and Guidelines with the winter closure in affect (Table 44).

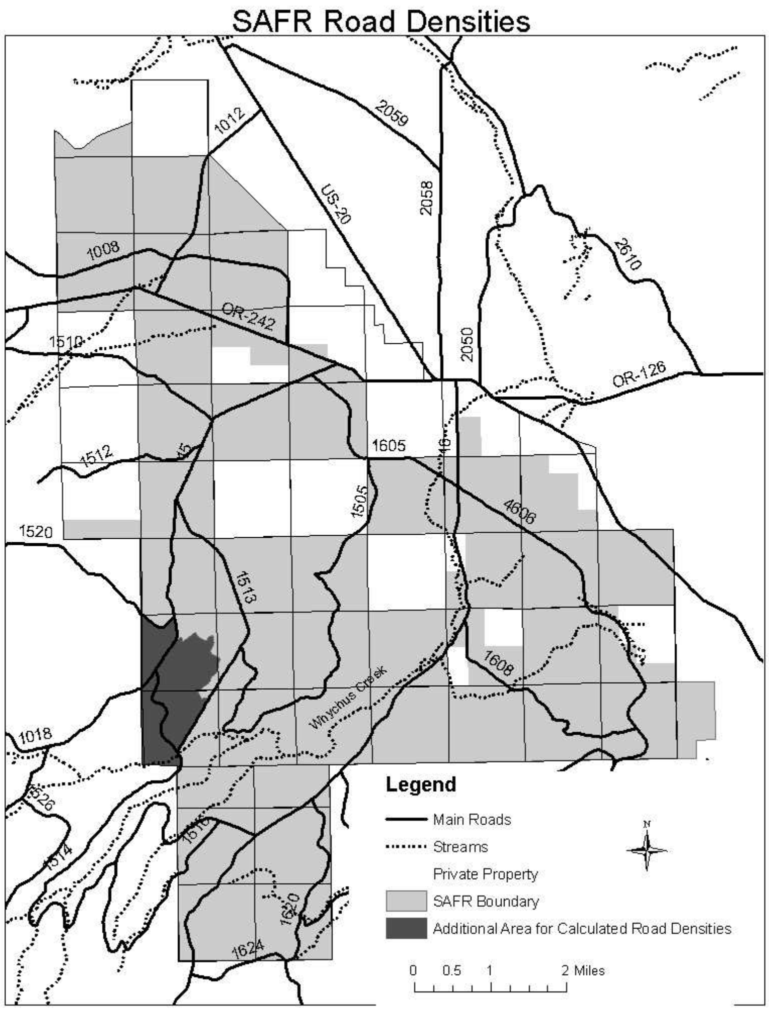


Figure 24. Road Density Calculations for the SAFR project.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the SAFR project on deer.

- Acres of cover treated within the project area.
- Acres of brush treated within the project area.

Late and Old Structural Stands
The goal of old and late structural stands is to provide representation of landscape ecology and habitat for plants and animal species associated with old growth forest ecosystems. In addition old and late structural stands should benefit the public enjoyment

by providing large, old tree environments (USDA 1990). Late and old structural stages are defined by the Eastside Screens as multi-strata stands with large trees and single strata stands with large trees. Multi-stratum stands are comprised of two or more tree canopy layers and two or more cohorts of trees. Medium and large sized trees dominate the overstory but trees of all size classes may be present. Stand structure and tree sizes are diverse. Single stratum stands are comprised of a single dominant canopy stratum consisting of medium or large sized trees. Large trees are common. Young trees are absent or few in the understory. The stand may appear "park-like".

Multi-stratum LOS conditions are favorable to those species that require or prefer more complex forested structure, e.g. northern goshawk, while the single stratum LOS habitats are preferred by species such as the white-headed woodpecker and pygmy nuthatch.

The Whychus watershed analysis (1998) describes historical conditions within the ponderosa pine PAGS as stands that were composed of mature ponderosa pine and ponderosa pine regeneration in relatively even-age groups, with minor amounts of Douglas-fir and white fir. Historic surveyor's notes describe stands as large even-aged (single story) stands of ponderosa pine, many with grass understories.

The Whychus watershed analysis (1998) describes historical conditions within the mixed conifer dry and wet (MCD and MCW) PAGS as stands that were composed of early seral species. Ponderosa pine was the major species present with minor amounts of Douglas-fir and white fir. The watershed analysis notes that currently a large portion of the MCD PAG is outside of the historical range. Within the MCD PAG historic surveyor's notes describe lots of heavy yellow pine (ponderosa) in the overstories with few areas that had dense understories in the lower elevations. Within the MCW PAG historic surveyor's notes describe lots of heavy yellow pine (ponderosa) and fir in the overstories with dense understories of pine and fir in some areas.

There are presently an estimated 4,439 acres (18% of the project area) of LOS habitat on National Forest lands within the SAFR project. Within the Whychus Watershed Analysis the acres dominated by big trees (over 21 inches DBH) has decreased by 88% in the ponderosa pine, 80% in the dry mixed conifer, and 75% in the wet mixed conifer since 1953 (USDA 1998).

There is also 534 acres of land allocated as Old Growth Management Areas. Of that 475 acres meet the definition of LOS. The goal of Management Area 15 (Old Growth), as described in the Deschutes National Forest LRMP is to provide naturally evolved old growth forest ecosystems for:

- Habitat for plant and animal species associated with Old Growth forest ecosystems.
- Representations of landscape ecology.
- Public Enjoyment of large, old-tree environments.
- The needs of the public from an aesthetic spiritual sense.

The general theme and objectives for Management Area 15 state that old growth will be managed to provide for:

- Large trees.
- Abundant standing and down dead trees.
- Vertical structure (multiple vegetative canopy heights).

Connectivity

Maintaining connectivity between habitats, particularly late and old structured habitat, is believed to be important for numerous wildlife species. Connectivity of habitats is believed to allow free movement an interaction of adults and dispersal of young. Table 45 shows how well the landscape is connected by looking at the percent canopy cover of trees 9 inches dbh and greater.

Table 45: Existing Condition of the SAFR Project Areas Connectivity.

Percent Canopy Closure in 9 inch DBH Trees and Greater	Acres
0 to 19 %	13,627
20 to 29%	6,753
30 to 39%	2,884
40 to 49%	661
50% and Greater	542

Special or Unique Habitat and Associated Species

Springs, seeps, cliffs, and talus slopes provide unique habitats within the forest that provide a unique habitat for species of wildlife. Within the SAFR project area four unique habitats have been identified, and they are all spring/seeps. One of the springs is located in the Cold Springs aspen stand and was prescribed burned in the spring of 1997, the summer of 2001, and the fall of 2005. During all three burns the vegetation surrounding the spring did not burn due to moisture content. These burns were initiated to restore the aspen stand and were covered under the Underline EA.

Snags

Not every stage of the snag's decay process is utilized by the same species, but rather a whole array at various stages or conditions. In forested environments, 93 wildlife species are associated with snags. This includes 4 amphibians, 63 birds, and 26 mammal species (Rose et al. 2001). Uses of snags include nesting, roosting, preening, foraging, perching, courtship, drumming, and hibernating.

Explanation of the DecAID advisory tool and how it was applied to the SAFR Project

In addition to eastside screen direction on snags and down wood, the DecAID Advisor (Mellen et al. 2006) is available. DecAID is being used as best available science information. DecAID is a web-based advisory tool to help managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags and down wood. It is a summary, synthesis, and integration of published scientific literature, research data, wildlife databases, forest inventory databases, and expert judgment and experience. For the SAFR project DecAID was not used to determine snag levels across the project area. The project does not target snags for removal, so the SAFR project will have a minimal effect on snag habitat. However, snags that pose safety hazards during operations will be felled in accordance with OSHA regulations. DecAID was used to compare the existing condition of snags to the "natural condition" for the effects analysis of the SAFR project. For a detailed description of how DecAID was utilized see the Non-TES Wildlife Report for the SAFR project.

Comparison of the Existing Condition to "Natural" Conditions from DecAID
DecAID was applied within the project area by matching Plant Association Groups (PAGS) found within the project area to comparable habitat types in DecAID. Two habitat types identified in DecAID are used to represent conditions occurring within the project area. The ponderosa pine/Douglas-fir habitat tree type is best represented by the PPD (ponderosa pine dry) and PPW (ponderosa pine wet) PAGS found within SAFR. The eastside mixed conifer habitat tree type is best represented by the MCD (mixed conifer dry) and MCw (mixed conifer wet) PAGS found within SAFR. The Whychus Watershed Analysis (1998) was referenced to find the seral stage distribution historically within the area.

Precise snag and down wood quantities for each stand within the Whychus watershed are not known. Table 46 displays estimated snag densities by diameter class for habitat types. This information was compiled from 1/10 acre snag and down wood plot data collected in conjunction with the stand exams of 1998 and 1999. For stands that did not receive stand exams, most similar neighbor (MSN) was utilized. (See the silvicultural report for more clarification of how MSN was used for the analysis). Not every stand within the Whychus Watershed received a snag or down wood figure. If a snag or down wood plot was taken in a stand or was used in the MSN analysis then a snag or down wood estimate was used. Our assumption is that the stands that have values represent the watershed. Within ponderosa pine/Douglas-fir 16% of the stands within the Whychus watershed were used as a sample. In the eastside mixed conifer 21% of the stands within the Whychus watershed were used as a sample.

Table 46: Existing Condition of Snag Densities across the Whychus Watershed.

DecAID Habitat Type/Structure Stage	**Snags per acre**				
Snags 10 Inches DBH and Greater					
	0 snags per acre	**0-4 snags per acre**	**4-8 snags per acre**	**8-12 snags per acre**	**12+ snags per acre**
Ponderosa Pine/ Douglas-fir	48%	46%	5%	0.5%	0%
	0 snags per acre	**0-6 snags per acre**	**6-12 snags per acre**	**12-18 snags per acre**	**18+ snags per acre**
Eastside Mixed Conifer, East Cascades/Blue Mountains	17%	59%	11%	7%	7%
Snags 20 Inches DBH and Greater					
	0 snags per acre	**0-2 snags per acre**	**2-4 snags per acre**	**4-6 snags per acre**	**6+ snags per acre**
Ponderosa Pine/ Douglas-fir	73%	19%	8%	0%	0%
Eastside Mixed Conifer, East	38%	29%	19%	8%	6%

Cascades/Blue Mountains					

Figures numbered 25 through 29 compare the existing snag distribution to the HRV of snag distributions.

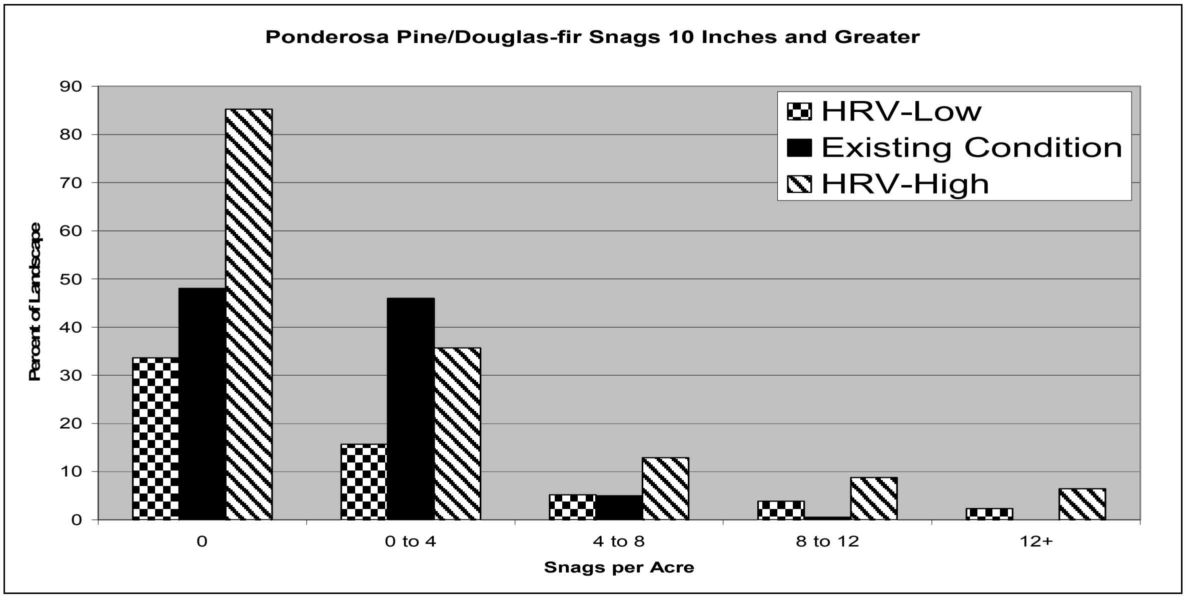


Figure 25: Ponderosa Pine/Douglas-fir Snags Greater than 10 Inches DBH within the Whychus Watershed.

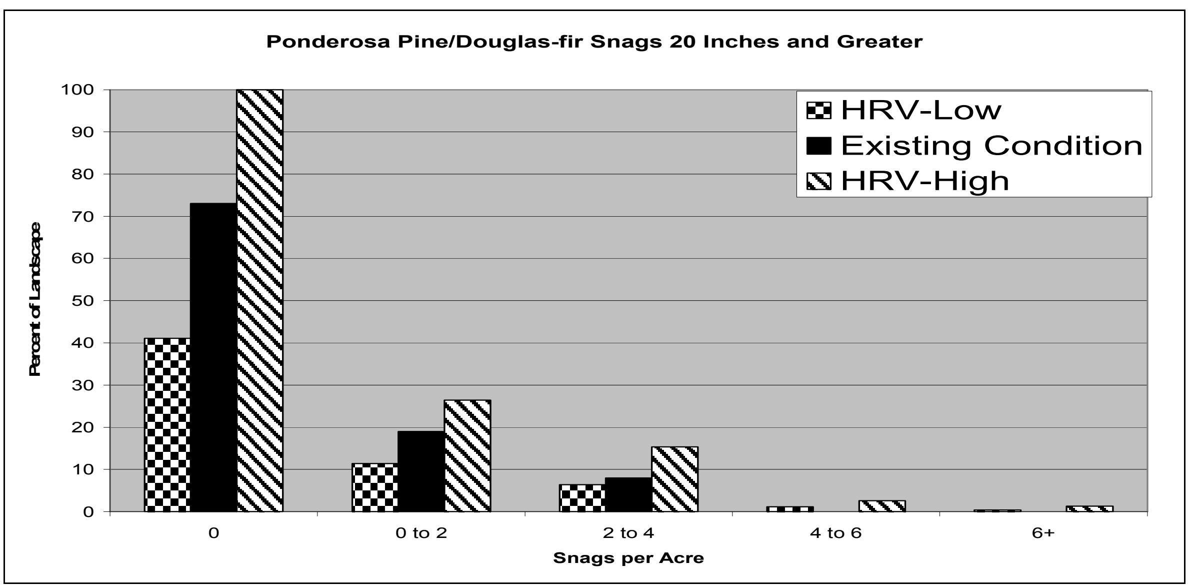


Figure 26: Ponderosa Pine/Douglas-fir Snags Greater than 20 Inches DBH within the Whychus Watershed.

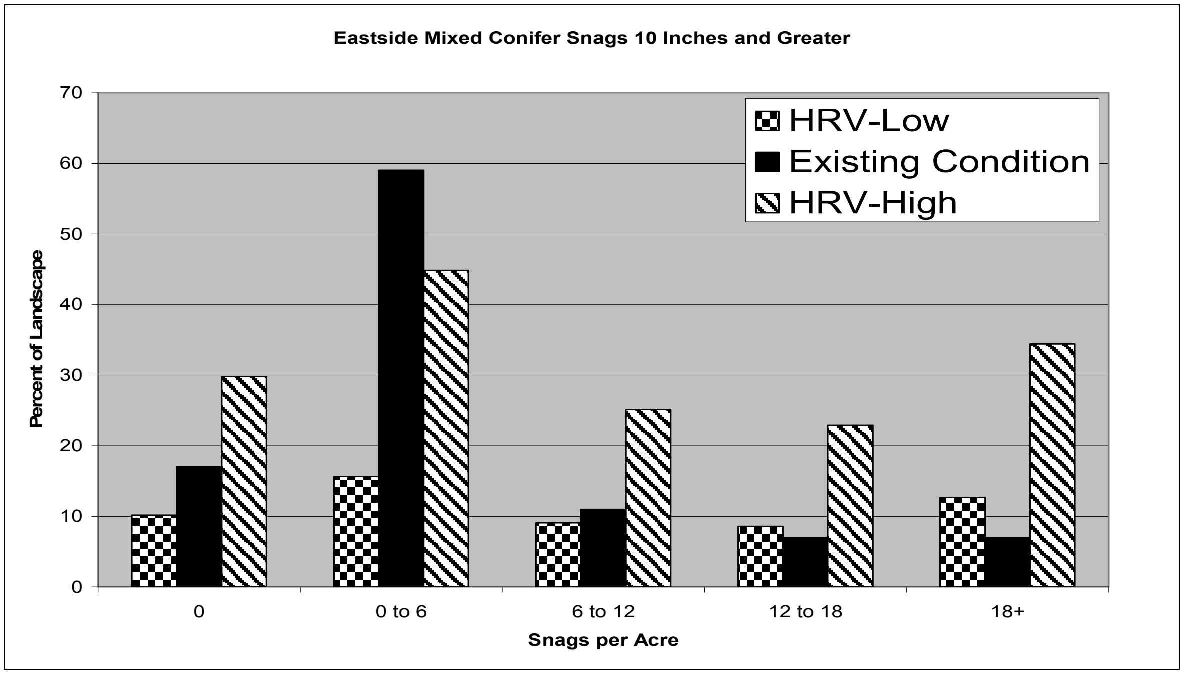


Figure 27: Eastside Mixed Conifer Snags Greater than 10 Inches DBH within the Whychus Watershed.

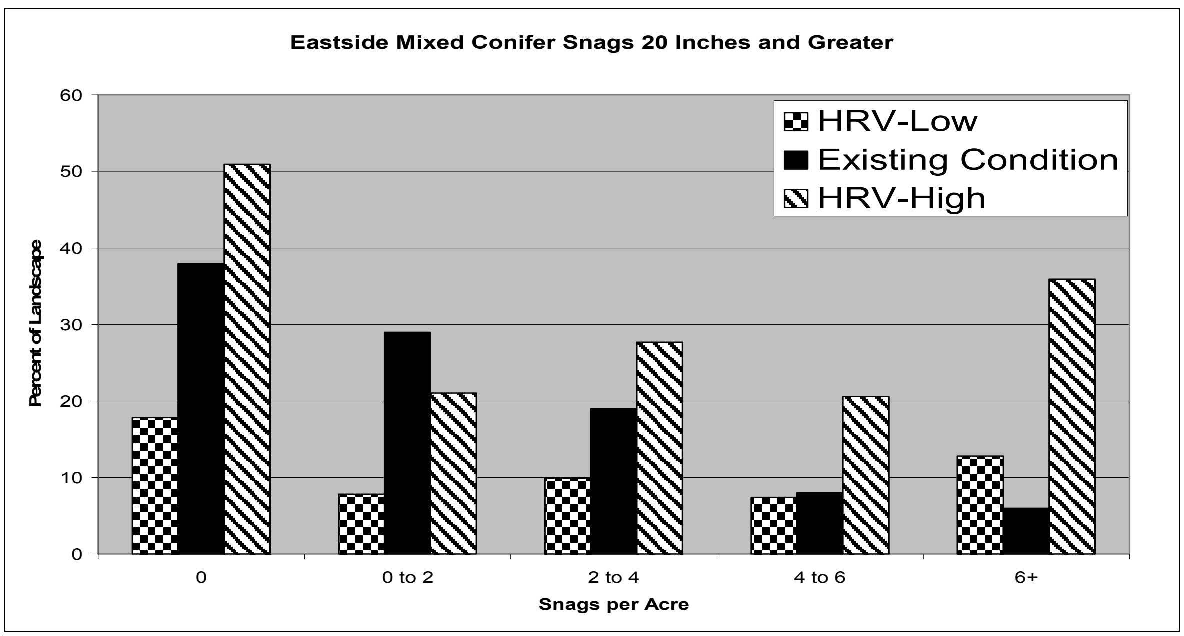


Figure 28: Eastside Mixed Conifer Snags Greater than 20 Inches DBH within the Whychus Watershed.

Within the Whychus watershed the ponderosa pine/Douglas-fir habitat type is below the historic range for acres that have at least 8 snags per acre 10 inches dbh and greater. The ponderosa pine/Douglas-fir habitat type is also below the historic range for acres with at least 4 snags per acre 20 inches dbh or greater. Within the Whychus watershed the eastside mixed conifer habitat type is below the historic range for acres that have at least 12 snags per acre 10 inches dbh and greater. The ponderosa pine/Douglas-fir habitat type is also below the historic range for acres with at least 6 snags per acre 20 inches dbh or greater.

The SAFR project snag analysis assumes that if existing snag numbers are similar to the "natural" conditions found in DecAID then the Whychus Watershed would be meeting the snag needs of cavity nesting birds under the historic range of variability.

Down Wood

Logs are an important component on the landscape. They provide organic and inorganic nutrients in soil development, provide microhabitats for invertebrates, plants, amphibians, and other small vertebrates, and provide structure for riparian associated species in streams and ponds. It has been shown that size, distribution, and orientation may be more important than tonnage or volume. Small logs provide escape cover or shelter for small species. It is still unknown what levels of down woody material are needed to provide quality habitat for associated species. (Bull et al. 1997).

Too much down material may impede travel by big game and present a fire hazard. However, increased levels also provide cover for small invertebrates and may protect seedlings from browse and scorching. Orientation has also been shown to be important, where logs that lie along a contour are used more than those lying across contours. Larger sized logs are also used more and by more species than smaller logs. (Bull et al. 1997).

A variety of species are associated with down wood. Use by species differs in relation to size, decay class, and purpose of use, as well as many other factors. Therefore, by providing for varying densities, sizes, species, and decay classes on the landscape, it will provide for an array of wildlife species. Brown et al. (2003) is used to help determine acceptable downed wood levels to realize benefits to wildlife while managing for acceptable fire risk.

Optimum levels of down woody material for providing acceptable risks of fire hazard and fire severity while providing desirable amounts for soil productivity, soil protection, and wildlife needs were calculated for warm dry forest types and cool subalpine forest types by Brown et al. (2003). A range of 5 to 20 tons per acre for warm, dry types and 10 to 30 tons per acre for cool types seemed to best meet most resource needs. For wildlife, these optimum levels included both standing and downed coarse woody debris. Levels representing the high end for pre-settlement conditions were found as follows: 5 to 10 tons per acre for warm, dry ponderosa pine and Douglas-fir types and 10 to 20 tons per acre for cool Douglas-fir types (Brown et al. 2003).

Down wood abundance on the Deschutes National Forest is highly variable due to many factors. The Deschutes National Forest lies on the eastside of the Cascades where there is a limited availability of water and nutrients as compared to the west side of the Cascades. This, combined with overcrowded stand conditions due to fire suppression, has led to tree mortality above historic levels especially within smaller size classes. In particular, plant associations groups that tend to be drier (i.e. ponderosa pine and mixed conifer dry) may recruit a higher level of down wood today than did historically.

Snags are the main contributors to down wood so for the SAFR down wood analysis assumes that if existing snag numbers are similar to the "natural" conditions found in DecAID then the Whychus Watershed would be meeting the down wood needs of down wood dependent species under the historic range of variability. Figures 25 through 29 show how snags compare to the historical range of variability. It is also assumed that fire suppression within the watershed has decreased the consumption rate of down wood; while other human practices such as firewood gathering has removed down wood.

Estimates of down wood were compiled from 1/10 acre snag and down wood plot data collected in conjunction with stand exams as described eariler. The down wood plot survey described above measured all down wood at least 6 feet long with a small end diameter of 12 inches. Inventory plots compiled in DecAid measured down wood 3.3 feet long with a diameter of 5 inches. Down wood data that was collected during the down wood survey cannot be compared to DecAid numbers. However, the down wood data collected in the Whychus watershed can be compared against the Eastside Screens down log retention guidelines (Table 47).

Based upon down wood plot data described in Table 47, currently 95% of the ponderosa pine/Douglas-fir landscape meets Forest Plan standards for down logs. When looking at eastside mixed conifer stands 46% of the landscape currently meets or exceeds the Forest Plan standards for down logs.

Table 47: The percent of the Whychus Watershed that has various Lineal Feet of Down Wood at least 6 feet long with a small end diameter of 12 inches dbh.

	Percent of the Landscape		
Habitat Type	**0 to 19.9 lineal feet**	****20 to 40 lineal feet**	**Greater than 40 lineal feet**
Ponderosa Pine/ Douglas-fir	5%	14%	80%
	0 to 99.9 lineal feet	****100 to 140 lineal feet**	**Greater than 140 lineal feet**
Eastside Mixed Conifer	54%	7%	39%
** *Eastside Screen Standards for lineal feet of down wood.*			

WOODPECKERS (CAVITY NESTERS)

DecAID is not a viability model, and tolerance levels should not be interpreted as population viability "thresholds". DecAID tolerance levels "may be interpreted as three levels of "assurance": low (30% tolerance level), moderate (50% tolerance level), and high (80% tolerance level)" (Mellen et al. 2006). The higher the tolerance level, the higher the "assurance" that snag habitat is being provided.

Wildlife Data Tolerance Level
A tolerance level as it relates to wildlife data is defined as follows: "tolerance intervals are estimates of the percent of all individuals in the population that are within some specified range of values" (Mellen et al. 2006). For example, data from the wildlife species curves for white-headed woodpeckers is used for small and medium tree, ponderosa pine/ Douglas-fir habitat types.

Snag density (≥10"dbh) for white-headed woodpeckers:
30% tolerance level = 0.3 snags/acre
50% tolerance level = 1.7 snags/acre
80% tolerance level = 3.7snags/acre

- Areas with <0.3 snags/acre would be expected to be used for nesting by only 30% of the individuals within the population of white-headed woodpeckers, and conversely 70% of the population would be expected to nest in areas with ≥0.3 snags/acre.
- Half the individuals within the population would be expected to nest in areas with <1.7 snags/acre and the other half would be expected to nest in areas with ≥1.7 snags/acre.
- 80% of the individuals within the population of white-headed woodpeckers would be expected to nest in areas with <3.7 snags/acre and conversely 20% of the population would be expected to nest in areas with ≥3.7 snags/acre.

DecAID synthesized data from research studies to create density related use of snags in various habitat types for wildlife species. Tables 48 and 49 show snag density as related to wildlife species use.

Table 48: Synthesized data for wildlife use of snag densities from various studies for 10 inch and greater and 20 inch and greater snags in Ponderosa Pine/Douglas-fir Small/Medium and Large Structure Types.

Species	30% TL Snag Density (#/acre)	50% TL Snag Density (#/acre)	80% TL Snag Density (#/acre)
Snags 10 Inches DBH and Greater			
Black-backed woodpecker	2.5	13.6	29.2
Cavity nesting birds	1.2	4.7	10.0
Long-legged myotis	3.8	17.0	37.1
Pileated woodpecker**	14.9	30.1	49.3
Pygmy nuthatch	1.1	5.6	12.1
White-headed woodpecker**	0.3	1.7	3.7
Williamson’s sapsucker**	14.0	28.4	49.7
Snags 20 Inches DBH and Greater			
Black-backed woodpecker	0.0	1.4	5.7
Cavity nesting birds	0.0	1.0	2.8
Pileated woodpecker**	3.5	7.8	18.4
Species	**30% TL Snag Density (#/acre)**	**50% TL Snag Density (#/acre)**	**80% TL Snag Density (#/acre)**
Pygmy nuthatch	0.0	1.6	4.0
White-headed woodpecker**	0.5	1.8	3.8
Williamson’s sapsucker**	3.3	8.6	16.6
*** Caution should be exercised when using the white-headed woodpecker snag density data, which are from a population where adult mortality is outpacing recruitment (Frenzel 2004). Density of snags may or may not be part of the issue with this species, white-headed woodpeckers do not rely on snags for foraging and thus may be able to use areas with lower snag densities than other woodpecker species that do forage extensively on snags. The highest snag densities are for Williamson's sapsucker (Nielsen-Pincus 2005) and pileated woodpecker (Bull 1987 and Nielsen-Pincus 2005) and are from studies that included many sites in Eastside Mixed Conifer habitat types, which tend to have higher snag densities than Ponderosa pine/Douglas-fir habitat types. Pileated woodpeckers likely to not occur in dryer portions of the PPDF habitat type.*			

Table 49: Synthesized data for wildlife use of snag densities from various studies for 10 inch and greater and 20 inch and greater snags in Eastside Mixed Conifer, East Cascades/Blue Mountains Small/Medium and Large Structure Types.

Species	30% TL Snag Density (#/acre)	50% TL Snag Density (#/acre)	80% TL Snag Density (#/acre)
Snags 10 Inches DBH and Greater			
American Marten	11.8	12.8	14.4
Black-backed woodpecker	2.5	13.6	29.2
Long-legged myotis	N/A	10.2	N/A
Pileated woodpecker	14.9	30.1	49.3
Pygmy nuthatch	1.1	5.6	12.1
Silver-haired bat**	N/A	56.4	N/A
White-headed woodpecker**	0.3	1.9	4.3
Williamson's sapsucker	14.0	28.4	49.7
Snags 20 Inches DBH and Greater			
American Marten	3.7	4.0	4.5
Black-backed woodpecker	0.0	1.4	5.7
Cavity nesting bird	N/A	2.4	N/A
Pileated woodpecker	3.5	7.8	18.4
Pygmy nuthatch	0.0	1.6	4.0
Silver-haired bat**	N/A	16.8	N/A
White-headed woodpecker**	0.0	1.5	3.8
Williamson's sapsucker	3.3	8.6	16.6

*** Caution should be exercised when using the white-headed woodpecker data, which are from a population where adult mortality is outpacing recruitment (Frenzel 2004). Density of snags may or may not be part of the issue with this species, white-headed woodpeckers do not rely on snags for foraging and thus may be able to use areas with lower snag densities than other woodpecker species that do forage extensively on snags. The data point for silver-haired bat is much higher than the other data points. These data came from a study in NE Washington (Campbell 1993); snag densities were significantly (p=0.01) higher at roost sites than random sites. However, the plots size was very small (0.071 ha (0.18 acre)), and when snag density in small clumps is extrapolated to a per hectare basis the numbers may be deceivingly high. However, as indicated by the inventory data from unharvested plots, snag densities do occur at these high levels in the East Cascades/Blue Mountains subregion.*

Table 50 displays the existing Whychus snag information in tolerance level categories for cavity nesting bird species with density data in DecAID. Only the ponderosa pine/Douglas-fir and Eastside Mixed Conifer, East Cascades/Blue Mountains are displayed, because these are the two habitats found in the SAFR project.

Table 50: Existing Tolerance Levels for Various Species in the Whychus Watershed.

Species	0 - 29 % tolerance (percent of the landscape)	30 - 49 % tolerance (percent of the landscape)	50 - 79 % tolerance (percent of the landscape)	≥ 80 % tolerance (percent of the landscape)
Black-backed woodpecker	67%	29%	2%	6%
Cavity nesting bird	65%	30%	5%	0%
Pileated woodpecker	98%	2%	<1%	<1%
Pygmy nuthatch	52%	39%	5%	4%
White-headed woodpecker	52%	27%	16%	5%
Williamson's sapsucker	97%	3%	<1%	<1%

If a species had tolerance levels identified in the ponderosa pine/Douglas-fir and Eastside Mixed Conifer, East Cascades/Blue Mountains they were combined to display what percentage of the ponderosa pine/Douglas-fir and eastside mixed conifer within the watershed met the various tolerance levels. If a species had requirements in the 10 and 20 inch snag dbh categories, the acres were added into the lowest tolerance level percentage.

Table 50 shows ponderosa pine/Douglas-fir and eastside mixed conifer habitat types within the Whychus watershed have limited portions of the landscape providing at the 50% tolerance level and above. Within ponderosa pine/Douglas-fir and eastside mixed conifer habitat types, the watershed has limited patches of habitat with high densities of snags. For the SAFR project snag analysis it is assumed existing snag numbers are similar to the "natural" conditions that are found in DecAID then the Whychus Watershed would be meeting the snag needs of cavity nesting birds under the historic range of variability.

Birds of Conservation Concern

The "Birds of Conservation Concern 2002" (BCC) identifies species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973. While all of the bird species included in BCC 2002 are priorities for conservation action, the list makes no finding with regard to whether they warrant consideration for ESA listing. The goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservations actions (USFWS 2002). The U.S. Shorebird Conservation Plan (USFWS 2004) revised the 2001 Plan with new information and developed a list of U.S. and Canadian shorebirds considered highly imperiled or of high conservation concern. Conservation measures were not included but these lists should be consulted to determine reasons for conservation concern.

Bird Conservation Regions (BCRs) were developed based on similar geographic parameters. One BCR encompasses the Sisters Ranger District – BCR 9, Great Basin. BCR birds with potential habitat are shown in Table 51. For a complete list of bird of conservation concern within the Great Basin see Appendix C of the Non-TES Wildlife Report.

Table 51: BCR 9 (Great Basin) BCC 2002 list of species with habitat within SAFR.

Bird Species	Preferred Habitat	Potential Habitat within the SAFR Project Area
Flammulated Owl	Ponderosa pine forests	Yes
Lewis's Woodpecker	Ponderosa pine forests	Yes
Williamson's Sapsucker	Ponderosa pine forests	Yes
White-headed Woodpecker	Ponderosa pine forests	Yes

Landbird Strategic Plan

The Forest Service has prepared a Landbird Strategic Plan (January 2000) to maintain, restore, and protect habitats necessary to sustain healthy migratory and resident bird populations to achieve biological objectives. The primary purpose of the strategic plan is to provide guidance for the Landbird Conservation Program and to focus efforts in a common direction. On a more local level, individuals from multiple agencies and organizations with the Oregon-Washington Chapter of Partners in Flight participated in developing a publication for conserving landbirds in this region. A Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington was published in June 2000 (Altman 2000). This document outlines conservation measures, goals and objectives for specific habitat types found on the east-slope of the Cascades and the focal species associated with each habitat type. Sisters Ranger District lies within the Central Oregon subprovince. See Table 52 for specific habitat types highlighted in that document, the habitat features needing a conservation focus and the focal bird species for each.

Table 52: Priority habitat features and associated focal species for Central Oregon.

Habitat	Habitat Feature	Focal Species for Central Oregon
Ponderosa Pine	Large patches of old forest with large snags	White-headed woodpecker
	Large trees	Pygmy nuthatch
	Open understory with regenerating pines	Chipping sparrow
	Patches of burned old forest	Lewis' woodpecker
Mixed Conifer (Late-Successional)	Large trees	Brown creeper
	Large snags	Williamson's sapsucker
	Interspersion grassy openings and dense thickets	Flammulated owl
	Multi-layered/dense canopy	Hermit thrush
	Edges and openings created by wildfire	Olive-sided flycatcher
Lodgepole Pine	Old growth	Black-backed woodpecker
Meadows	Wet/dry	Sandhill Crane
Aspen	Large trees with regeneration	Red-naped sapsucker
Subalpine fir	Patchy presence	Blue grouse

Six species from Table 51 and Table 52 are identified as cavity nesters having the potential to be found within the SAFR project area. All other non-cavity nester will be addressed further in this EA under Other Birds of Concern. The project area does nto contain any habitat for the black-backed woodpecker and will not be addressed. The species that will be focused on in this analysis are representative primary cavity excavators and secondary cavity nesters that may be found in this area. They include: white-headed woodpecker, pygmy nuthatch, Lewis' woodpecker, pileated woodpecker, Williamson's sapsucker, flammulated owl, and red-naped sapsucker. Species were chosen from the Why-Chus Watershed Analysis, USFWS Species of Conservation Concern (USFWS 2002), and A Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon (Altman 2000).

Ponderosa Pine/Douglas-fire Habitats – Lewis' Woodpecker, White-headed Woodpecker, Pygmy Nuthatch

Habitat for the Lewis' woodpecker, a migrant in this part of its range, includes old-forest, single-storied ponderosa pine. Lewis' woodpeckers feed on flying insects and are not strong cavity excavators. They require large snags in an advanced state of decay that are easy to excavate, or they use old cavities created by other woodpeckers. Nest trees generally average 17 inches to 44 inches (Saab and Dudley 1998, Wisdom et al. 2000). The Lewis' woodpecker is identified in the Conservation Strategy for Landbirds of the East-Slope of the Cascades Mountains in Oregon and Washington as a focal species for Ponderosa Pine Forests with patches of burned old forest (Altman 2000).

White-headed woodpeckers and pygmy nuthatches share similar habitat of large open ponderosa pine, low shrub levels, and large snags. The white-headed woodpecker is a primary cavity excavator of soft snags, while the pygmy nuthatch is a secondary cavity nester and can take advantage of natural cavities as well as woodpecker created cavities. The white-headed woodpecker is the only woodpecker species to rely heavily on seeds of ponderosa pine for food (Marshall et al. 2003 p. 364). Both the white-headed woodpecker and pygmy nuthatch are identified in the Conservation Strategy for Landbirds of the East-Slope of the Cascades Mountains in Oregon and Washington as focal species for Ponderosa Pine Forests with large patches of old forest with large snags and large trees respectively (Altman 2000).

A long term study on the white-headed woodpecker has occurred on the Deschutes and Winema National Forests from 1997-2004. Both species prefer similar diameter trees as the Lewis' woodpecker for nesting, averaging 23 inches for the pygmy nuthatch and 31 inches for the white-headed woodpecker (Wisdom et al. 2000). Frenzel (2000) calculated the mean diameter for white-headed woodpecker nest trees to be 26.2"dbh while Dixon (1995) found similar results (mean diameter of 25.6"dbh). Frenzel (2003) found nests at sites with a high density of large diameter trees had a higher survival rate than nests in recently harvested sites. Unharvested sites or sites with greater than 12 trees per acre >21"dbh had a success rate of 63.1% while nests at previously harvested sites or lower densities of large trees had a success rate of 39.8%. Therefore, white-headed woodpeckers were positively associated with higher densities of large trees. On the Winema National Forest, white-headed woodpeckers were found to be using small-diameter trees, logs in a slash pile, and upturned roots (6-13" dbh) where large snags were uncommon (Frenzel 2002).

Although there are approximately 22,100 acres of ponderosa pine dominated plant associations, there is limited quality habitat for Lewis' woodpecker, white-headed woodpecker, and pygmy nuthatches in the project area. Within the Why-Chus Watershed the acres dominated by big trees (over 21 inches DBH) have decreased by 88% since 1953 (USDA 1998). In addition a large portion of the ponderosa pine within the Why-Chus Watershed is dense stands of small size class trees (9-21 inches DBH) and bitterbrush, snowbrush, and manzanita now dominate some sites (USDA 1998). Fire suppression had also resulted in increased shrub cover which has led to an increase in small mammal and avian predation on white-headed woodpeckers(Frenzel 1999).

No surveys have been conducted for the Lewis' woodpecker, white-headed woodpecker, and pygmy nuthatch within the SAFR project area.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities:

- Acres of fuels treatments within ponderosa pine habitat.

Mixed Conifer Habitats – Williamson's Sapsucker, Pileated Woodpecker
Williamson's sapsuckers, a summer resident, prefer large decadent snags in mixed conifer or ponderosa pine forests. They feed mostly on sap from "wells" they drill in ponderosa pine or Douglas-fir trees, phloem fibers, cambium, and insects. They are not strong cavity excavators and select soft decayed wood in about any tree species for nesting (Marshall et al. 2003 pp. 355-356). They favor larger trees, generally averaging 27"dbh but have been shown to utilize snags ranging from 21"dbh to 37"dbh as evidenced by the 30 and 80 percent tolerance levels for nest snag diameter in DecAID (Mellen et al. 2006).

The Williamson's sapsucker is identified in the Conservation Strategy for Landbirds of the East-Slope of the Cascades Mountains in Oregon and Washington as a focal species for mixed conifer late-successional forests with large snags (Altman 2000). The biological objectives for habitat, where ecologically appropriate, are to initiate actions in mixed conifer late-successional forests to maintain or provide greater than 1 snag/acre greater than 12"dbh except ponderosa pine snags should be greater than 18"dbh and a mean canopy cover of 25-70% (Altman 2000).

Pileated woodpeckers share similar habitats in denser mixed conifer forests. Bull and Holthausen (1993) found pileateds selected stands for nesting with old growth, grand fir, no logging, and ≥60% canopy closure. They are rarely found in pure ponderosa pine forests. The largest woodpecker in the U.S., it needs large snags for nesting, generally averaging 25-35 inches in diameter in green forests and slightly larger snags in open habitats (24-45"dbh) (Mellen et al. 2006). Snags, live trees, and down logs (at least 15"dbh) are needed for foraging (Bull and Holthausen 1993). A major food source for the pileated woodpecker includes carpenter ants found in decaying snags and logs (Bull et al. 1997). Pileateds also utilize roosts, primarily at night. These tend to be cavities in dead or hollow trees with hollow trees used more often (Bull, Holthausen, and Henjum 1990). Both woodpeckers are identified as focal species for mixed conifer habitats within the Whychus Watershed (USDA 1998).

Although there are approximately 1,900 acres of mixed conifer plant associations, there is limited quality habitat for Williamson's and Pileated Woodpeckers in the project area. Within the Whychus Watershed Analysis the acres dominated by big trees (over 21 inches DBH) have decreased by 80% in the dry mixed conifer and 75% in the wet mixed conifer since 1953 (USDA 1998). In addition increased stand densities have raised concern of significant habitat loss due to stand replacement fire (USDA 1998).

No surveys have been conducted for the Williamson's sapsucker and pileated woodpecker within the SAFR project area.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities:
- Acres of fuels treatments within mixed conifer habitat.

Mixed Conifer, Interspersion grassy openings and dense thickets – Flammulated Owl
The flammulated owl is a focal species for fire climax ponderosa pine and mixed conifer dry habitats. Preferred habitat is typically a mosaic of open forests containing mature and old growth ponderosa pine and Douglas-fir trees, interspersed with dense patches of second growth providing roosting areas. All stands with a significant component of mature and old growth trees are considered potential habitats. This owl will nest in medium to large snags 6.2" to 51.6" dbh with a mean of 24.5" dbh (Mellen et al 2006). It forages primarily on arthropods and other insects (USDA 1994a).

Using the LOS layer, there are currently there are 4,477 acres of potential habitat within the SAFR project area.

There have been no formal surveys for the area and there are no known flammulated owl sites within the project area.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities on the flammulated owl:
- The amount of mature forest that will receive fuels treatments to open up the understory.

Aspen – Red-naped Sapsucker
The red-naped sapsucker is a summer resident typically found in forested habitats, especially riparian areas with aspen and cottonwood. It can be found in ponderosa pine stands as well and occurs less frequently in mixed conifer forests. Most nests are found in large diameter aspen trees with a mean diameter of approximately 10”. It also breeds in cottonwood trees and prefers more moderately decayed trees for nesting. It drills holes resulting in sap wells, which provides food for other birds, insects, and mammals. Diet includes sap, cambium, soft parts beneath bark, insects found under bark, and berries. (Marshall et al. 2003 pp. 356-358).

Threats known to this species include long-term degradation of aspen and other riparian forest habitats from fire suppression and the lack of hardwood regeneration (Marshall et al. 2003 p. 358). In the past 100 to 150 years, there has been a dramatic decline in aspen forests due to a change in fire intervals (Bartos and Shepperd 1999). The lack of fire has allowed late successional species (e.g. conifer species) to move into aspen stands and out-compete the aspen. Bartos and Shepperd (1999) stated that most aspen will eventually be replaced by other communities like conifers, sagebrush, and other tall shrubs without some type of disturbance. Most known stands on the Sisters Ranger District have experienced conifer encroachment and are in need of treatment.

There are fifteen known locations of aspen in the project area totaling approximately 34 acres (Table 35). In addition there is 35 acres of hardwood PAG identified within the SAFR project boundary. There is also various stands of cottonwood along Whychus creek.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities:

1. Acres of conifer reduction within aspen and other hardwood stands.

OTHER BIRDS OF CONCERN

When looking at the Birds of Conservation Concern (USFWS 2002) and the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington (Altman 2000) there are some birds and habitat that are of concern. Sixteen species are identified from these lists with the potential to be found within the SAFR project area. However, there is less than one acre of meadow habitat within the project area and there is no lodgepole pine or subalpine fir plant associations within the project area. Therefore, the sandhill crane, blue grouse and black-backed woodpecker will not be addressed. Some of these species are also covered as individual species. The following species can be found within the snag discussion in the document: white-headed woodpecker, pygmy nuthatch, Lewis' woodpecker, Williamson's sapsucker, flammulated owl, and red-naped sapsucker. The remaining species (chipping sparrow, Brewer's sparrow, olive sided flycatcher, brown creeper, and hermit thrush) will be addressed as they relate to specific habitat associations. The golden eagle is addressed in the MIS discussion.

Table 53: BCR 9 (Great Basin) BCC 2002 list of species with habitat within SAFR.

Bird Species	Preferred Habitat	Habitat within the SAFR Project Area
Golden Eagle	Elevated Nest Sites in Open Country	Yes
Flammulated Owl	Ponderosa pine forests	Yes
Lewis's Woodpecker	Ponderosa pine forests	Yes
Williamson's Sapsucker	Ponderosa pine forests	Yes
White-headed Woodpecker	Ponderosa pine forests	Yes
Brewer's Sparrow	Sagebrush clearings in coniferous forests/bitterbrush	Yes

Table 54: Priority habitat features and associated focal species for Central Oregon.

Habitat	Habitat Feature	Focal Species for Central Oregon
Ponderosa Pine	Large patches of old forest with large snags	White-headed woodpecker
	Large trees	Pygmy nuthatch
	Open understory with regenerating pines	Chipping sparrow
	Patches of burned old forest	Lewis' woodpecker
Mixed Conifer (Late-Successional)	Large trees	Brown creeper
	Large snags	Williamson's sapsucker
	Interspersion grassy openings and dense thickets	Flammulated owl
	Multi-layered/dense canopy	Hermit thrush
	Edges and openings created by wildfire	Olive-sided flycatcher
Lodgepole Pine	Old growth	Black-backed woodpecker
Meadows	Wet/dry	Sandhill Crane
Aspen	Large trees with regeneration	Red-naped sapsucker
Subalpine fir	Patchy presence	Blue grouse

Chipping Sparrow and Brewer's Sparrow

Both species are summer residents preferring open habitats with a shrub or grass component. Chipping sparrows prefer open coniferous forests or stands of trees interspersed with grassy openings or low foliage (Marshall et al. 2003). These species seem to be associated with higher elevations with the Brewer's sparrow occupying the widest elevational band (up to 6000' in the Cascades). The Brewer's sparrow is more reliant on shrub-steppe communities while the chipping sparrow can be found in a wider variety of habitat types. Declines in populations have been noted from Breeding Bird Survey (BBS) results for both species ranging from 2.6% per year for the Brewer's sparrow to 3.9% per year for the chipping sparrow. Some reasons for these declines include habitat changes due to fire suppression, grazing, invasion of exotic species and fragmentation.

Chipping sparrow habitat is open ponderosa pine stands with some regenerating pockets of thicker pine.

Ecological types were mapped for the project area using information on soil types and the potential natural vegetation. The potential natural vegetation may differ from the existing vegetation, however the ecotype has the potential to produce the climax vegetation if disturbance events were to occur naturally. Three ecotypes were developed for the SAFR project. Ecotypes 1 and 2 meet have been identified as potential Brewer's sparrow habitat. They are defined as:

Pine-juniper/sagebrush-bitterbrush/fescue (Ecological Type 1)

- Without disturbance understory consists of a mixture of sagebrush and bitterbrush. With repeated disturbance understory typically converts to Idaho fescue and forbs with little or no brush. Disturbance followed by a recovery period in this ecotype appears to favor rabbit brush over sagebrush.

Pine/bitterbrush/fescue (Ecological Type 2)

- This is the most productive ecotype for bitterbrush production and without disturbance the understory vegetation consist of mainly bitterbrush. With repeated disturbance understory typically converts to Idaho fescue and forbs with little or no brush. Areas with dense tree canopy can also limit the amount of bitter brush in the understory.

There have been no formal surveys within the project area. However, potential habitat exists across the project area in varying degrees of quality.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities:

- Acres of fuels reduction within ponderosa pine stands for chipping sparrow.
- Acres of fuels reduction within Ecotypes 1 and 2 for Brewer's sparrow.

Olive-sided Flycatcher
The olive-sided flycatcher is a summer resident that breeds in low densities throughout coniferous forests of Oregon. The olive-sided flycatcher, an aerial insectivore, prefers forest openings or edge habitats where forest meets meadows, harvest units, rivers, bogs, marshes etc. (Marshall et al. 2003). Nesting success was highest within forest burns where snags and scattered tall, live trees remain (Marshall et al. 2003 and Wisdom et al. 2000). Common features of nesting habitat include tall prominent trees and snags used as foraging and singing perches. This species forages from high prominent perches at the tops of snags or from the uppermost branches of live trees and needs unobstructed air space to forage. It preys on flying insects and in particular, bees and wasps. (Marshall et al. 2003).

Population trends based on BBS data show highly significant declines with an Oregon statewide decline of 5.1% per year from 1966-1996. Factors potentially contributing to population declines on breeding grounds include habitat loss through logging, alteration of habitat through management activities (e.g., clearcutting, fire suppression), and lack of food resources. (Marshall et al. 2003). Wisdom et al. (2000) also noted that where altered fire regimes result in fewer but larger fires, the juxtaposition of early and late seral habitats becomes less favorable. However, within the Columbia Basin our area (Southern Cascades) shows increases of >60% for the olive-sided flycatcher compared to other areas.

There have been no formal surveys within the project area. However, potential habitat exists across the project area in varying degrees of quality.

Evaluation Criteria
The following measures will be used to evaluate the impacts of the planned activities:
- Acres of prescribed burning within the mixed conifer plant association.

Brown Creeper
The brown creeper is the only North American bird that relies on both the trunk and bark of trees for nesting and foraging. It is found predominantly in coniferous forests but can be located in hardwood stands as well. It nests under loose sloughing bark of large diameter snags with little to moderate decay. The mean diameter of nest trees range from 16" dbh to 42" dbh. In northeastern Oregon, creeper abundance was positively associated with the height of the canopy and density of trees. (Marshall et al. 2003). Adams and Morrison (1993) found similar results with creepers being highly correlated with mature-aged stands with moderate overall stand density. Threats to this species include the loss of large diameter snags and live trees.

Evaluation criteria
The following evaluation criteria will be used to evaluate the effects of planned activities and provide a comparison between alternatives:
- Total number of acres of fuels reduction within brown creeper habitat.

Hermit Thrush
The hermit thrush is a summer resident preferring mid to high elevation mature and old growth forests. It breeds in mature forests of all types especially those with a shaded understory of brush and small trees ranging from aspen groves to juniper woodlands to moderately open coniferous forests. It nests on the ground or uses small trees in the understory. It is a ground forager of insects; however fruits and berries may also be consumed especially during migration and in winter. Populations seem to be stable at this time. However, threats to this species include the loss of mature forests and controlled burning of forest understories. (Marshall et al. 2003 pp. 483-485). Hermit thrush responses have been known to decrease after fires (Sallabanks 1995).

Evaluation criteria
The following evaluation criteria will be used to evaluate the effects of planned activities and provide a comparison between alternatives:
- Total number of acres of fuels reduction within the mixed conifer PAG.

Environmental Consequences

Cooper's and Sharp-shinned Hawks
Alternative 1 – Ecological Trends
There are no known direct impacts to Cooper's or sharp-shinned hawks associated with this alternative. Habitat conditions would remain the same for the short-term. Stand densities would continue to increase due to fire suppression. This would increase the potential habitat over time. However, with increased stand densities comes increased risk of loss from disturbance events (insects, disease, or fire). These events would likely impact the densest stands the greatest due to the stand conditions which would result in reduced availability of suitable habitat in the project area.

Great Blue Heron
Alternative 1 – Ecological Trends
There are no known nests, colonies, or rookeries within the project area. In the absence of disturbance events, habitat trends would continue with increased stand densities, canopy cover, down woody debris and snags. However, with increased stand densities comes increased risk of loss from disturbance events. In addition, the limited meadow habitat may also exhibit conifer encroachment, which would limit available foraging habitat. Trees growing in heavily stocked stands may also lead to smaller limb structure, which would limit available nesting habitat.

Golden Eagle
Alternative 1 – Ecological Trends
There are no known direct impacts associated with the no action alternative. Many of the large trees that provide potential nest, perch, and roost sites are surrounded by dense patches of smaller trees with an understory of brush. Competition for nutrients and water makes these trees more susceptible to insects and disease. The larger trees within densely stocked stands are more susceptible to wildfire, due to increased fuel loadings from 100 years of fire suppression. Under the no action alternative large trees will continue to be at an increased risk to insect, disease, and wildfire.

Currently there are a limited number of large trees available for potential nest and roost sites located within golden eagle habitat. Replacement large trees are also a concern. Many of the future eagle trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired height and size. Many of the future large trees have been growing in dense pockets, which create large trees with small branches. Therefore, many of the future large trees may lack larger branch structure that is needed to hold heavy nest structures that eagles create.

Northern Goshawk
Alternative 1 – Ecological Trends
No direct impacts will occur and no known goshawk habitat will be impacted with the implementation of this alternative. Nesting and foraging habitat are not static and in the short term (<50 years), may be reduced in quality or lost due to environmental factors such as insects, disease, and/or wildfires. Much of the existing habitat is overstocked, and in some areas, have a high occurrence of disease problems. Within the mixed conifer

stands large ponderosa pine and Douglas-fir would continue to be lost and replaced by white fir. Canopy closure may be sufficient for goshawks, however large structure would be sparse over the landscape and may reduce potential nesting habitat. Stands occurring in the mixed conifer wet and riparian PAGs have a higher potential of becoming goshawk nesting habitat in the long term.

Osprey
Alternative 1 – Ecological Trends
No direct impacts will occur and no potential osprey habitat will be impacted with the implementation of this alternative. Current potential nest trees (snags) are often located within densely stocked stands and are more susceptible to wildfire, due to increased fuel loadings from 100 years of fire suppression. Under the no action alternative, potential nest sites will continue to be at an increased risk to wildfire. There are also a limited number of large trees available for potential future nest sites located within potential osprey habitat. Replacement large trees are also a concern many future potential nest trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size and height.

Red-tailed Hawk
Alternative 1 – Ecological Trends
There are no known direct impacts associated with this project for red-tailed hawk. Suitable habitat would be maintained for the short-term until past harvest units begin to grow, which will reduce foraging opportunities. Large snags and trees will remain on the landscape. Stand densities will continue to increase, increasing the risk of a large scale fire event occurring, resulting in a loss of large snags and structure. This would reduce both existing and future nesting habitat.

Waterfowl
Alternative 1 – Ecological Trends
There are no known direct impacts to waterfowl associated with no action alternative. There is limited potential waterfowl habitat occurring only along Whychus Creek within the SAFR project area.

American Marten
Alternative 1 – Ecological Trends
There are no known direct impacts to marten under the no action alternative. Marten habitat will remain for the short term. Canopy cover and stand densities will continue to increase over time, which would increase the potential for use by marten. It may also result in increased amounts of snags and down woody material. Due to the open nature of the project area, complex horizontal structure may never be generated. In the long term, within potential habitat, large structure will be lost due to white fir encroachment leading to degraded habitat quality. With increased stand densities, there is an increased risk of loss from a disturbance event. Disturbances such as insects or disease would result in increased levels of snags and down woody material. However, canopy cover would be reduced so habitat created may be of a lower quality. A stand replacing fire

event would remove most of the canopy cover, prolonging the development of habitat for several decades.

Elk
Alternative 1 – Ecological Trends
Thermal cover and hiding cover will remain. However, with current densely stocked stands comes increased risk of loss from disturbance events. These events would likely impact the densest stands the greatest due to the stand conditions resulting in reduced cover.

Hiding cover is present in denser stands, ponderosa pine thickets, and along riparian reserves. Patch size varies but most stands contain a mosaic of small tree thickets and larger trees.

Available forage will remain in the short-term. As stands of trees continue to grow and canopy cover increase available forage will start to decline. Forage potential would decrease due to reduced sunlight hitting the forest floor. No cycling of grass, forbs, and shrubs would occur.

Winter recreation use continues to increase in the area resulting in increased stress levels in the animals during critical periods. However, a large portion of the elk winter range is in the winter road closure area, therefore stress from motor vehicles should be limited.

Total open road densities within the SAFR project within the biological elk winter range will not change with this alternative.

Mule Deer
Alternative 1 – Ecological Trends
There are no known direct impacts associated with this alternative.

Cover
Thermal cover and hiding cover will remain for the short term. Stand densities would continue to increase due to fire suppression, increasing potential cover over time. However, with increased stand densities comes increased risk of loss from disturbance events. If these events were to occur they would likely impact the densest stands the greatest due to the stand conditions which would result in reduced availability of cover in the project area.

Forage
Available forage will remain in the short term. As stands of trees continue to grow and canopy cover increase available forage will start to decline. Forage potential would decrease due to reduced sunlight hitting the forest floor. No cycling of shrubs would occur. Mature shrubs that are above snow levels and accessible to deer would increase in abundance through time but as shrubs become decadent the nutritional quality would decline. In addition, the no action alternative would not reduce the risk of stand

replacement wildfire occurring in mule deer winter forage. A large scale disturbance event could reduce potential winter forage (bitterbrush) across the entire project area.

The trend of residential development surrounding this area would cause these undeveloped forested parcels to become increasingly more important in the future for migration as well as for forage and cover. Recreation pressure continues to increase in the area. Winter use in the area is also increasing which results in increased stress levels in the animals during critical periods. However, a large portion of the deer winter range is in the winter road closure area, therefore stress from motor vehicles should be very limited.

Road Densities
Total open road densities within the SAFR project, MA-7, or biological winter range will not change with this alternative.

Late and Old Structural Stands
Alternative 1 – Ecological Trends
There are no known direct impacts associated with the no action alternative. Many of the large trees that provide LOS are surrounded by dense patches of smaller trees with an understory of brush. This competition for nutrients and water makes these trees more susceptible to insects and disease. In addition the larger trees that are within densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from 100 years of fire suppression. Under the no action alternative LOS habitat will continue to be at risk to disturbance events.

Connectivity
Alternative 1 – Ecological Trends
There are no known direct impacts associated with the no action alternative. Many of the trees that provide connectivity between LOS are within dense patches of trees with an understory of brush. This competition for nutrients and water makes these trees more susceptible to insects and disease. In addition the connectivity areas that are within densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from 100 years of fire suppression. Under the no action alternative connectivity will continue to be at risk.

Within the mixed conifer plant associations, areas have a significant white fir component, are overstocked, and in some areas, have a high occurrence of disease problems. These connectivity areas would continue to lose large ponderosa pine and Douglas-fir components being replaced by white fir.

Special or Unique Habitat and Associated Species
Alternative 1 – Ecological Trends
There are no known direct impacts to the springs or seeps associated with the no action alternative. There will be no change in the function of springs and seeps.

Snags

Alternative 1 – Ecological Trends

There are no known direct impacts to snags with the no action alternative. Currently there are a limited number of large snags on the landscape. Current fuel continuity due to increased fuel loadings from 100 years of fire suppression have put the landscape at risk of a large uncharacteristic fire. These large stand replacement events create snags, however the pulse of snags is short lived and there is a long lag until snags are available on the landscape. Under the no action alternative, snags will continue to be at an increased risk to wildfire.

In addition there are limited large trees to provide future large snag habitat. Many of the future snags (i.e. live trees) are within overstocked stands, which will increase the amount of time the trees will take to get to the desired height and size.

Competition will continue to increase in overstocked stands with the no action alternative smaller snags are expected to increase across the landscape.

Down Wood

Alternative 1 – Ecological Trends

There are no known direct impacts associated with the no action alternative. Small diameter down wood will continue to be created as competition for nutrients and water makes trees more susceptible to insects and disease. There are also limited large trees (i.e. over 21 inches dbh) available for future large down wood recruitment. Many of the larger trees occur in densely stocked stands, which will increase the amount of time the trees will take to get to the desired size.

WOODPECKERS (CAVITY NESTERS)

Lewis' Woodpecker, White-headed Woodpecker, Pygmy Nuthatch

Alternative 1 – Ecological Trends

There are no known direct impacts associated with the no action alternative. Continued fire suppression has led to unsuitable conditions for these species. Due to this, an increase in shrub layers is likely to persist. Increased shrub layers may also lead to an increase in small mammal densities which could lead to increased predation pressures on white-headed woodpeckers (Frenzel 1999).

Increased stand densities perpetuates the problem of losing large structure over time, which these species require for suitable nesting and foraging habitat. In dense stands, smaller trees will require a longer period of time to develop into suitable habitat due to competition for nutrients. It also minimizes nest site availability, which could increase competition for existing sites between species and may lead to greater risk of predation. Increased stand densities may increase the risk of loss from fire. These species require snags for nesting and utilize softer snags (moderate decay). These structures would be consumed more rapidly with increased fire intensities and may lead to large areas of the landscape being unsuitable if such an event were to occur.

Williamson's Sapsucker, Pileated Woodpecker

Alternative 1 – Ecological Trends

There are no known direct impacts associated with the no action alternative. Increased stand densities perpetuates the problem of losing large structure over time, which these species require for suitable nesting and foraging habitat. In dense stands, increased competition for nutrients will prolong the development of large trees. Nest site availability will be limited increasing competition for existing sites leading to greater predation risks. Increased stand densities may increase the risk of loss from fire. These structures would be consumed more rapidly with increased fire intensities and may lead to large areas of the landscape being unsuitable if such an event were to occur.

Flammulated Owl
Alternative 1 – Ecological Trends
There are no known direct impacts associated with this alternative. Within the suitable habitat the shrub layer that exists limits the available forage base for the owl by decreasing the diversity of forest floor plants, which may discourage some arthropods and other insects from occupying these sites. It also hinders foraging attempts due to the somewhat limited maneuverability of flammulateds with increased shrub structure (USDA 1994a).

Increased stand densities perpetuates the problem of losing large structure over time from competition and disturbance events, which this species requires for suitable nesting and foraging habitat. It also limits available nest sites, resulting in more competition for existing sites between species. Increased stand densities may increase the risk of loss from fire. This species requires snags for nesting and utilizes softer snags (moderate decay). In the event of fire, softer snags are lost and replaced with hard snags, limiting nesting habitat until developed by primary cavity excavators.

Red-Naped Sapsucker
Alternative1 – Ecological Trends
There are no known direct impacts associated with the no action alternative. The no action alternative will continue to allow the advancement of conifer species into aspen stands and eventually replace the aspen with conifer communities without some type of disturbance.

OTHER BIRDS OF CONCERN
Chipping Sparrow and Brewer's Sparrow
Alternative 1 – Ecological Trends
There are no known direct impacts associated with this alternative. Primary risks to habitat will continue due to increased fuel loading from fire suppression, which has resulted in increased stand densities. The densely stocked stands that currently exist impact both species by reducing the open areas. Potential habitats that occur adjacent to densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from the last 100 years of fire suppression. Under the no action alternative habitat will continue to be at an increased risk to insect, disease, and wildfire.

Olive-sided Flycatcher
Alternative 1 – Ecological Trends

There are no known direct impacts associated with the no action alternative. Current potential habitat will remain. In addition the densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from 100 years of fire suppression. If a wildfire was to occur habitat would be created in the remaining mixed mortality areas and underburned areas due to the presence of both live and dead trees and the amount of edge created.

Brown Creeper
Alternative 1 – Ecological Trends
There are no known direct impacts associated with the no action alternative. Many of the large trees that provide potential habitat are surrounded by dense patches of smaller trees with and understory of brush. Competition for nutrients and water makes these trees more susceptible to insects and disease. In addition the larger trees that are within densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from 100 years of fire suppression. Under the no action alternative large trees will continue to be at an increased risk to insect, disease, and wildfire.

Currently there are a limited number of large trees available for potential use. Replacement large trees are a concern. Many of the future habitat trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size.

Hermit Thrush
Alternative 1 – Ecological Trends
Many of the large trees that provide potential habitat are surrounded by dense patches of smaller trees with and understory of brush. This makes suitable habitat but, competition for nutrients and water makes these trees more susceptible to insects and disease. In addition the larger trees that are within densely stocked stands are more susceptible to wildfire, due to increased fuel loadings and ladder fuels from 100 years of fire suppression. Under the no action alternative habitat will continue to be at risk.

Cooper's and Sharp-shinned Hawks
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: There are no known Cooper's or sharp-shinned nest sites in the project area. However, 172 acres of potential habitat will be thinned leaving 316 acres of potential habitat in the project area. Remaining habitat will continue to be at risk from disturbance, although breaking up the fuel continuity across the landscape will reduce the risk of a larger scale event. Designated no treatment areas within riparian habitat conservation areas and areas identified as hiding cover and thermal cover within mule deer winter range will also continue to provide habitat for Cooper's and sharp-shinned hawks. These areas tend to have higher stocking rates so they have the potential to provide habitat currently or are expected to provide habitat in the future (approximately within 20 years).

In areas that are identified to be thinned, canopies will be opened up and stand densities reduced to lessen the risk of a large-scale event (insects, disease, or fire). Thinning will directly reduce acres of Cooper's and sharp-shinned habitat, but it will also reduce the fire risk to individual stands breaking up the fuel continuity across the landscape, reducing the risk of larger scale disturbance events. However, each unit identified for thinning will leave 10% in retention clumps. These areas will have a higher stocking rate and may provide habitat for Cooper's and sharp-shinned hawks as well as prey species.

Mastication and burning treatments are also proposed. These treatments will reduce both fuels associated with thinning and overall fuel loadings to acceptable levels. Fuel treatments will reduce fire risk and will reduce competition to established trees, further increasing the stands resiliency to wildfire. Fuels treatments will also reduce the understory complexity which may result in a change or reduction in potential prey species. However, adjacent untreated areas should provide the structural complexity for prey species that will provide potential foraging opportunities.

Overall, all the treatments described above will aid in the development a more resilient landscape to disturbance.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) that are applicable for Cooper's hawks and sharp-shinned hawks. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Great Blue Heron
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: There are no known nests, colonies, or rookeries within the project area. Areas that are not treated will exhibit the same impacts as described in the no action alternative, although breaking up the fuel continuity across the landscape will reduce the risk of a larger scale disturbance event.

Seventy-five acres of the Whychus Creek riparian habitat conservation area will be thinned. However, no trees over 9 inches will be removed. In these areas ladder fuels will be reduced, which will reduce the risk of stand replacing wildfire and open the stands up. Thinning will create open grown trees increasing branch size and nesting availability in the future.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) that are applicable for great blue herons. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Golden Eagle
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Disturbance may occur to foraging eagles during treatments which may result in altering their foraging locations or behavior. Approximately 109 acres of golden eagle habitat will receive treatment. However, green trees 21 inches and

greater (potential roost, nest, and perch trees) will not be removed. In addition large snags are not targeted for removal. However, there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments. However, it is assumed that some level of direct impact would occur, as OSHA regulations requirements would result in those impacts.

Thinned areas within golden eagle habitat will reduce ladder fuels associated with large trees. Ladder fuel reduction will decrease risk of losing the remaining large trees within golden eagle habitat. In addition, removal of understory in overstocked stands will decrease the competition for nutrients and water, which should also lower the susceptibility to insects and disease. An important benefit to thinning is the reduction in beetle caused mortality (Cochran and Barret 1999a).

Currently there are a limited number of large trees available for potential nest and roost sites, as well as replacement large trees. Many of the future eagle trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size and height. Thinning stands will reduce competition, increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined that there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined that the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees.

Many of the future large trees have been growing in dense pockets, which will create large trees with small branches. Therefore, many of the future large trees may lack the larger branch structure that is needed to hold the heavy nest structures that eagles create. Cochran and Barret (1999b) determined that crown widths were significantly greater in the absence of understory vegetation. Using the assumption that larger crown widths equate to larger branch structures, the study shows that open grown trees with limited understory will have larger branches than large trees in densely stocked stands.

Proposed mastication and burning treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuels reduction will reduce fire risk and competition between established trees, increasing stand resiliency to wildfire. Fuels treatments will also reduce the understory complexity, creating more open areas that could increase habitat for golden eagles to forage.

Negative effects of treatments may result in large snags being removed for safety purposes reducing large snag habitat. Disturbance may also occur to foraging eagles during treatment which may result in altering their foraging patterns.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) applicable for golden eagles. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Northern Goshawk

Alternative 2 – Proposed Action / Alternative 3

Direct/Indirect Impacts: There are two known historic nest sites within the project area. The established 30 acre nest core areas will receive no treatments. Within the PFA's approximately 501 acres are identified for thinning. Thinning treatments proposed within PFAs were designed to meet goshawk objectives by maintaining current Late and Old Structure (LOS) and or moving younger stands toward LOS.

In untreated habitat there will continue to be an increased risk from disturbance, although breaking up the fuel continuity across the landscape will reduce the risk of a larger scale disturbance events. In addition some areas identified for no treatment occur within higher site potential areas (i.e. riparian habitat conservation areas), which allows them to produce large trees with greater canopy closure. These areas have the potential to provide future goshawk habitat.

Within identified habitat approximately 88 acres (38%) of potential nesting and approximately 601 acres (54%) of potential foraging habitat are identified for treatment. In these areas canopies will be opened up and stand densities reduced to lessen the risk of a large-scale event (insects, disease, or fire). Thinning will be from below, therefore the largest trees are targeted for retention. However, thinning will directly reduce canopy cover, but it will also reduce the fire risk to individual stands by breaking up the fuel continuity across the landscape reducing the risk of larger scale disturbance events. In addition, each unit identified for thinning will retain 10% in retention clumps. Retention clumps could benefit some prey species by providing areas with higher stocking rates providing some diversity of canopy cover across the landscape.

While treatments may reduce current goshawk habitat, treatments will:

- Move the ponderosa pine PAG towards the historic condition where stands were composed of mature ponderosa pine and ponderosa pine regeneration in relatively even-age groups, with minor amounts of Douglas-fir and white fir in the overstory and many areas with grass understories. These conditions will mimic those outlined in Whychus watershed analysis (1998) historical references.
- Move the mixed conifer dry PAG towards the historic condition where stands were composed of ponderosa pine in the overstories with relatively open understories to create conditions that mimic those outlined in Whychus watershed analysis (1998) historical references.
- Move the mixed conifer wet PAG stands towards the historic condition where stands were comprised of primarily of early seral species with some areas having dense understories of pine and fir.

Proposed mastication and burning treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuels reduction will reduce fire risk and competition between established trees, increasing stand resiliency to wildfire. Fuels treatments will also reduce the understory complexity, which may result in a change or reduction in potential prey species. However, adjacent untreated areas may be able to provide the structural complexity for prey species and will support foraging opportunities.

Overall, the treatments described above will aid in the development a more resilient landscape to disturbance.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) for northern goshawks. The SAFR project is also consistent with Standards and Guidelines outlined in the Regional Forester's Forest Plan Amendment #2 (1995) applicable for northern goshawks. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Osprey

Alternative 2 – Proposed Action / Alternative 3

Direct/Indirect Impacts: Treatments within the project area will break up the fuel continuity and reduce the risk of a landscape scale fire event, which should reduce the risk to individual large snags and trees. Green trees 21 inches and greater (future large snags) will not be removed and large snags are not targeted for removal. However, there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments, but due to OSHA regulations snags posing a hazard may be removed.

Currently there are a limited number of large trees available for potential nest and roost sites located near Watson Reservoir. Many of the future large snags are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size and height. Thinning stands will reduce competition, increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined that the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees.

Within the areas that have prescribed fire identified, there is also potential of changing large snags into down wood. Burning prescriptions fuels reduction should reduce the chance of losing large snags. However, it is assumed that a small percentage of large snags will be affected by prescribed burning.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) applicable for osprey. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Red-tailed Hawk

Alternative 2 – Proposed Action / Alternative 3

Direct/Indirect Impacts: Implementation of proposed actions will not impact or remove trees >21" dbh. During thinning operations it is expected that individual snags would be lost through the felling of snags that pose a hazard to workers and/or equipment. In addition, during prescribed fire treatments incidental snags could be lost from fire or trees may be converted to snags. Mastication and prescribed fire treatments will remove some cover for small mammals increasing potential foraging habitat for red-tailed hawks. Increases in the amount of high quality foraging habitat should occur in the short term due to a more open landscape with less vegetation (shrubs) to supply areas for small mammals to hide.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) applicable for red-tailed hawk. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Waterfowl
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: There are no known direct impacts to waterfowl associated with Alternatives 2 or 3. There is limited potential waterfowl habitat occurring within the project area and it occurs along the edge of Whychus Creek. There will be no treatments within 30 feet of Whychus Creek, so no treatments will occur within waterfowl habitat.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) applicable waterfowl. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

American Marten
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Treatments in the mixed conifer will focus on moving stands toward more sustainable habitat conditions, which will lessen the risk of a large-scale fire event and retain more long-lived, fire tolerant, and disease resistant species. Approximately 162 acres of suitable habitat will be treated leaving approximately 324 acres of habitat untreated. However, mixed conifer stand targeted for treatment not currently identified as habitat, are expected to provide habitat in the future.

Thinning from below will favor species like ponderosa pine and Douglas-fir. Different scenarios exist depending on the existing basal area, site productivity, and stand structure. This treatment aids in maintaining large trees by reducing their susceptibility to fire and insects by removing competition for space and nutrients. Thinning decreases stand densities and allows for faster growth of young trees while reducing risk (removal of ladder fuels). However, canopy cover is reduced overall resulting in more open stands. This treatment results in both negative and beneficial impacts to martens. Negative impacts will result from more open stands by decreasing canopy cover, which may impact use and dispersal through the area. Beneficial impacts should result from reducing risk to existing suitable habitat and facilitating the development of future habitat.

Prescribed fire will occur in stands with a more fire resistant overstory. Mastication of brush may also occur where existing brush density and height would contribute to undesirable fire behavior. This treatment aids in maintaining the overstory by reducing the susceptibility to wildfire and will favor longer-lived, more fire resistant species like ponderosa pine and Douglas-fir. Beneficial impacts should result in more stable habitat over the long term. Negative impacts may result in the potential degradation of habitat with the consumption of some softer snags and down woody material. However, they will be minimal when compared to wildfire because of lower burn intensities.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) applicable for American (pine) marten. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Elk

Alternative 2 – Proposed Action / Alternative 3

Direct/Indirect Impacts: Thinning and prescribed fire treatments will result in a reduction of approximately 895 acres of thermal cover and approximately 567 acres of hiding cover within biological elk winter range. However, approximately 1,072 acres of cover will still remain. The size of hiding cover patches will be decreased and there will be greater distances between these patches. This may result in big game being more visible to predators and hunters and may result in higher mortality rates. It will also decrease the thermal cover properties of these patches by altering the microsite climate (warmer in the summer and colder in the winter).

Table 55: Elk habitat acres on Forest Service Administered Lands within the SAFR Project Area within biological winter range.

Elk Habitat Type	Quality of Habitat	Existing Condition	Alt. 2 and Alt. 3
Thermal Cover	40 + Canopy Cover	38 acres	20 acres
	30-39 Canopy Cover	234 acres	81 acres
	25-29 Canopy Cover	134 acres	92 acres
	20-24 Canopy Cover	851 acres	118 acres
Hiding Cover	Hiding Cover that doesn't meet Thermal Definition	1,277 acres	801 acres
	Acres of Cover	**2,534 acres**	**1,112 acres**
Thermal cover data equals the percent canopy cover of trees 9 inches dbh or greater. All plantations were considered hiding cover in the existing condition calculations. In the proposed action it was assumed that 15% of the treated plantations will serve as hiding cover for elk. In addition areas that had 200 trees per acre or greater in the 1 to 8 inch category were considered hiding cover.			

Thinning treatments should result in a reduction in canopy cover allowing more sunlight to hit the forest floor, which may stimulate herbaceous plant growth increasing foraging opportunities.

Mastication and prescribed burning will result in shrub cycling and will increase grass and forbs production. Mastication and burning in areas of heavy ceanothus and manzanita growth could stimulate the growth of herbaceous plant material increasing foraging opportunities. Reduction in the shrub layer may also decrease hiding cover for calves within the project area. This could result in increased predation.

Total open road densities within the SAFR project within the biological elk winter range will not change with this alternative.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) applicable to elk. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Mule Deer
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: During operations, noise and equipment may displace deer within or adjacent to harvest units. Increased traffic may also put more deer at risk of collisions with vehicles. From December 1 through March 31 disturbance should be minimized within the Tumalo Winter Range Road Closure as the only treatment that may occur will be prescribed fire.

Cover
The untreated (approximately 6,907 acres) stands will continue to provide cover at various levels for deer. In the denser stands there will continue to be a risk of loss from disturbance events. These events would likely impact the densest stands the greatest due to the stand conditions which would result in reduced availability of cover in the project area.

Areas not proposed for treatment that do not currently meet the definition of cover will continue to grow and are expected to meet the cover definition at some point in the future depending on existing stocking levels and site potential.

With implementation of proposed action it is expected that approximately 1,921 acres of thermal cover of varying quality will remain in MA-7 and approximately 6,191 acres of cover will remain across the project area (Table 56).

Table 56: Cover Levels for the No Action and the Proposed Actions within SAFR.

Cover Type	Quality (DBH and Canopy Closure)	Acres within MA-7		Acres outside of MA-7		Acres within Bio. Winter Range	
		Alt. 1	Alt. 2 and 3	Alt. 1	Alt. 2 and 3	Alt. 1	Alt. 2 and 3
Thermal	9 inch DBH at least 40% CC	55	36	N/A**	N/A**	34	19
	9 inch DBH 30-39% CC	278	156	N/A**	N/A**	285	98
	5 inch DBH at least 40% CC	212	169	N/A**	N/A**	80	76
	5 inch DBH 30-39% CC	699	469	N/A**	N/A**	665	424
	9 inch DBH 25-29% CC	120	105	N/A**	N/A**	147	92
	5 inch DBH 25-29% CC	1,138	571	N/A**	N/A**	807	427
	9 inch DBH 20-24% CC	879	175	N/A**	N/A**	840	139
	5 inch DBH 20-24% CC	1,207	240	N/A**	N/A**	1,106	199
Hiding	Hiding Cover that doesn't meet Thermal Definition	1,118	628	12,564	3,642	1,526	688
	Total	**5,706**	**2,549**	**12,564**	**3,642**	**5,490**	**2,163**
**** Note- Outside MA-7 Hiding Cover Meets the Definition of Thermal Cover.**							
All plantations were considered hiding cover in the existing condition. In the proposed action it was assumed that 15% of the treated plantations will serve as hiding cover for deer, due to stocking levels of thinned plantations. Areas that had 200 trees per acre or greater in the 1 to 8 inch category were considered hiding cover. In addition areas that had 25% cover or greater in brush at least 3 ½ feet tall were considered hiding cover.							

Cover should make up forty percent of the land area within MA7. Of that 40% three quarters should be thermal cover with the remainder being hiding areas. By maintaining defensible space adjacent to the urban interface, thermal cover cannot be provided in these areas. Objectives in the defensible space areas will never provider thermal cover in the future. Frequent entries will be implemented within defensible space to keep the risk of catastrophic fire low as well as providing areas to safely suppress wildfires. The project has proposed a Forest Amendment that will remove areas defined as defensible space from the requirement. Below are the acres of MA7 before the forest plan amendment within the project area and the reduction of acres after the amendment in the project area.

- Acres of MA7 = 7,439 Acres of MA7 identified as defensible space = 1,323
- 7,439 – 1,323 = 6,116 Acres of MA7 outside of defensible space.
- 6,116 Acres * 40% = 2,446 Acres of cover needed within MA7.

2,549 acres will be retained that has been identified as cover. Therefore, 42% of MA7 outside of defensible space will remain as cover.

Hiding cover must be present over 30% of the area outside MA7. Black bark pine is not included in this calculation as it has a separate management objective.

- Acres of Forest Service administered lands outside of MA7 = 16,977
- Acres of Forest Service administered lands outside of MA7 identified as black bark = 5,569
- 16,977 – 5,569 = 11,408 Acres used in the 30% calculation for WL-54.
- 11,408 * 30% = 3,422 Acres of cover needed outside of MA7.

3,642 acres will be retained that has been identified as cover. Therefore, 32% of the SAFR project, excluding MA7 and black bark stands, will remain as cover for deer.

Within each unit 10% of the area will be left in clumps. The clumps left will serve as visual screens as well as small patches of cover, however the smaller patches are expected to be warmer in the summer and colder in the winter than the cover that occurs in the no treatment areas.

In areas identified for mastication and prescribed fire there will be a reduction in hiding cover for deer. There are areas within the project area that the height and amount of brush create hiding cover (i.e. will hide 90% of an adult deer from human view at 200 feet). In addition areas of substantial brush may be used by deer during fawning season. Again 10% of the area has been identified to remain in retention clumps, which will create visual screening patches.

In units that have a prescribed fire treatment associated with them, the 10% retention clumps have the potential to be burned through. Fire will likely decrease the effectiveness of the clumps as visual screens, as underburns tend to prune lower limbs.

Forage

In no treatment areas, trees will continue to grow and canopy cover should increase, however shrubs will decline due to increased canopy cover not allowing sunlight to reach the forest floor. In addition no cycling of shrubs will occur.

Areas identified for thinning are expected to open up individual stands (reduce canopy cover) and allow more sunlight to hit the forest floor, stimulating shrub, grass, and forbs growth increasing summer foraging opportunities primarily.

Winter Range

The future desired condition is to cycle shrubs through the seral stages so there will be a sustainable supply of bitterbrush through out time. The goal is to eventually move the shrub seral ratios towards the desired condition of 1/3 early seral, 1/3 mid seral, and 1/3 late seral stage of shrubs. As units move from one seral stage to the next, shrub conditions will need to be re-addressed and other areas may need to be treated to ensure desired seral ratios are maintained.

Areas identified in the proposed action for mowing and burning would result in an estimated reduction of approximately 3,328 acres of brush habitat (primarily bitterbrush) within MA7. Outside of defensible space treatments, shrub seral ratios would move towards the desired condition of 1/3 early seral, 1/3 mid seral, and 1/3 late seral stage of shrubs. Table 57 describes the changes in shrub seral stages between the alternatives.

Table 57: Shrub seral condition within MA-7 and Biological Winter Range.

Deer Habitat	Seral Condition	Alt. 1 Acres (Percent)	Alt. 2 and Alt. 3 Acres (Percent)
MA-7 Including Defensible Space	Early	1,034 (14%)	3,542 (47%)
	Mid	1,825 (24%)	1,461 (20%)
	Mixed	642 (9%)	493 (7%)
	Late	3,989 (53%)	1,996 (27%)
** MA-7 Excluding Defensible Space	Early	793 (13%)	2,034 (34%)
	Mid	1,554 (26%)	1,461 (24%)
	Mixed	500 (8%)	492 (8%)
	Late	3,131 (52%)	1,991 (33%)
Biological Winter Range	Early	334 (5%)	3,596 (49%)
	Mid	1,652 (22%)	1,241 (17%)
	Mixed	723 (10%)	416 (6%)
	Late	4,214 (57%)	2,106 (29%)
	Unknown	466 (6%)	29 (0%)
** Within MA7 in the SAFR project shrubs will me managed at 33% in early seral stage, 33% in mid seral stage, and 33% in late seral stage in areas not identified as defensible space. Please see MA7 amendment proposal located on page 7.			

Areas currently in the mid and late seral stage identified for shrub retention will not be treated and mature shrubs that are above snow levels will continue to be accessible to deer. Thinning treatments within and around mature shrubs as well as shrub treatments adjacent to these blocks of bitterbrush are designed to break up the continuity of fuels throughout the landscape, reducing the potential for a large scale fire event. An event of this magnitude could remove a large portion of mature shrubs within the project area. These shrubs are expected to become decadent at some point in the future (depending on existing and site potential) resulting in a nutritional quality decline.

In areas returned to the early seral stage, grass and forbs forage values are expected to increase in the short term. In the long term bitterbrush is expected to re-occupy those sites and become the mature bitterbrush needed by deer for winter forage in the future.

Outside Winter Range
Outside MA-7, approximately 12,796 acres are proposed for mastication and/or prescribed fire. In treated areas grass and forbs are expected to increase, which should improve forage opportunities.

Road Densities
Total open road densities within the SAFR project, MA-7, or biological winter range will not change with Alternatives 2 and 3. There will be no new road construction to inc

Forest Plan Amendment
With the Forest Plan Amendments to the Deschutes LRMP (USDA 1990) outlined in this EA, Standards and Guidelines are consistent with management direction for mule deer. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Late and Old Structural Stands
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Within the SAFR project approximately 77% of the LOS identified is planned for treatment. Table 58 describes what treatments will occur by PAG.

Table 58: LOS within the SAFR project

PAG	Treatment	Acres	Percent of LOS
Ponderosa Pine	Burn	6	Less than 1
	Mastication and Burn	203	5
	No Treatments	1,063	27
	Thin and Burn	11	Less than 1
	Thin and Mastication	23	1
	Thin, Mastication, and Burn	2,598	65
	Treat Plantation	72	2
	Total	**3,976**	**100**
MCD	Mastication and Burn	44	13
	No Treatments	156	47
	Thin, Mastication, and Burn	134	40
	Total	**334**	**100**
MCW	No Treatments	67	97
	Thin, Mastication, and Burn	2	3
	Total	**69**	**100**

Approximately 3,090 (71%) acres of identified LOS are scheduled to be treated. These treatments will reduce canopy cover and change some stands from multi-storied to single storied. However, no trees over 21" dbh will be removed. In addition, the stands will still function as LOS post treatment. It is the goal of the SAFR project to return large portions of a once fire dominated landscape to a state where fire can be re-introduced. Treatments proposed in the SAFR project will move the LOS stands in that direction.

Thinning, mastication, and/or burning in approximately 2,913 acres of LOS will move the ponderosa pine PAG towards the historic condition where stands were composed of mature ponderosa pine and ponderosa pine regeneration in relatively even-age groups, with minor amounts of Douglas-fir and white fir in the overstory and many areas with grass understories. These conditions will mimic those outlined in Whychus watershed analysis (1998) historical references.

Thinning, mastication, and/or burning in approximately 178 acres of LOS will move the mixed conifer dry PAG towards the historic condition where stands were composed of ponderosa pine in the overstories with relatively open understories. These conditions will mimic those outlined in Whychus watershed analysis (1998) historical references.

Thinning, mastication, and burning identified in approximately 2 acres of mixed conifer wet PAG are designed to move stands towards the historic condition where stands were comprised of primarily of early seral species with some areas having dense understories of pine and fir.

No trees larger then 21 inches dbh will be removed and the prescriptions will be thin from below so the largest trees on the landscape will be left. Treatments will not move stands out of LOS, they will move stands from multiple story highly stocked stands to historic single story stand conditions that could sustain fire entries.

Approximately 443 acres are identified for treatment that meet the definition of LOS and occur within an allocated Old Growth Management Area (MA 15). All but three of those acres occur within the ponderosa pine PAG. Within the Old Growth Management Area prescriptions will be written to provide sustainable habitat conditions for the northern goshawk as outlined in the Deschutes LRMP.

In areas currently LOS there are a limited number of large trees available. Many of the future large trees are within overstocked stands, which will increase the amount of time the trees will take to start functioning as LOS. Thinning stands will reduce competition, increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees.

Mastication and burning treatments are also proposed. These treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuel treatments will reduce fire risk and will reduce competition to established trees, further increasing the stands resiliency to wildfire.

The SAFR project is consistent with Standards and Guidelines outlined in the Regional Forester's Forest Plan Amendment #2 (1995) that are applicable. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Connectivity

Alternative 2 – Proposed Action / Alternative 3

Direct/Indirect Impacts: In areas identified as no treatment current connectivity would remain. Connectivity across the landscape would decrease with the proposed action by reducing canopy cover in areas treated (Table 59). After a discussion with the project silviculturist (Brian Tandy) we assumed that treatments would move the percent canopy closure outlined to the next lower percentage. For example, if the no action has 100 acres that have a canopy cover of 50% or greater post treatment that 100 acres would have a canopy closure of 40 to 49%.

Table 59: SAFR Project Area Connectivity on National Forest Lands.

Percent Canopy Closure in 9 inch DBH Trees and Greater	No Action Acres	Alt. 2 and Alt. 3 Acres	Change in Acres from Alt. 1 to Alt. 2 and 3
0 to 19 %	13,613	17,921	4,308
20 to 29%	6,753	4,285	-2,468
30 to 39%	2,884	1,390	-1,494
40 to 49%	661	598	-63
50% and Greater	542	259	-283

Management direction pertaining to maintaining connectivity between late and old structured stands, as well as allocated old growth management areas is provided by the Eastside Screens.

Eastside Screen direction is to maintain or enhance the current level of connectivity between LOS stands and between all LRMP designated old growth habitats by maintaining stands between them. LOS stands and old growth habitats need to be connected to each other inside the project area, as well as, to adjacent project areas by at least two directions. Connectivity corridor stands should be those in which medium diameter or larger trees are common, and canopy closures are within the top one-third of site potential. Stand widths should be at least 400 feet wide at their narrowest point. If stands meeting this description are not available then the next best stands should be used for connections. The length of corridors between LOS stands and old growth management areas should be as short as possible (Eastside Screens).

Consistent with Eastside screens, wildlife connectivity corridors were designated to connect Old Growth Area allocations MA-15 within and adjacent to the project area. In addition LOS stands were also connected. Figure 30 shows the identified connectivity corridors.

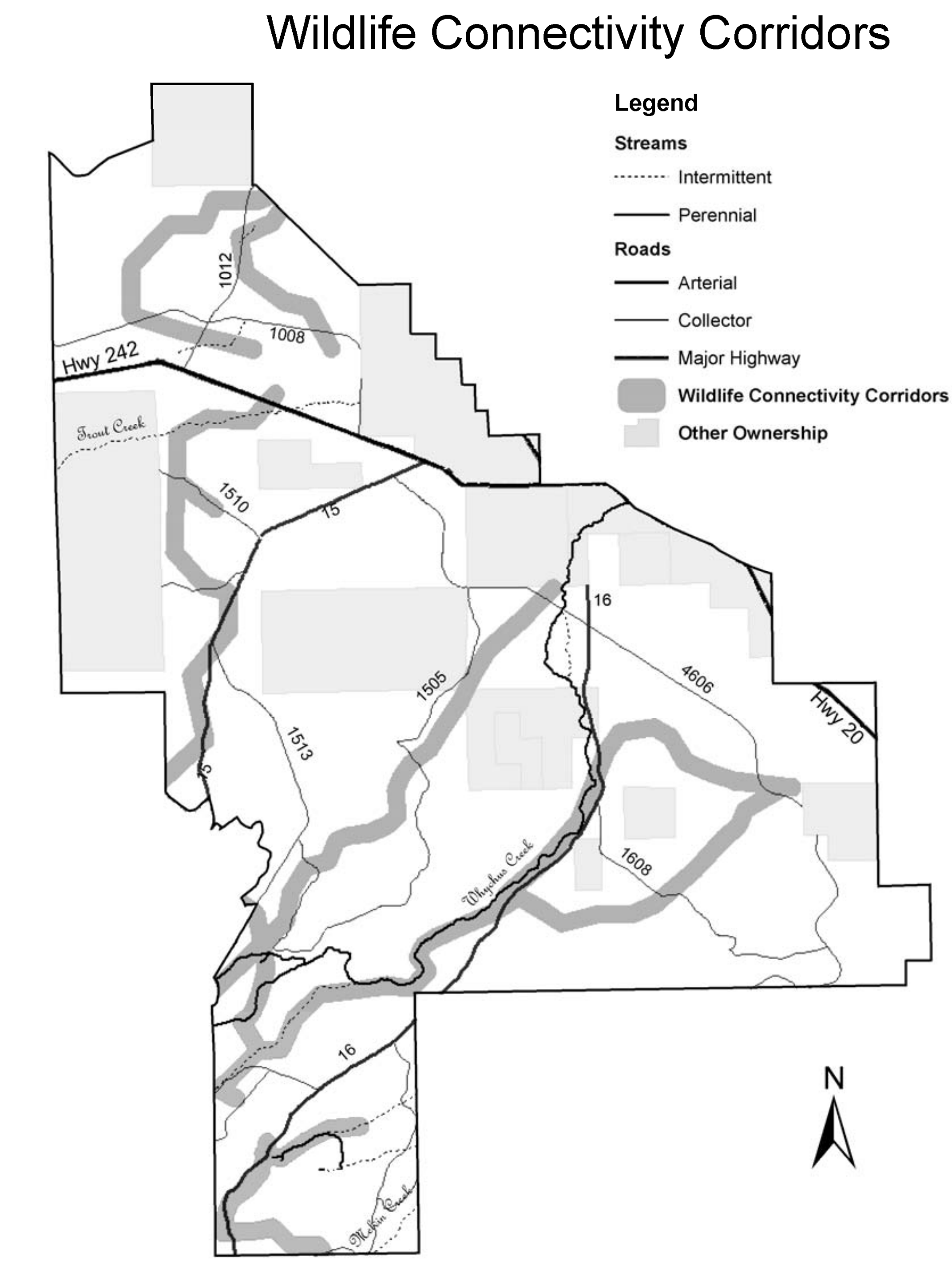


Figure 29: Wildlife Connectivity Corridors within the SAFR Planning Area

Treatments within wildlife connectivity corridors were designed to maintain canopy cover in the corridors. Prescribed burning will occur within the identified connectivity corridor. In addition mechanical treatment of brush and trees up to 4 inches dbh would be permitted. No additional thinning would occur in the corridors. Areas in which the connectivity corridors and evacuation and access routes overlap will be treated as described above. In addition, areas where the connectivity corridors and defensible space overlap, adjacent to private lands (approximately 106 acres) lands will be treated as described for defensible space with the exception that all trees 12 inches dbh and larger will be retained to provide canopy cover. Treatments occurring within the connectivity corridor would reduce understory tree density but would not affect the density of medium or large diameter trees and would not degrade or eliminate any of the connectivity corridors.

The SAFR project is consistent with Standards and Guidelines regarding connectivity are outlined in the Regional Forester's Forest Plan Amendment #2 (1995). For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Special or Unique Habitat and Associated Species
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: There are no known direct impacts to the springs or seeps associated with any alternative. The four spring/seeps are in areas that have been identified as no treatment. There are no impacts to spring and seeps associated with this project. There will be no change in the function of springs and seeps.

The SAFR project is consistent with Standards and Guidelines outlined in the Deschutes National Forest LRMP (USDA 1990) and is applicable for special or unique habitat and associated species.

Snags
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Treatments within the project area will break up the fuel continuity and reduce the risk of a landscape scale fire event, which should reduce the risk to individual large snags and trees. Green trees 21 inches and greater (future large snags) will not be removed. Snags will not be targeted for removal, but there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments, but due to OSHA regulations snags posing a hazard may be felled. Levels of live tree retention in all units will provide adequate numbers of green tree replacements to provide future snag and down log levels.

Future large snags are a concern; many green trees are in overstocked stands, which will increase the time it takes the trees to reach desired size and height. Thinning overstocked stands will reduce competition which should increase growth rates to the remaining trees. Cochran and Barret (1999a) were able to show 30 years after thinning there were large differences in average tree sizes among different group stocking levels. They also showed the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees.

Within the areas that have prescribed fire identified, there is also potential of converting large snags into down wood. Burning prescriptions along with thinning and mowing prior prescribed fire should reduce the chance of losing large snags. However, it is assumed that a percentage of large snags will be affected by prescribed burning. Randall-Parker and Miller (2002) found fall prescribed fires in Arizona resulted in turning 20% of the snags into down wood. In the Randall-Parker and Miller study 1,000 fuel moistures ranged form 13 to 16 %. Fall prescribed fire 1,000 hour fuel moistures are similar in the SAFR project area, so similar results can be expected.

The SAFR project is consistent with Standards and Guidelines outlined in the Regional Forester's Forest Plan Amendment #2 (1995) applicable for snags. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

Down Wood

Alternative 2 – Proposed Action / Alternative 3

Direct/Indirect Impacts: Green trees 21 inches and greater (future large snags) will not be removed. Snags and down wood are not targeted for removal, but there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments, but due to OSHA regulations snags posing a hazard may be felled. Snags over 10 inches dbh that are determined to be safety hazards will be felled and left as down wood.

Future large down wood (currently smaller green trees) are a concern, many are in overstocked stands, which will increase the time it takes the trees to reach desired size and height. Thinning overstocked stands will reduce competition which should increase growth rates to the remaining trees. Cochran and Barret (1999a) were able to show 30 years after thinning there were large differences in average tree sizes among different group stocking levels. They also showed the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees. Thinning is expected to reduce down wood recruitment in the short-term, however in the long-term there will be more large trees that can be recruited into down wood.

Within the areas that have prescribed fire identified, the potential exists to recruit down wood. Burning prescriptions along with thinning and mowing prior prescribed fire should reduce the chance of losing large snags. However, it is assumed that a percentage of large snags will be affected by prescribed burning. Randall-Parker and Miller (2002) found that fall prescribed fire in Arizona resulted in turning 20% of the snags into down wood. In addition, down wood that is on the ground is at the risk of being consumed. The same study by Randall-Parker and Miller (2002) found that 50% of the down logs were consumed in the Arizona prescribed fires. In the Randall-Parker and Miller study

1,000 fuel moistures ranged form 13 to 16 %. Fall prescribed fire 1,000 hour fuel moistures are similar in the SAFR project area, so similar results can be expected.

For the SAFR project 20 to 40 lineal feet of down wood in ponderosa pine and 100-140 lineal feet of down wood in mixed conifer will remain per acre with no more than 3 inches of total consumption, as outlined in the Eastside Screens.

In areas that do not have prescribed fire as part of the treatments, all current down wood will remain.

The SAFR project is consistent with Standards and Guidelines outlined in the Regional Forester's Forest Plan Amendment #2 (1995) applicable for down wood. For detailed Standards and Guidelines and rationale please see the SAFR Wildlife Report for Non-TES species.

WOODPECKERS (CAVITY NESTERS)
Lewis' Woodpecker, White-headed Woodpecker, Pygmy Nuthatch
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Disturbance may occur during treatments which may result in altering foraging locations or behavior for Lewis' woodpecker, white-headed woodpecker and pygmy nuthatch. Approximately 16,312 acres of ponderosa pine habitat will receive treatment. However, green trees 21 inches and greater will not be removed. In addition large snags are not targeted for removeal, but there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments. However, it is assumed that some level of direct impact would occur, as OSHA regulations requirements would result in those impacts.

Thinned areas will open up stands which should benefit Lewis' woodpecker, pygmy nuthatch, and white-headed woodpeckers. Thinning will open up site distances around nests, which should help these species with predator avoidance around nest sites. In addition the thinning will reduce ladder fuels associated with large trees. Ladder fuel reduction will decrease the risk of losing the remaining large trees. In addition, removal of the understory in overstocked stands will decrease the competition for nutrients and water, which should also lower the susceptibility to insects and disease. An important benefit from thinning is the reduction in beetle caused mortality (Cochran and Barret 1999a). Cochran and Barret (1999b) also showed crown widths were significantly greater in the absence of understory vegetation. Using the assumption that larger crown widths equate to more crown to forage on should increase the quality of habitat for white-headed woodpeckers and pygmy nuthatches in areas treated.

Currently there are a limited number of large snags and trees available as well as replacement large trees. Many of the future large trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size and height. Thinning stands will reduce competition, increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees. Increasing growth rates will benefit pygmy nuthatches, Lewis' woodpeckers, and white-headed woodpeckers by creating more available suitable habitat.

Proposed mastication and burning treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuels reduction will reduce fire risk and competition between established trees, increasing stand resiliency to wildfire. Fuels treatments will also reduce the understory complexity, which will lower small mammal densities. A reduction in small mammal populations should reduce predation pressures on white-headed woodpecker nest sites.

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for Lewis' woodpeckers, white-headed woodpeckers, and pygmy nuthatches. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Williamson's Sapsucker, Pileated Woodpecker
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Approximately 835 acres of mixed conifer habitat will receive treatment. However, green trees 21 inches and greater will not be removed. In addition large snags are not targeted for removal, but there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments, but it is assumed that some level of direct impact would occur, as OSHA regulations requirements would result in those impacts.

In untreated habitat (approximately 1,065 ascrs), there will continue to be an increased risk from disturbance, although breaking up the fuel continuity across the landscape will reduce the risk of a larger scale disturbance event. In addition some of the areas identified for no treatment occur within higher site potential areas (i.e. riparian habitat conservation areas), sites capable of producing large trees with greater canopy closure. These areas have the potential to provide habitat.

In areas identified for thinning, canopies will be opened up and stand densities reduced to lessen the risk of a large-scale event (insects, disease, or fire). Thinning will directly reduce canopy cover, but it will also reduce the fire risk to individual stands by breaking up the fuel continuity across the landscape, reducing the risk of larger scale disturbance events. However, each unit identified for thinning will leave 10% in retention clumps. These areas will have a higher stocking rate and will provide some diversity of canopy cover across the landscape. Thinning treatments are expected to reduce pileated woodpecker habitat, but should still provide Willamson's sapsucker habitat if snags are currently available.

Mastication and burning treatments are also proposed. These treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuel treatments will reduce fire risk and will reduce competition to established trees, increasing the stands resiliency to wildfire.

Overall, the treatments described above will aid in the development a more resilient landscape to disturbance. A resilient landscape should produce more stable habitat for Willamson's sapsuckers and pileated woodpeckers in the future (depending on stocking levels and site potential).

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for Williamson's sapsuckers. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Flammulated Owl
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Approximately 3,093 acres of mature forest will receive treatment. However, green trees 21 inches and greater will not be removed. In addition large snags are not targeted for removal, but there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments, but it is assumed that some level of direct impact would occur, as OSHA regulations requirements would result in those impacts.

Thinned areas within flammulated owl habitat will reduce ladder fuels associated with large trees. Ladder fuel reduction will decrease the risk of losing the remaining large trees. In addition, removal of understory in overstocked stands will decrease the competition for nutrients and water, which should also lower the susceptibility to insects and disease. An important benefit from thinning is the reduction in beetle caused mortality (Cochran and Barret 1999a). In addition the thinned areas should create more open understories for foraging. The 10% retention clumps that will occur within treatments units will create dense thickets next to openings, which should benefit flammulated owl habitat.

Currently there are a limited number of large snags and trees available as well as replacement large trees. Many of the future large trees and snags are within overstocked stands, prolonging development of trees of the desired size and height. Thinning stands will reduce competition increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees. Thinning will reduce the time it takes to produce the size of trees that flammulated owl utilize for nesting.

Proposed mastication and burning treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuels reduction will reduce fire risk and competition between established trees, increasing stand resiliency to wildfire. Fuels treatments will also reduce the understory complexity.

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for flammulated owls. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Red-naped Sapsucker
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: There will be no known direct effects to red-naped sapsuckers. Disturbance may occur during treatments altering their foraging patterns. Approximately 6 acres will be burned and less than one acre will be fenced. However, aspen are not targeted for removal. In addition large snags are not targeted for removal, but there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments, but it is assumed that some level of direct impact would occur.

Aspen restoration is a small-scale treatment within the project area but will result in increased habitat diversity. Aspen restoration will result in small openings in the short term. However openings will stimulate growth of herbaceous plants and induce suckering of aspen. Treatments will benefit aspen stands in the long-term and create suitable habitat for the red-naped sapsucker.

OTHER BIRDS OF CONCERN

Chipping Sparrow and Brewer's Sparrow
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: There are approximately 7,033 acres of proposed treatments within ecotypes 1 and 2. Thinning, mastication, and burning that occur within ecotype 1 will reduce canopy closure and move those areas towards historical conditions, which will improve habitat in the long term for Brewer's sparrow.

Approximately 5,756 acres of ponderosa pine are identified for no treatment. In these areas understories may be too dense to be utilized by chipping sparrows. Approximately 16,312 acres of ponderosa pine are proposed for thinning, mastication, and burning. The treatments will move the ponderosa pine towards conditions that better meet the habitat requirements of chipping sparrows. Thinning from below will create more open understories. Retaining 10% of each unit in clumps should leave pockets of shrubs and regenerating pine. In ponderosa pine approximately 1,436 acres are identified for thinning which will open understories. In these areas shrub levels will remain at current levels. With a variety of treatments occurring across the project in ponderosa pine more habitat should be available for chipping sparrows post treatment. These treatments should move ponderosa pine closer to historical conditions.

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for chipping sparrow and Brewer's sparrows. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Olive-sided Flycatcher
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Approximately 835 acres of the mixed conifer is proposed to be treated with prescribed fire. Prescribed fire areas that occur adjacent to areas that are not burned have the potential to create edge that is identified as olive-sided flycatcher habitat.

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for olive-sided flycatchers. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Brown Creeper
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Approximately 835 acres of mixed conifer will receive treatment. However, trees 21 inches and greater will not be removed. In addition large snags are not targeted for removal. However, there is a possibility for incidental loss of snags during treatments. Generally, snags would be avoided during treatments. However, it is assumed that some level of direct impact would occur, as OSHA regulations requirements would result in those impacts.

In areas thinned there will be a reduction of ladder fuels surrounding large trees. The reduction in ladder fuels will decrease risk of loss to the remaining large trees. In addition, removal of understory in overstocked stands will reduce competition for nutrients and water, which should lower the susceptibility to insects and disease. An important benefit for thinning is the reduction in beetle caused mortality (Cochran and Barret 1999a).

Currently there are a limited number of large trees available and replacement large trees are another concern. Many of the large trees are within overstocked stands, which will increase the amount of time the trees will take to get to the desired size. Thinning stands will reduce competition increasing growth rates to the remaining trees. A study conducted by Cochran and Barret (1999a) determined there were large differences in average tree sizes among different group stocking levels, 30 years post treatment. They also determined the growth rates of the 20 largest diameter trees per acre were reduced by competition from smaller trees.

Mastication and burning treatments are also proposed. These treatments will reduce both activity fuels and overall fuel loadings to acceptable levels. Fuel treatments will reduce fire risk and will reduce competition to established trees, further increasing the stands resiliency to wildfire. Fuels treatments will also reduce the understory complexity.

Negative effects of treatments may result in large snags being removed for safety purposes reducing large snag habitat. However, large snag loss is expected to negligable as snags are not identified for removal.

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for brown creepers. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Hermit Thrush
Alternative 2 – Proposed Action / Alternative 3
Direct/Indirect Impacts: Approximately 992 acres will remain untreated and should continue to provide habitat for hermit thrushes. There are approximately 835 acres of mixed conifer that are proposed to be treated with the proposed action. Canopy cover and amount of understory will be decrease in these areas, which will reduce hermit thrush habitat suitability. However, treatments in the LOS will move the mixed conifer dry PAG towards the historic condition where stands were composed of ponderosa pine in the overstories with relatively open understories conditions will mimic those outlined in Whychus watershed analysis historical references. Treatments within the mixed conifer wet PAG are designed to move stands towards the historic condition where stands were comprised primarily of early seral species with some areas having dense understories of pine and fir.

The SAFR project is consistent with the Landbird Conservation Strategy Biological Objectives for hermit thrushes. For detailed rationale of how the project is meeting the objectives please see the SAFR Wildlife Report for Non-TES species.

Cooper's and Sharp-shinned Hawks
Cumulative Impacts: Due to the high percent canopy cover the Cooper's and sharp-shinned hawks require for nesting territories on the Sisters RD have historically been located within the mixed conifer PAGs. Therefore, mixed conifer PAGs on the Sisters Ranger District will be used in the cumulative impacts analysis. The mixed conifer PAGs experienced moderate to heavy mortality with the insect outbreak of the early 1990's with impacts occurring a few years later. This event had the greatest influence on Cooper's and sharp-shinned hawk habitat across the district due to the reduction of canopy cover prior to the fires of 2002 through 2006. These open stands are considered unsuitable nesting habitat for these two species.

Several large wildfires have occurred on district in the past 6 years – Eyerly, Cache Mountain, Link, B&B, Black Crater, and Lake George. An estimated 28,100 acres of mixed conifer forests experienced stand replacement fire further reducing cover in this forest type. Not every acre of the mixed conifer forests were considered suitable for these two species but all stand replacement habitat is now considered unsuitable. The recent fires have negated many of the impacts of past management actions within the fire areas (e.g. Corridor Follow-up, Happy Jack, Jack Canyon, North Slope, and Santiam Corridor).

Activities identified under the Eyerly Fire Salvage project, Coil Fiber, Lower Jack Reoffer and B&B Fire Recovery timber sales did not impact Coopers and sharp-shinned hawk habitat since suitable habitat was avoided and concentrated primarily on the removal of dead material within stand replacement burned areas. In addition, several vegetation management projects have occurred or may occur within suitable habitat (McCache, Metolius Basin Forest Management Project, Big Bear, Bear Garden, Broken Rim, Walla Bear, Davis Creek Thinning, Highway 20, and West Trout). Overall, treatments proposed will reduce the risk of loss of existing habitat from other large-scale disturbances. However, stand densities were reduced within treatment units below suitable conditions used for nesting in many areas.

An estimated 148,600 acres of potentially suitable habitat still remains in the mixed conifer habitat type after the impacts of the fires and past vegetation management projects due to the overstocked conditions of many forested stands in addition to existing mature and old growth stands.

Cumulatively, with ongoing forest management projects, less than 1% additive reduction in suitable habitat is expected. Across the district, Cooper's and sharp-shinned hawk populations are expected to decline due to the loss of nesting habitat from the fires and past projects. Populations would begin to recover several decades after the forested habitat develop.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the Cooper's and sharp-shinned hawks.

Great Blue Heron

Cumulative Impacts: Riparian areas on the Sisters Ranger District will be used to analyze cumulative impacts for the great blue heron. Trends are indicating increased recreation levels within our national forests. Much of this use is concentrated around waterbodies/waterways. Increased recreation use along waterways may deter use by herons for nesting. However, road closures identified within riparian reserves (Jack Canyon, McCache, Metolius Basin, and B&B Fire Recovery project areas) will aid in reducing disturbance potential for nesting great blue herons. In addition, two project managing vehicles to reduce impacts to riparian have been implemented on the district. The Whychus Creek Restoration project and the Bulltrout Stream Restoration project restricted vehicle traffic within the riparian area along Abbot, Brush, Candle, Canyon, Jack, Roaring, and Whychus Creek.

Fire suppression has resulted in degradation of some meadows across the district due to conifer encroachment and the accumulation of deep thatch layers, further reducing foraging habitat. Meadow enhancement has been implemented in two meadows within the past 5 years (Glaze meadow and Trout Creek Swamp) and is planned for more areas in the future, which may enhance foraging habitat.

Implementation of fisheries projects (Canyon Creek Crossing, Metolius Down Wood, and Incidental Hazard trees by adding down woody material to streams, etc.) will aid in promoting healthy riparian reserves, increasing prey species and foraging habitat.

Cumulatively, less than 1% additive reduction in suitable habitat is expected with the implementation of this project.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the great blue heron.

Golden Eagle

Cumulative Impacts: Historically, golden eagle habitat most likely occurred on the eastern edge of the district in the ponderosa pine PAG. Therefore, the ponderosa pine PAGs on the Sisters Ranger District will be used to analyze cumulative impacts to golden eagles. There has been a history of timber harvest within the ponderosa pine. This past activity is one of the reasons acres of large tree habitat for golden eagles are currently below the historic range of variability (HRV). For example, within the ponderosa pine PAG's in the Whuychus watershed, acres dominated by medium and large size tree classes have decreased by 88% (USDA 1998). Other factors reducing golden eagle habitat across the district is the forest consists of denser stands of trees. These dense stands make flight through the forest difficult for the large eagles that prefer more open habitats. Historic open grown single story old-growth ponderosa pine stands were probably more suitable for the large golden eagles to both nest and forage in.

Past vegetation management projects (e.g. B&B Fire Recovery, Bear Garden, Big Bear, Broken Rim, Coil Fiber, Lower Jack Re-offer, Metolius Basin Forest Vegetation Management Project, McCache, and Walla Bear) have occurred at higher elevations in areas most likely not historically occupied by golden eagles. The Eyerly Fire Salvage project is the one exception. In the Eyerly Fire Salvage there were no large live trees removed and large snags were targeted for retention (i.e. trees 25 inches and greater dbh).

Historically, management activities did not promote the maintenance or improvement of large tree habitats. However, under current management direction, activities are being designed to move vegetative conditions towards their HRV which will promote and maintain golden eagle habitat across the district.

Treatments are expected to benefit eagles in the long term by creating large trees with large branches and creating a more open pine forest, which should increase the foraging opportunities for golden eagles. Cumulatively, the project is expected to increase suitable habitat for golden eagles with the implementation of this project.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the golden eagle.

Northern Goshawk

Cumulative Impacts: Due to the dense canopy cover the northern goshawks require for nesting territories on the Sisters Ranger District, they have historically been located within the mixed conifer PAGs. Therefore, mixed conifer PAGs on the Sisters Ranger District will be used in the cumulative impacts analysis.

The majority of nest sites on the Sisters RD are located within the mixed conifer PAGs (14 of 18). These PAGs experienced moderate to heavy mortality with the insect outbreak of the early 1990's with impacts occurring a few years later. This event probably had the greatest influence on goshawk habitat across the district due to the reduction of canopy cover prior to the fires. These open stands are considered unsuitable nesting habitat for goshawks.

Several large wildfires have occurred on district in the past 6 years – Cache Mountain, Eyerly, Link, B&B, Black Crater, and Lake George fires. The recent fires have eliminated nesting habitat and negated many of the impacts resulting from past management projects (e.g. Corridor Follow-up, Happy Jack, Jack Canyon, North Slope, and Santiam Corridor). In addition, past vegetation management projects outside the fire area have resulted in a reduction in habitat (approx. 1,990 acres) by harvesting dead and dying trees (e.g. Bear Garden, Big Bear, Broken Rim, and Walla Bear). Activities implemented under the Eyerly Fire Salvage project, Coil Fiber, Lower Jack Reoffer, and B&B Fire Recovery timber sales did not impact goshawk habitat since suitable habitat was avoided. In addition, three vegetation management are already happening or may occur within suitable goshawk habitat (McCache, Metolius Basin Forest Management Project, and West Trout). Measures were incorporated to retain suitable nesting habitat for each project area as well as enhance habitat conditions. Overall, treatments proposed will improve goshawk habitat conditions by promoting the development of large structure and reducing the risk of loss of existing habitat from other large-scale disturbances.

An estimated 30 miles of roads have been decommissioned across the district. In addition, 60 miles of decommissioning was implemented under the Metolius Basin project. These closures, along with the road closures for the B&B project (approximately 60 miles), will aid in reducing the disturbance potential to existing nest sites and will lessen fragmentation leading to reduced disturbance potential to future nest sites.

Past thinning projects, BAER activities, hazard tree removal, and fuels treatments did not impact goshawk nesting or fledging habitat. Thinning occurred in stands that are not yet considered habitat due to the small average diameter of the trees. Hazard trees may have removed some trees within potential habitat however, this is minor in scope and limited to a very small area along roads primarily. Fuels treatments reduced brush levels which may have altered foraging habitat somewhat.

Private lands are not managed for goshawk habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term.

Goshawk populations are expected to decline across the district due to the loss of nesting and fledgling habitat from the fires of 2002 through 2006. Most of the currently known nests are expected to remain active territories, especially with associated road closures and subsequent reduction in human disturbance. Fledging and dispersing goshawks, however, will likely have difficulty in establishing new territories due to limited habitat availability and increased competition for what remains. Cumulatively, less than 1% additive reduction in suitable habitat is expected with the implementation of this project due to the protection of known sites and the limited amount of mixed conifer plant association that is being treated.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the goshawk.

Osprey

Cumulative Impacts: Osprey feed primarily on fish therefore RHCA's surrounding lakes, wetlands, and fish bearing streams on the Sisters Ranger District will be used to analyze cumulative impacts. The fires over the past 5 years have created a large influx of snag habitat however within the riparian reserves snag creation has not occurred at such a large scale. Currently there are 16,260 acres of riparian reserves surrounding lakes, wetlands, and fish bearing perennial streams on the Sisters Ranger District. Approximately 14% of the potential osprey habitat in riparian reserves have experienced stand replacement fire, resulting in short term snag habitat and the direct loss of known nest sites, particularly in the Eyerly fire.

Habitat was enhanced under the Metolius Basin Forest Vegetation Management project. Measures were incorporated to retain suitable habitat as well as enhance habitat conditions. Overall, treatments proposed will improve osprey habitat conditions in the long term by promoting the development of large structure, protecting large snag habitat within riparian reserves, and reducing the risk of loss of existing habitat from other large-scale disturbances. Riparian reserves had not been entered with past vegetation management projects except for site specific instances since 1994.

Danger trees are routinely removed from recreation facilities (campgrounds, summer home tracts, etc.) and major travel routes. Continued loss of large snag habitat in and adjacent to recreation facilities and major travel routes due to safety reasons limits available nesting sites along suitable water bodies (e.g., Suttle Lake, Metolius River, Lake Billy Chinook). Most danger trees removed do not occur directly on the shoreline in most cases but do occur within the riparian reserve. Large snag habitat outside designated recreation areas is important to retain since most, if not all, large snag habitat will eventually be lost in the recreation sites over time.

Past thinning projects, BAER activities, and fuels treatments did not impact osprey nesting habitat. Thinning and fuels treatments generally occurred outside riparian reserves. The BAER activities did occur within riparian reserves but overall habitat will be enhanced by providing more stable habitat over time.

Private lands are not managed for osprey habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term.

Cumulatively, less than 1% additive reduction in suitable habitat is expected with the implementation of this project due to the limited amount of work occurring in riparian areas.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the osprey.

Red-tailed Hawk

Cumulative Impacts: The Sisters Ranger District will be used to analyze cumulative impacts for red-tailed hawks. Activities proposed under the Eyerly Fire Salvage project, Coil Fiber, and Lower Jack Re-offer timber sales did not impact red-tailed hawk habitat since impacts to suitable habitat was minimized by retaining large snags. Other ongoing forest management projects and hazard tree removal may have reduced nesting habitat in the watershed. Past management projects occurring outside the fire areas have also resulted in a slight reduction of habitat by harvesting dead and dying trees (e.g. Bear Garden, Big Bear, Broken Rim, and Walla Bear). However, snag retention guidelines and green trees remained in treatment units.

Past thinning projects, BAER activities, and fuels treatments did not impact red-tailed hawk habitat. Thinning occurred in stands not yet considered habitat due to the small average diameter of the trees and fuels treatments may have helped to improve foraging habitat by reducing brush layers and opening up the understory.

Habitat was enhanced under the Metolius Basin Forest Vegetation Management project. Measures were incorporated to retain large tree and snag habitat as well as enhance habitat conditions. Overall, treatments proposed will improve red-tailed hawk habitat conditions by promoting the development of large structure and reducing the risk of loss of existing habitat from other large-scale disturbances.

Private lands are not managed for red-tailed hawk habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term.

Cumulatively, red-tailed hawk populations are expected to remain stable across the district due to their generalist behavior. There may be increased competition for remaining nest sites among this species and other large raptor species. Also distribution of red-tailed hawks across the district may become more patchy, focusing on low-severity burn areas near open habitat. Long-term there may be a decrease in the populations due to the long period of time before late seral habitat develops for nesting (due to salvage efforts and ongoing projects) and the newly created foraging areas will become grown over with shrubs and small trees.

Cumulatively, less than 1% additive reduction in suitable habitat is expected with the implementation of this project.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the red-tailed hawk.

Waterfowl
Cumulative Impacts: Activities proposed for the SAFR project will not incrementally add to cumulative impacts as there are no direct or indirect effects/impacts associated with the project for this species.

American Marten
Cumulative Impacts: The majority of potentially suitable habitat outside the wilderness on the Sisters RD is located within the mixed conifer and lodgepole PAGs. Therefore, mixed conifer, mountain hemlock, and lodgepole PAGs higher than 3,400 feet in elevation and a canopy cover of 40% or greater on the Sisters Ranger District will be used in the cumulative impacts analysis. The mixed conifer PAG experienced moderate to heavy mortality with the insect outbreak of the early 1990's with impacts occurring a few years later. Currently, the lodgepole pine PAG is experiencing a mountain pine beetle infestation primarily within the Three Sisters Wilderness. A large area approximately ranging from south of Black Crater to Three Creeks Lake and about 3-4 miles wide is now showing signs of mass mortality within the lodgepole and high elevation PAGs. This may lead to unsuitable habitat conditions for the marten as stands lose their canopy cover further reducing potential habitat on the district. These events probably had the greatest influence on marten habitat outside the wilderness due to the reduction of canopy cover prior to the fires. These open stands are not considered suitable for martens.

Several large wildfires have occurred on district in the past 6 years – Cache Mountain, Eyerly, Link, B&B, Black Crater, and Lake George. Abundant down woody material will be present on the landscape due to these events however canopy cover will be absent. The recent fires have negated many of the impacts resulting from past management projects (e.g. Corridor Follow-up, Happy Jack, Jack Canyon, North Slope, and Santiam Corridor).

Activities proposed under the Eyerly Fire Salvage project, Coil Fiber, and Lower Jack Reoffer timber sales did not impact marten habitat since suitable habitat was avoided. Most vegetation management projects do not impact marten habitat greatly as treatments are focused on the reduction of stand densities by thinning from below (e.g. Bear Garden, Big Bear, Broken Rim, and Walla Bear). Large tree habitat and abundant down woody material are not proposed to be removed.

An estimated 30 miles of roads have been decommissioned across the watersheds. These closures, along with closures implemented for the B&B project (60 miles), will lessen fragmentation leading to reduced disturbance potential.

Past hazard tree removal, BAER activities, thinning projects, riparian restoration projects, and wildlife enhancement projects did not impact marten habitat. Thinning occurred in stands that are not yet considered habitat due to the small average diameter of the trees. Fuels treatments reduced brush levels which may have reduced fire risk to existing habitat.

Because a majority the potential habitat has experienced some sort of disturbance (fire or insect), marten populations will likely decrease across the district. Actions to reduce fragmentation, human disturbance, and the loss of dead and downed wood will create more fire-resilient habitat that will closer mimic historic conditions benefiting marten populations in the long-term.

Cumulatively, less than 1% additive reduction in suitable habitat is expected with the implementation of this project due to the limited amount of mixed conifer and lodgepole plant associations being treated.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the marten.

Elk

Cumulative Impacts: The Sisters Ranger District will be used to discuss cumulative impacts to elk. Several large vegetation management projects have occurred in the past several years. These include Big Bear, Bear Garden, Broken Rim, Highway 20, Jack Canyon, McCache, Santiam Corridor, Happy Jack, Walla Bear, Canal Thinning, BBR Fuels, Davis Creek Thin, and Underline. With the exception of Highway 20, all occurred within summer range and were developed to address the mass mortality caused by insects in the early 1990's. Within these project areas, there has been an overall decrease in cover. However, stands were declining or dead, and as a result cover was also decreasing. Down woody material levels also increased across the landscape. This provides added benefits in the form of hiding cover, especially in calving areas; but abundant down woody material levels also impede movement and increase the risk of loss of existing cover to a large fire event. An increase in forage also resulted in these project areas. This forage increase may have helped to increase the health and vigor of resident herds using the area leading to increased survival rates.

During the summers of 2002 through 2006 large wildfires occurred on the district. Summer forage values were expected to increase dramatically within the fire areas with the re-sprouting of forbs and shrubs. This prediction held true with an explosion of grasses, forbs, and shrubs occurring throughout the fire areas. It was also noted through casual observation, increases in the amount of elk within the fire areas.

An estimated 30 miles of roads have been decommissioned across the district. In addition, 60 miles of decommissioning was implemented under the Metolius Basin project. These closures, along with closures for the B&B project (60 miles), will aid in reducing disturbance to big game and reduce the potential for noxious weed spread. Additional noxious weed treatments will continue and aid in enhancing potential habitat.

Private lands are not managed for big game habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term. A large portion of the identified biological elk winter range is located on private lands to the south and east of the SAFR project area.

Big game populations are expected to increase across the district due to the increase in foraging habitat and reduced road densities. Use patterns are expected to change as well due to the loss of cover.

The action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the elk.

Mule Deer

Cumulative Impacts: The Sisters Ranger District is being used as the scale for analysis for big game, in particular winter range, MA-7. Based on that review, the potential cumulative impacts are those discussed below.

Several large vegetation management projects have occurred in the past several years. These include Big Bear, Bear Garden, Broken Rim, Highway 20, Jack Canyon, McCache, Santiam Corridor, Happy Jack, Walla Bear, Canal Thinning, BBR Fuels, Davis Creek Thin, and Underline. With the exception of Highway 20, all occurred within summer range and were developed to address the mass mortality caused by insects in the early 1990’s. Within these project areas, there has been an overall decrease in cover. However, stands were declining or dead and cover would have been lost overtime. Down woody material levels also increased across the landscape. This provides added benefits in the form of hiding cover, especially in fawning areas; but abundant down woody material levels also impede movement and increase the risk of loss of existing cover to a large fire event. An increase in forage also resulted in these project areas. This forage increase may have helped to increase the health and vigor of resident herds, leading to increased survival rates.

The Highway 20 project area was located within deer transition range and MA-7. Approximately 1,044 acres were treated with this project. The Metolius Basin project area was the first vegetation management project planned to occur within biological winter range. Overall, an estimated 12% of the winter range on the Sisters Ranger District is proposed to be treated with the Metolius Basin project. This area is not as important as other portions of the winter range in that snow conditions may preclude use for much of the winter. It was noted in the Metolius Mule Deer Winter Range Plan that approximately 90% of the deer occupying the Metolius Basin area during the summer move toward the east to the high plains area for the winter months.

During the summers of 2002 through 2006 several wildfires occurred on the district. Summer forage values were expected to increase dramatically within the fire areas with the re-sprouting of forbs and shrubs. This prediction held true with an explosion of grasses, forbs, and shrubs occurring throughout the fire areas. It was also noted through casual observation, increases in the amount of big game use within the fire areas.

An estimated 30 miles of roads have been decommissioned across the district. In addition, 60 miles of decommissioning was implemented under the Metolius Basin project. These closures, along with road closures for the B&B project (60 miles), will aid in reducing disturbance to big game and reduce the potential for noxious weed spread. Additional noxious weed treatments will continue and aid in enhancing potential habitat.

Past hazard tree removal, BAER activities, and riparian restoration projects did not impact big game habitat. These projects were small in scope compared to big game needs.

Private lands are not managed for big game habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term.

Over the district taking into account past and ongoing projects, deer cover habitat (hiding cover and thermal cover) has been reduced and foraging habitat increased. Reductions in cover were not as great in the winter range as they were in summer and transition range. High road densities on the district can compound the impact of a lack of cover. This could result in a shift in habitat use patterns by deer.

Deer populations are expected to increase across the district due to the increase in foraging habitat and reduced road densities. Use patterns are also expected to change due to the loss of cover.

With the Forest Plan Amendment (see Proposed Amendment #1, page 22) action alternatives are consistent with the Deschutes National Forest Land and Resource Management Plan Standards and Guides for the mule deer.

Further Evaluation of Road Densities

To further evaluate road densities within the SAFR project area thirteen subwatersheds were analyzed. These subwatersheds occur within or near the SAFR project boundary. As displayed in Table 60, eight of the thirteen subwatersheds (Deep Canyon, Fourmile Butte, Lower Indian Ford, Lower Trout Creek, Middle Whychus Creek, Three Creek, Upper Indian Ford, and Upper Whychus Creek) have open road densities that range from 2.7 to 5.5 miles per square mile of land exceeding the 2.5 mile target for further evaluation.

Table 60: Road Densities for the SAFR Project Further Evaluation

SUBWATERSHEDS	Open road density April 1 through Nov. 30	Open road density Dec. 1 through March 31
BULL CREEK	2.3	1.7
DEEP CANYON	2.9	0.5
FOURMILE BUTTE	2.7	2.7
HEADWATERS WHYCHUS CREEK	0.9	0.9
LOWER INDIAN FORD	3.3	3.3
LOWER TROUT CREEK	5.5	5.5
LOWER WHYCHUS CREEK	0.2	0.2
MIDDLE WHYCHUS CREEK	3.6	1.7
THREE CREEK	3.9	3.4
TRIANGLE HILL	1.7	0.9
UPPER INDIAN FORD	4.1	4.1
UPPER WHYCHUS CREEK	4.3	4.3
UPPER TROUT CREEK	1.2	1.2

Both action alternatives propose the construction of temporary roads and the re-opening of currently closed roads to access treatment sites. The majority of the SAFR project treatments will occur within the Lower Trout Creek and Upper Whychus Creeks (5.5 and 4.3 miles respectively). While big game animals would tend to move away from the logging and road use disturbance there are security areas available in the Headwaters of Whychus Creek, Lower Whychus Creek, and Upper Trout Creek subwatersheds.

Because the project purpose and need is to reduce the risk of large-scale forest loss to insects, tree diseases, and wildfire, the proposed activities would be consistent with managing big game habitats for the long-term. Maintaining a well distributed mix of forage and cover blocks for the long-term in each subwatershed is a desired objective. Losing these habitat components in a large event similar to the B&B fire should be avoided. For example, the B&B fire created over 30,500 acres of early-seral habitats. While early-seral stages will provide abundant forage for several decades, an event of this magnitude and intensity did not leave blocks of cover scattered within the interior of the fire. The SAFR project while converting some stands from hiding and security cover to a more open forest condition, would reduce the likelihood of another event of this magnitude from occurring. Either alternative would provide a balanced habitat condition for deer on their summer and winter ranges.

This evaluation concludes that the net effect of the SAFR proposed activities on big game is consistent with Forest Plan wildlife objectives for the following reasons.

- While some subwatersheds may exceed the 2.5 miles per square mile target averaged over the entire subwatersheds there are areas within each subwatershed with lower road densities to provide habitat effectivness.

- The temporary roads will be obliterated after the completion of all harvest and fuels related activities.
- All currently closed roads re-opened for access to treatment units will be closed to vehicular traffic after the completion of forest management activities.
- Implementation of the SAFR project would result in no net increase in open road densities after project completion.
- While the action alternatives propose 17,560 acres of treatments not all of this would be ongoing at the same time so big game security acreage would be available in all subwatersheds.

Late and Old Structural Stands
Cumulative Impacts: The Sisters Ranger District will be used to discuss cumulative impacts to LOS. Prior to the late 1980s, loss of suitable old growth was limited to timber harvest. Between the late 1980s and early 1990s the district experienced a spruce budworm epidemic resulting in the degradation or loss of a large amount of old growth habitat in the mixed conifer. The Sisters Ranger District has approximately 197,190 acres that have trees greater than 21" when utilizing the PI layer that was constructed based on photo interpretation from the 1995 aerial flights. Harvest activities occurred in approximately 3,710 acres (Big Bear, Corridor Follow-up, Davis Creek Thin, Demo, Happy Jack, Jack Canyon, Santiam Corridor, Twin Swamp, and Walla Bear).

Fires have also reduced old growth habitat across the forest. Since 1995 approximately 59, 290 acres of LOS were located in wildfires (B&B, Black Crater, Cache, Cache Mountain, Dugout, Eyerly, Lake George, Link, Park Meadow, Pole Creek, and Street Creek). In the past four years, fires have reduced old growth habitat on the Sisters Ranger District. While not all acres within those fires were considered old growth a majority of the old growth within those acres was lost to stand replacement events.

Planned activities and recent harvest activities (Metolius Basin Vegetation Management, McCache, and West Trout) are aimed at reducing risk to existing habitat and promoting desired species composition to develop and maintain habitat.

Cumulatively, the action alternatives will not lead to a trend toward Federal listing for species that utilize LOS habitats.

Connectivity
Cumulative Impacts: The Sisters Ranger District will be used to discuss cumulative impacts to connectivity. Prior to the late 1980s, loss of connectivity was limited to timber harvest. Between the late 1980s and early 1990s the district experienced a spruce budworm epidemic resulting in the degradation or loss of a large amount of connectivity in the mixed conifer. Recent harvest activities (Big Bear, Corridor Follow-up, Davis Creek Thin, Demo, Happy Jack, Jack Canyon, Santiam Corridor, Twin Swamp, and Walla Bear) reduced connectivity.

Fires have also reduced connectivity creating fragmented habitat across the forest. In the past five years, fires have reduced connectivity on the Sisters Ranger District. Connectivity losses have occurred within the wildfires (B&B, Black Crater, Cache, Cache Mountain, Dugout, Eyerly, Lake George, Link, Park Meadow, Pole Creek, and Street Creek) on the Sisters Ranger District. While not all acres within those fires were considered connectivity most of the connectivity within those acres was reduced to the fire events.

With connectivity corridors in place fragmentation of LOS stands should not occur with the action alternatives.

Snags and Down Wood
Cumulative Impacts: The Whychus watershed will be used to discuss cumulative impacts to snags and down wood. Timber harvest, fire suppression, road construction, wildfire, and firewood cutting have impacted the distribution and density of snags and down wood across the analysis area. These activities have created the existing condition of dead wood habitats in the analysis area.

Harvest activities have occurred within the analysis area over the last 30 years. Past harvest activities including regeneration harvest, overstory removal, and salvage that occurred prior to 1988 would have removed most or all overstory trees, snag, and down wood habitat.

Harvest activities occurring between 1988 and 1994 retained minimal snag and down wood habitat. It is assumed that harvest units occurring within this time frame retained 1 to 4 snags per acre.

Sales planned west of the spotted owl line after 1994 utilized the Northwest Forest Plan standards and guidelines and followed Late-Successional Reserve Assessment guidelines by plant association group, which ranged from 4 to 13 snags and per acres depending on the plant association group and 120 linear feet of down wood at least 16 inches in diameter and 16 feet long. Sales planned after 1995 east of the owl line utilized the Eastside Screens, which calls for 2.25 snags 20 inches dbh or greater per acre and 20 to 40 lineal feet per acre in ponderosa pine and 100-140 lineal feet per acre in mixed conifer.

Shelterwood harvest prescriptions (1975 to present) retained 8 to 20 live overstory trees providing for some future large snag and log habitat as the younger stand develops into a mature stand, but would have eliminated the understory and mid-story cover and feeding substrate. Removal of snags does not normally occur with this treatment however incidental removal occurs due to safety reasons.

A western spruce budworm epidemic occurred within the analysis area starting in the late 1980s and continued into the early 1990s in the mixed conifer plant association west of Trout Creek Butte (USDA 1998). Tree mortality and defoliation occurred throughout. This event produced a small pulse of dead wood habitat at slightly elevated levels.

Within the Whychus watershed two wildfires occurred in the early 1990's, the Delicious and Stevens Canyon Fires. Two wildfires also occurred in 2006, the Black Crater and Lake George. These events created pulses of higher snag and down wood densities than would normally occur with natural succession. These high density snag rich areas are short-lived on the landscape with most snags falling down within 25 years.

Danger tree activities include the routine removal of snags along roads, high use recreation areas, and facilities. This activity occurs approximately 160 feet (one site potential tree height) either side of roads and from high use areas. Snag habitat remains in these areas however as they pose a danger to the public or facilities they are removed, therefore these areas are not managed for this habitat component. An annual danger tree removal project occurs focusing on recreation areas like campgrounds. Snag levels continue to decline around these facilities.

Fuels reduction projects include mowing, burning, and thinning stands from below. Burning varies but may include underburning, jackpot burning of concentrations, pile burning, or some combination of these activities. A reduction in down woody material is usually associated with these activities with some incidental snag loss. Material impacted primarily includes smaller size classes (<15"dbh) and those in more advanced decayed stages (Decay Classes 3-5). These treatments, although some minor impacts occur, reduce the risk of loss to existing large snags and logs by reducing fuel levels and ladder fuels.

Future vegetation management projects include the West Trout and Glaze Meadow projects, which will focus on reducing understory vegetation to reduce risk of loss from wildfire. It is assumed that snags will not be impacted however, smaller sized down woody material may be depending on treatments proposed. Overall, these impacts are expected to be minor and material for future recruitment will be available in the remaining stands.

Cumulatively, the action alternatives will not lead to a trend toward Federal listing for species that utilize snag or down wood habitats

WOODPECKERS (CAVITY NESTERS)

Cumulative Impacts

The Sisters Ranger District will be used to discuss cumulative impacts to cavity nesters. Several large wildfires have occurred on district in the past 5 years – Cache Mountain, Eyerly, Link, B&B, Black Crater, and Lake George. These fires reduced available habitat for white-headed and pileated woodpeckers as well as Williamson's sapsuckers. In addition the fires reduced flammulated owl and pygmy nuthatch habitat. The fires have created habitat for Lewis' woodpecker in areas of larger ponderosa pine that were in stand replacement events.

Work is occurring under the B&B Fire Timber Sales, Eyerly Fire Salvage, Coil Fiber, and Lower Jack Reoffer timber sales. Activities under these timber sales are not impacting pileated woodpecker, Williamson's sapsucker, flammulated owl, or pygmy nuthatche habitat since suitable habitat was avoided and concentrated primarily on the removal of dead material within stand replacement burned areas. The removal of dead wood within stand replacement areas is removing potential habitat for the white-headed and Lewis' woodpecker. Although, approximately 91% of the B&B Fire and approximately 70% of the Eyerly Fire remained untreated. In the treated areas, snag retention guidelines were designed to leave appropriate dead wood habitat available.

In addition, several vegetation management projects have occurred or may occur within suitable habitat (McCache, Metolius Basin Forest Management Project, BBR Fuels, and Highway 20). Overall, treatments proposed will reduce the risk of loss of existing habitat from other large-scale disturbances. Treatments reduced stand densities but focused on retaining large structure. However, stand densities (regenerating trees) and shrubs were reduced within treatment units impacting habitat for the short term until regeneration occurs again. Mowing and burning were widely prescribed and will maintain grassy understories, which should benefit flammulated owls.

An estimated 30 miles of roads have been decommissioned across the district. In addition, 60 miles of decommissioning is proposed under the Metolius Basin project. These closures, along with closures for the B&B project (60 miles), will aid in reducing disturbance potential to existing territories and the potential for noxious weed spread. Additional noxious weed treatments will continue and aid in enhancing potential habitat.

Private lands are not managed for above mentioned species. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term.

Cumulatively, the alternatives will not lead to a trend toward Federal listing for the for white-headed woodpecker, Lewis' woodpecker, pileated woodpecker, Williamson's sapsucker, flammulated owl, or pygmy nuthatch.

Birds of Conservation Concern that were addressed above were analyzed to show effects of the SAFR Project. To better understand how these bird species are doing over a larger scale, the Breeding Bird Surveys (BBS) were used to look at population trends within Oregon (Sauer et al. 2005). Table 61 shows trend data for these species.

Table 61: Trend data from BBS for Birds of Conservation Concern

Bird Species	**Trend***
White-headed woodpecker	Slight Increase
Pygmy nuthatch	Slight Increase
Lewis' woodpecker	Slight Decline
Pileated woodpecker	Slight Increase
Williamson's sapsucker	Slight Decline
##Flammulated owl	Decline
** Red-naped sapsucker	Slight Increase
##There is no data in the BBS for flammulated owls. However, source habitat has	

decreased (Wisdom et al. 2001).
*** In the BBS three species of sapsuckers are combined for Oregon.*

Table 62 shows predicted changes in habitat over time for the Sisters Ranger District of the Deschutes National Forest.

Table 62: Predicted changes in habitat over time for cavity nesters.

Bird Species	Trend*	Reason for Change
White-headed woodpecker	Increase	Increase in thinning and prescribed fire acres, which will increase late and old structural single story ponderosa pine forests.
Pygmy nuthatch	Increase	Increase in thinning and prescribed fire acres, which will increase late and old structural single story ponderosa pine forests.
Lewis' woodpecker	Increase	Increase in uncharacteristic fire within ponderosa pine creating habitat. Some acres have already been created.
Pileated woodpecker	Decrease	Increase in uncharacteristic large wildfire events resulting in a reduction of late successional mixed conifer stands.
Williamson's sapsucker	Decrease	Increase in uncharacteristic large wildfire events resulting in a reduction of late successional mixed conifer stands.
Flammulated owl	Decrease	Increase in uncharacteristic large wildfire events resulting in a reduction of late successional mixed conifer stands.
Red-naped sapsucker	Increase	Wildfire and mechanical treatments of aspen stands.

Special or Unique Habitat and Associated Species
Cumulative Impacts: There are no known impacts to springs and seeps from the proposed action.

Cumulatively, the alternatives will not lead to a trend toward Federal listing for species associated with springs or seeps.

OTHER BIRDS OF CONCERN

Cumulative Impacts: The Sisters Ranger District will be used to discuss cumulative impacts to Bird of Conservation Concern and Landbirds. Several large wildfires have occurred on district in the past 6 years – Cache Mountain, Eyerly, Link, B&B, Black Crater, and Lake George. These fires reduced available habitat for brewer's and chipping sparrow, as well as olive-sided flycatchers, brown creepers, and hermit thrushes.

Work is occurring under the Butte, Booth, Little, Eyerly Fire Salvage, Coil Fiber, and Lower Jack Reoffer timber sales. Activities under these timber sales are not impacting Brewer's sparrow, chipping sparrow, olive-sided flycatchers, brown creepers, or hermit thrushes habitat since suitable habitat was avoided and concentrated primarily on the removal of dead material within stand replacement burned areas.

In addition, several vegetation management projects have occurred or may occur within suitable habitat (McCache, Metolius Basin Forest Management Project, BBR Fuels, and Highway 20). Overall, treatments proposed will reduce the risk of loss of existing habitat from other large-scale disturbances. Stand densities (regenerating trees) and shrubs were reduced within treatment units impacting habitat for the short term until regeneration occurs again. Mowing and burning were widely prescribed and will maintain grassy understories, which should benefit chipping sparrows.

Olive-sided flycatcher habitat was enhanced under the Metolius Basin Forest Vegetation Management project. Measures were incorporated to retain large trees as well as enhance habitat conditions. Treatments proposed will improve habitat conditions by promoting the development of large structure, reducing stand densities, and reducing the risk of loss of existing habitat from other large-scale disturbances. Other ongoing forest management projects (Bear Garden, Big Bear, Broken Rim, Walla Bear, and McCache) and danger tree removal may have reduced nesting habitat on the district. Therefore, nesting habitat may be the limiting factor for occupation on the district.

In addition, several vegetation management projects have occurred or may occur within suitable brown creeper habitat (McCache, Metolius Basin Forest Management Project, Big Bear, and Bear Garden). Treatments proposed will reduce the risk of loss of existing habitat from other large-scale disturbances. Treatments reduced stand densities but focused on retaining large structure.

The McCache, Metolius Basin Forest Management Project, Big Bear, and Bear Garden. vegetation management projects have occurred or may occur within suitable hermit thrush habitat. Treatments proposed will reduce the risk of loss of existing habitat from other large-scale disturbances. Stand densities were reduced below suitable nesting conditions in many areas and mowing and burning were widely prescribed.

An estimated 30 miles of roads have been decommissioned across the district. In addition, 60 miles of decommissioning was implemented under the Metolius Basin project. These closures, along with closures for the B&B project (60 miles), will aid in reducing the disturbance potential to existing territories and the potential for noxious weed spread. Additional noxious weed treatments will continue and aid in enhancing potential habitat.

Private lands are not managed for Brewer’s sparrow, chipping sparrow, olive-sided flycatcher, brown creeper, or hermit thrush habitat. Therefore, it is assumed that any habitat provided by these parcels is incidental and may not be long term.

The project is consistent with the conservation strateygy for Landbirds of the East-Slope of the Cascade Mountains in Oregon (Altman 2000) for Brewer’s, chipping sparrow, olive-sided flycatcher, brown creeper, and hermit thrush habitat.

Birds of Conservation Concern that were addressed above were analyzed to show effects of the SAFR Project. To better understand how these bird species are doing over a larger scale, the Breeding Bird Surveys (BBS) were used to look at population trends within Oregon (Sauer et al. 2005). Table 63 shows trend data for these species.

Table 63: Trend data from BBS for Birds of Conservation Concern and Landbirds.

Bird Species	Trend*
Brewer's Sparrow	Slight Decline
Chipping Sparrow	Decline
Olive-sided Flycatcher	Sharp Decline
Brown Creeper	Slight Increase
Hermit Thrush	Slight Decrease

*Information from BBS 1966-2004 (Sauer et al. 2005).

Table 64 shows predicted changes in habitat over time for the Sisters Ranger District of the Deschutes National Forest.

Table 64: Predicted changes in habitat over time for Birds of Conservation Concern and Landbirds

Bird Species	Trend*	Reason for Change
Brewer's Sparrow	Slight Decline	Increase in prescribed fire and wildfire acres, which reduces sagebrush and bitterbrush across the landscape.
Chipping Sparrow	Increase	Increase in prescribed fire acres, which will increase grassy openings within ponderosa pine forests.
Olive-sided Flycatcher	Decline	Increase in uncharacteristic large wildfire events resulting in large tracts of stand replacement fires, which reduces available edge habitat.
Brown Creeper	Decline	Increase in uncharacteristic large wildfire events resulting in a reduction of late successional mixed conifer stands.
Hermit Thrush	Decline	Increase in uncharacteristic large wildfire events resulting in a reduction of late successional mixed conifer stands.

Soil Productivity

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Soil Productivity Report. Reference information is contained in the full specialist report.

Scope of the analysis

The long term sustainability of forest ecosystems depends on the productivity and hydrologic function of soils. Ground disturbing management activities directly affect soil properties, which may adversely change the natural capability of soils and their potential responses to use and management. A detrimental soil condition often occurs where heavy equipment or logs displace surface organic layers or reduce soil porosity through compaction. Detrimental disturbances reduce the soils ability to supply nutrients, moisture, and air that support soil microorganisms and the growth of vegetation. The biological productivity of soils relates to the amount of surface organic matter and coarse woody debris retained or removed from affected sites. Therefore, an evaluation of the potential effects on soil productivity is essential for integrated management of forest resources.

The soil resource may be directly, indirectly, and cumulatively affected within each of the activity areas proposed within the project area. An activity area is defined as "the total area of ground impacted activity and its feasible unit for sampling and evaluating" (FSM2520 and Forest Plan, page 4-71). For this project proposal, activity area boundaries are considered to be the smallest identified area where the potential effects of different management practices would occur. Thus, the discussion of soil effects and soil quality standards will be focused on the units proposed for silviculture and fuel reduction treatments. The activity areas range in size from a few acres to several hundred acres. Where appropriate and relevant, the effects discussion is expanded to the planning area to provide additional context and intensity.

Quantitative analyses and professional judgment were used to evaluate the issue measures by comparing existing conditions to the anticipated conditions which would result from implementing the Action Alternatives. The temporal scope of the analysis is defined as short term effects being changes to soil properties that would generally revert to pre existing conditions within five years or less, also considered the effectiveness and probable success of implementing the management requirements, mitigation measures, and Best Management Practices (BMPs) which are designed to avoid, minimize or reduce potentially adverse impacts to soil productivity.

Affected Environment

The SAFR Project area is located on the lower eastern flanks of the volcanic Cascade Range in Oregon, where essentially all landforms, rocks, and soil materials are derived from volcanism and glaciations. Approximately 90 percent of the planning area is comprised of gently sloping uneven lava plains. Ridges, buttes, narrow draws, wet meadows, and bottomlands make up less than 10 percent of the planning area. Slopes generally range from 0 to 30 percent with the exception of steeper side slops (30 to70) associated with ridge escarpments and buttes that comprise less than 5 percent of the area.

Elevations range from about 3,400 feet at the eastern end of the planning area to 3,900 feet to the North West. Mean annual precipitation averages between 12 and 16 inches, increasing from east to west. Except for a few small cinder cones and relatively minor areas of barren lava flows, dominant overlaying soils have developed form volcanic ash and pumice deposits that vary from 10 to 40 inches thick. These materials consist mainly of loose, fine sand size soil particles with little or no structural development.

The sandy textures of these ash influenced soils have high infiltration and percolation rates that readily drain excess moisture over much of the project area. The underlying residual soils and bedrock materials have a moderate capacity to store water. Most of the water yielded from these lands is delivered to streams as deep seepage and subsurface flows. Three perennial streams within the planning area include Whychus Creek, Pole Creek, and Black Pine Spring. Trout Creek is a perennial stream that flows from the west into the planning area where it flows intermittently during the winter and spring (see Hydrology/Fisheries section).

The project area contains 23 land type units based on similarities in landforms, geology, and climatic conditions that influence defined patterns of soil and vegetation (Soil Resource Inventory, Larsen, 1976). The biophysical characteristics of these land type units can be interpreted to identify hazards, suitabilities, and productivity potentials for natural resource planning and management.

The dominant ash influenced soils are moderately deep (20 to 40 inches) with fine loamy sand textures and low to moderate productivity potential for the growth of vegetation. Soils derived from volcanic ash and pumice deposits tend to be non cohesive (loose) and they have very little structural development due to the young geologic age of the volcanic parent materials. As is typical of volcanic ash soil types these soil types have naturally low soil bulk densities and the majority of the soil organic matter and plant nutrients concentrated in the surface soil horizon.

Mechanical disturbances can result in increases in soil bulk density, increases in soil strength (increased resistance to penetration), and changes in soil pore size distribution.

This in turn can reduce the soils ability to function in a desirable manner. Due to the absence of rock fragments within the soil profiles, these soils are well suited for tillage treatments (subsoiling) that loosen compacted soil layers and improve the soils ability to supply nutrients, moisture, and air that support vegetative growth and biotic habitat for soil organisms. The sandy textured surface layers are also easily displaced by equipment operations, especially during dry moisture conditions. The maneuvering of equipment is most likely to cause soil displacement damage on steeper landforms. Due to their lack of plasticity and cohesion, the dominant sandy textured soils within the project area are not susceptible to soil puddling damage.

On undisturbed sites with gentle slopes, surface erosion occurs at naturally low rates because soils are protected by vegetation and organic litter layers. Surface erosion by water is generally not a concern because dominant land types have gentle slopes and low to moderate erosion hazard ratings. Accelerated surface erosion is usually associated with disturbances that reduce vegetative cover, displace organic surface layers, or reduce soil porosity through compaction. Soils derived form volcanic ash are easily eroded where water becomes channeled on disturbed sites such as road surfaces, recreation trails, and logging facilities.

Land Suitability and Inherent Soil Productivity

The suitable lands database for the Deschutes National Forest LRMP identifies areas of land which are considered to be suitable for timber production using criteria affecting reforestation potential (FSH 2409.13). This data was developed to designate a broad scale timber base area for forest wide planning purposes. Lands that do not meet these criteria are considered unsuitable or partially suitable for timber harvest due to regeneration difficulties or the potential for irreversible damage to resource values from management activities.

Dominant land types within the SAFR Planning area generally have low to moderate productivity ratings. All activity areas proposed for commercial and /or non commercial thinning treatments meet the criteria for land suitability that would allow them to be regenerated or resist irreversible resource damage. The locations of the proposed activity areas exclude miscellaneous land types with site conditions and soil properties which are considered to be unsuitable for timber production.

Ecological types

Bitterbrush is a major component of the potential natural vegetation and is also an important food source for deer during the winter months (see wildlife specialist report, section under forage). Management direction regarding the management of shrubs is provided by the LRMP. The goal of the LRMP in Management Area 7, Deer Habitat, is to manage vegetation to provide optimum habitat conditions. The objective is to manage vegetation to provide optimum habitat considering the inherent productivity of the land. Recommendations for the management of shrubs are also provided by the Integrated Natural Fuels Management Strategy (IFMS 1998). The IFMS identified interim management goals of managing shrubs in shrub dominated landscapes (Deer Habitat MA-7) to have 33% of shrubs in an early seral condition, 33% in a mid seral condition, and 33% in a late seral condition. Currently 50% of MA-7 is within the late seral condition (Table 65)

Table 65: Shrub seral condition within MA-7 and Biological Winter Range.

Deer Habitat	Seral Condition	Acres (Percent)
MA-7	Early	1,036 (14%)
	Mid	1,906 (27%)
	Mixed	651 (9%)
	Late	3,559 (50%)
Biological Winter Range	Early	334 (5%)
	Mid	1,652 (22%)
	Mixed	723 (10%)
	Late	3,929 (53%)
	Unknown	749 (10%)

Ecological types were mapped for the project area using information on soil types and the potential natural vegetation. The potential natural vegetation may differ from the existing vegetation; however, the ecotype has the potential to produce the climax vegetation if disturbance events were to occur naturally. Three ecotypes were developed for deer winter range. They are: pine-juniper/sagebrush-bitterbrush/fescue, pine/bitterbrush/fescue, and pine/bitterbrush-manzanita /fescue. Each area shows differences in site productivity, fire risks, expected shrub recovery times and seral stages, and conversion potential to less desirable species.

Sensitive Soil Types

Based on criteria for identifying soils sensitive to management (Deschutes LRMP (Appendix 14, Objective 5), sensitive soils within the SAFR Project area include: 1) soils on slopes greater than 30 percent, 2) soils with seasonally high water tables, 3) soils located within the designated riparian habitat conservation areas (RHCAs). Less than one percent (944 acres) of the project area contains land types with localized areas of sensitive soils (Table 66).

Table 66: Land type acres that contain sensitive soils within the SAFR Project area (Soil Resource Inventory, Deschutes National Forest, 1996).

SRI Map Unit Symbol	Geomorphology (Representative landforms)	Type of Concern**	Land type Acres
68, 81,10	Soils on slopes greater than 30 percent	1&3	421
05, 08,	Soils with seasonally high water tables	2	548
05, 08, 10	Soils located within the designated riparian habitat conservation areas (RHCA's).	3	879

** Management Concerns

1) On slopes greater than 30 percent, loose sandy soils are susceptible to soil displacement.
2) Potentially wet soils with seasonally high water tables.
3) Soils within sensitive riparian areas and adjacent to streams thus increasing the potential for sediment delivery following soil disturbance.

Under Alternatives 2 and 3 no mechanical treatments would occur on slopes greater than 30 percent. Sensitive soil areas that occur within activity areas are discussed under the direct and indirect effects of implementing the management activities under the Action Alternatives.

Existing Condition

The current condition of soil within the SAFR Project area is directly related to soil porosity and the quantity and quality of surface organic matter within the planning area (Powers and Avery 1995). Ground disturbing management activities (i.e. timber harvest, road building, recreation) have caused some adverse changes to soil quality in previously managed areas, especially where mechanical disturbances removed vegetative cover, displaced organic surface layers, or compacted the soil.

Measure #1: Detrimental Soil Disturbance

Natural Disturbance

There is currently no evidence of detrimental soil conditions from natural disturbance events within the SAFR Planning area. The 2006 Black Crater fire burned 932 acres within the planning area; however, it burned at night at a low intensity and did not consume all of the surface soil litter and duff. Soil effects as a result of this burn were minimal; much like a prescribed fire would produce. Although other fires have occurred in the past enough time has passed since their occurrence that existing vegetation and forest litter are providing adequate sources of ground cover to protect mineral soil from water and wind erosion. There are no natural or management related landslides within the planning area. Therefore, natural soil disturbances were not included as existing sources of detrimental soil conditions within any of the activity areas proposed for this project.

Management Related Disturbances

In the 1920's and 1930's ground based railroad logging was used to harvest large diameter ponderosa pine over most of the eastern half of the planning area. Following this period the Forest Service acquired these lands through a land trade. Portions of the western half of the planning area was also rail road logged during this period, however, not as extensively as the area to the east. Visual evidence of this earlier logging on the soil resource is very difficult to observe due to vegetative growth and other ground cover. The establishment of native vegetation and accumulation of fine organic matter have helped to improve soil quality in these areas of past disturbance.

The degree, extent, distribution and duration of compacted soil can vary with the size and type of equipment used for forest vegetation management, volume and type of material being removed, frequency of entries, soil type and the soil conditions when the activity takes place (Froehlich 1976, Adams and Froehlich 1981, Gent et al. 1984, Snider and Miller 1985, Clayton et al. 1987, Miller et al. 1986, Page-Dumroese 1993). Soil monitoring results on local land types and similar soils have shown that 15 to 30 percent of the unit area can de detrimentally disturbed by ground-based harvest systems depending on harvest prescriptions and soil conditions at the time of harvest (Deschutes Soil Monitoring Reports, 1995, 1996, 1997 and 1999).

Based on more recent harvest history, various silvicultural treatments have been implemented since the rail road logging period. The primary sources of detrimental soil conditions are associated with the transportation systems used for timber harvest and yarding activities. Temporary roads, log landings, and primary skid trails were constructed and used to access individual harvest units of past timber sales. Most project related impacts to soils occurred on and adjacent to these heavy use areas. Mechanical disturbances include the removal of vegetative cover, displacement of organic surface soils, or compaction of the soil. Research studies and local soil monitoring have shown that soil compaction and soil displacement account of the majority of detrimental soil conditions resulting from ground based logging operations (Page-Dumroese 1993, Geist 1989, Powers 1999, Deschutes Soil Monitoring Reports).

Within the last decade several fuel treatment projects have been implemented within the planning area. Treatments have included the mowing of brush and the use of prescribed burning to both reduce fuels and provide a forest structure that will be more resistant to wildfires. Equipment used for these treatments is considerably smaller that that used to harvest timber and typically does not result in detrimental impacts to the soil resource. While prescribed burning does remove some of the surface organic matter, this process is a natural part of these ecosystems which historically experienced low intensity fire. These types of treatments also help to reduce the risk of impacts to the soil resource which can result from a high intensity uncharacteristic fires that could occur as a result of lack of management.

Soil condition assessments were conducted for a representative sample of past activities that include the following general prescriptions; partial removal harvest, regeneration harvest, mowing of brush and prescribed burning. Qualitative assessments of soil disturbance were made by establishing line transects and recording visual evidence of soil disturbance at 5 foot intervals within previously harvested areas (Howes et al. 1983). Detrimental soil compaction was the primary disturbance category observed where equipment operations were intensive on main skid trail systems, log landings, and existing roads.

Shovel probing was used to assess soil compaction using resistance to penetration as a measure. Soil displacement, as defined by FSM 2521.03, was more difficult to distinguish due to the establishment of native vegetation and the accumulation of forest litter. Observations suggested that equipment turns or movement generally caused more mixing of soil and organic matter than actual removal from a site. Based on the proportionate extent of overlap of sampled areas with the proposed activity areas, these field assessments results are included in the percentages of existing detrimental soil conditions discussed in the Environmental Consequences section.

Measure #2: Coarse Woody Debris (CWD) and Surface Organic Matter

The effects of management activities on soil productivity as well as other desired soil functions also depend on the amount of coarse woody debris (CWD) and surface organic matter retained or removed on affected sites. Due to the historical frequent fire occurrence within the ecological types in the planning area, there most likely were not large amounts of CWD historically. Observations of prescribed burns indicate that recruitment of CWD is significant process for maintaining adequate levels of CWD for desired soil functions. Prescribed fires commonly burn CWD on the ground while recruiting new materials through the killing of some trees as well as causing dead standing trees to fall to the ground. Observations indicate that through these processes CWD is maintained at an adequate level in areas of prescribed burns.

A balance between fuel management objectives and ensuring adequate amounts of CWD is an important goal for maintaining long term soil productivity. Using mycorrhizal fungi as a bio-indicator of productive forest soils, research studies were used to develop conservative recommendations for leaving sufficient CWD following management activities (Graham et al. 1994, Brown et al. 2003). To maintain soil productivity Graham et al. (1994), recommends retaining a minimum of 5 to 10 tons per acre of coarse woody debris (greater than 3 inches in diameter) on dry ponderosa pine sites and 10 to 15 tons of CWD per acre on mixed conifer sites. This level of CWD is consistent with the east side screens requirement of 20 to 40 lineal feet of down wood per acre for ponderosa pine sites and 100 to 140 lineal feet of down wood per acre for mixed conifer sites. A sufficient number of standing dead snags and /or live trees should also be retained for future recruitment of organic matter.

Conserving surface litter (i.e., organic materials such as pine needles, twigs and branches less than 3 inches in diameter) is also important for protecting mineral soil from erosion, buffering the effects of soil compaction, and supplying nutrients that support the growth of vegetation and native populations of soil organisms. The management goal is to provide a balance between fuel management objectives that will reduce the risk of soil impacts that may result from wildfire and the maintenance of enough surface litter to maintain soil functions.

It is expected that adequate amounts of coarse woody debris and surface organic matter currently exist to protect mineral soil from erosion and provide nutrients for maintaining soil productivity within the majority of activity areas. There are some older activity areas, prior to LRMP direction (1990), where management activities likely resulted in less than desired amounts of CWD on the ground. In other portions of the project area, fire suppression has resulted in vegetation conditions that have fuel loadings in excess of historic conditions. Although current levels of CWD and surface litter are not known for all activity areas, it is expected that previously managed areas have been improving towards optimum conditions as additional woody materials have accumulated through mortality, windfall, and recruitment of fallen snags over time. Annual leaf and needle fall, small diameter branches, twigs and other forest litter have increased organic matter levels for soil nutrient cycling.

Measure #3: Project Design and Mitigation

Cumulative levels of existing and predicted amounts of new soil disturbance need to be considered to determine whether soil quality standards will be met following project implementation. For activity areas that have already been impacted by previous management, project plans need to include options for avoiding, reducing, and mitigating adverse impacts for project activities to meet soil quality standards (see Mitigation Measures and Project Design Criteria).

Management Direction

The Deschutes Land and Resource Management Plan (LRMP) specifies that management activities are prescribed to promote maintenance or enhancement of soil productivity potential following land management activities (Forest Plan page 4-70, SL-1 and SL-3). This is accomplished by following Forest-wide standards and guidelines to ensure that soils are managed to provide sustained yields of managed vegetation without impairment of the productivity of the land. Standard and Guideline (SL-4) directs the use of rehabilitation measures when the cumulative impacts of management activities are expected to cause damage exceeding soil quality standards and guidelines on more than 20 percent of an activity area. Standard and Guideline (SL-5) limits the use of mechanical equipment in sensitive soil areas. Operations will be restricted to existing logging facilities (i.e., skid trails, landings) and roads whenever feasible.

LRMP Management Areas do not contain specific standards and guidelines for the soil resource. Forest wide standards and guidelines apply to this project proposal.

The Pacific Northwest Region developed soil quality standards and guidelines that limit detrimental soil disturbances associated with management activities (FSM 2520, R-6 Supplement No. 2500-98-1). This Regional guidance supplements LRMP standards and guidelines, which are designed to protect or maintain soil productivity. Detrimental soil impacts are those that meet the criteria described in the Soil Quality Standards listed below.

- Detrimental Soil Compaction in volcanic ash/pumice soils is an increase in soil bulk density of 20 percent, or more, over the undisturbed level.
- Detrimental Soil Puddling occurs when the depth of ruts or imprints is six inches or more.
- Detrimental Soil Displacement is the removal of more than 50 percent of the A horizon from an area greater than 100 square feet, which is at least 5 feet in width.
- Severely Burned Soils are considered to be detrimentally disturbed when the mineral soil surface has been significantly changed in color, oxidized to a reddish color, and the next one half inch blackened from organic matter charring by heat conducted through the top layer.

The Regional supplement to the Forest Service Manual (FSM 2520, R-6 Supplement No. 2500-98-1) provides policy for planning and implementing management practices which maintain or improve soil quality. This Regional guidance is consistent with LRMP interpretations for standards and guidelines SL-3 and SL-4 that limit the extent of detrimental soil conditions within activity areas.

When initiating new activities

- Management direction USDA Forest Service Regional Soil Quality Standards
  - Design new activities that do not exceed detrimental soil conditions on more than 20 percent of an activity area. (This includes the permanent transportation system).
  - In activity areas where less than 20 percent detrimental soil impacts exist from prior activities, the cumulative amount of detrimentally disturbed soil must not exceed the 20 percent limit following project implementation and restoration.
  - In activity areas where more than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration must, at a minimum, not exceed the conditions prior to the planned activity and should move conditions toward a new improvement in soil quality.
- Management direction USDA Forest Service east side screens
  - Down wood (if present) - Meet the standards listed below with pre-activiey and logging debris down wood. Do not fall materials to meet requirements.

- Ponderosa pine sites – Leave 20 to 40 lineal feet of down wood per acre with a small end diameter or 12 inches.
- Mixed conifer sites – Leave 100 to 140 lineal feet of down wood per acre with a small end diameter of 12 inches.

Desired Future Condition

Primary management goals for this landscape are described in the Purpose and Need statement. Management goals for the soil resource are to maintain or enhance soil conditions at acceptable levels which allow the soil to function in a desirable manner. The extent of detrimental soil disturbances will be minimized through the application of management requirements and mitigation measures designed to minimize, avoid or eliminate potentially significant impacts, or rectifying impacts in site specific areas by restoring the affected environment. The functioning of the soil is ensured by management prescriptions that retain adequate supplies of surface organic matter and coarse woody debris without compromising fuel management objectives and the risk of soil damage from large scale stand replacement wildfire.

Environmental Effects

The best information about the Action Alternatives was used in conjunction with the location of activities to analyze the potential effects on the soil resource. The potential for detrimental changes to soil physical properties was quantitatively analyzed by the extent (surface area) of temporary roads, log landings, and designated skid-trail systems that would likely be used to facilitate yarding activities within each of the proposed activity areas. Professional judgment was used to evaluate changes in the amount and composition of coarse woody debris and surface organic matter. These analyses also considered the effectiveness and probable success of implementing the soil mitigation and resource protection measures which are designed to avoid, minimize or reduce potentially adverse impacts to soil productivity.

The following section, Important Interactions, provides a discussion of the potential effects on soil and biological conditions from implementing the various vegetation management treatments. After this discussion, the environmental effects are presented and tracked by the issue measures used to evaluate the estimated impacts on soil productivity.

Important Interactions

The proposed management activities include commercial and non-commercial thinning of forest stands combined with fuel reduction treatments to reduce stand densities and hazardous fuels. Types of mechanical harvest equipment used in the thinning operation vary with the types of trees being removed. Thinning would include predominantly tress in the smaller diameter class. This may be accomplished manually using chainsaws or with the use of specialized low ground pressure machinery. Low ground pressure machinery would only be allowed to make a limited number of equipment passes to transport material to existing roads or other disturbed sites for use as firewood or processing wood fiber. Both hand piling and mechanical piling of slash may occur. Mechanical slash piling would be limited to working off of existing trails. Management activities also include mechanical shrub and small tree treatments (mowing or mastication) and the use of prescribed fire to reduce fuel loadings and treat the shrub layer.

There would be no new construction of roads that would remain as classified system roads. It was estimated that approximately 5 miles (total) of temporary road would be established or reopened to allow access to some of the activity areas proposed for mechanical vegetation treatments. Many of these spur roads would consist of reopening short segments of old access roads from previous entries. These temporary roads would be closed and obliterated upon completion of the vegetation management activities.

The effects of ground based logging disturbances on soil productivity vary based on the types of silvicultural treatments, the duration of activities, and the amount of ground disturbance with each entry. The cumulative amount of soil impacts also depends on existing conditions prior to entry, the ability to reuse previously established landings and skid trail systems, types of equipment, amount of material removed from treatment areas, operator experience, and contract administration.

Soil condition assessments for similar soils and types of harvest equipment, research references, local monitoring reports, SAFR field surveys and observation were used to predict the potential extent of detrimental soil disturbance associated with this project proposal (Deschutes Soil Monitoring Reports 1996, 1997, 1999, 2005). Estimates for predicted amounts of detrimental soil conditions account for the expected amount of volume removal, the type of logging equipment, the spacing of skid trails, and the number of log landings that would be needed to deck accumulated materials. Since the same types of mechanical treatments are proposed on similar land types and ash influenced soils, the nature of the effects to the soil resource is similar for project activities that use ground based equipment to accomplish management objectives.

Fuel Reduction Activities

A combination of treatments including thinning trees from below, mechanical treatment of small trees and brush, and prescribed burning would be used to reduce the fuel loading in the planning area.

Most of the slash generated from commercial harvest would be hand piled or machine piled and burned on log landings and/or main harvester trails. Machine piling on temporary roads or main skid trails would have a minimal effect on the overall extent of detrimentally disturbed soil because equipment would operate off the same logging facilities used during yarding operations. The same designated skid trail systems would be used as primary travel routes. The use of specialized equipment such as small backhoes with grapple arms, tracked excavators, and other low ground-pressure machines are capable of accumulating woody materials without moving appreciable amounts of topsoil into slash piles. This fuel reduction method would not cause additional soil impacts because the piling and burning would occur on previously disturbed sites that already have detrimental soil conditions.

Mechanical treatment of brush and small trees (mowing and mastication) would not cause detrimental soil displacement and increases in soil bulk density are inconsequential. The primary factors that limit soil compaction are the low ground pressure of the tractor and mowing heads, the limited amount of traffic (one equipment pass), and the cushioning effect of surface organic matter. These activities have been monitored in the past, and results show that increases in soil displacement and compaction do not meet the criteria for detrimental soil conditions (Soil Monitoring Report, 1997).

Prescribed fire would be used to reduce fuel accumulations in some of the activity areas proposed for mechanical harvest and non-commercial thinning as well as other activity areas where prescribed burning would be used exclusively to treat the shrub layer and reduce natural fuels. Prescribed burning activities are conducted at times and under conditions that maximize benefits while reducing the risk of resource damage. The degree of soil heating depends upon fuel type (grass, brush, trees), fuel density, nature of the litter and duff layers (thickness, moisture content), and burn conditions at the time of ignition. For the treatment areas proposed with this project, natural fuel accumulations consist mainly of fine fuels (i.e., decadent brush, tree branches, and needle cast litter) that typically do not burn for long duration and cause excessive soil heating. Therefore, it is expected that there would be no detrimental changes in soil properties from prescribed burning activities in timber stands because soil moisture guidelines would be included in burn plans to minimize the risk for intense ground-level heating.

Prescribed burn plans would comply with all applicable LRMP standards and guidelines and Best Management Practices (BMPs) prior to initiation of burn treatments. Soil heating during spring burns would be negligible because higher moisture levels at this time of year generally result in cooler burns with lower potential for causing severely burned soil. Fall burning would be conducted following brief periods of precipitation. Prescribed underburns in timber stands would be accomplished under carefully controlled conditions to minimize damage to standing trees. These activities are planned to meet fuel and visual management objectives without removing all of the protective surface cover. It is expected that adequate retention of coarse woody debris and fine organic matter (duff layer) would still exist for protecting mineral soil from erosion and supplying nutrients that support the growth of vegetation and populations of soil organisms. Fuel reductions achieved through planned ignitions usually burn with low-to-moderate intensities that do not result in severely burned soils. The effects of low-intensity fire do not easily consume material much larger than 3 inches in diameter, and charring does not substantially interfere with the decomposition or function of coarse woody debris (Graham et al., 1994). The successful implementation of these proposed activities would likely result in beneficial effects by reducing fuel loadings and wildfire potential as well as increasing nutrient availability in burned areas.

In most cases existing roads and other existing fuel breaks would be used to effectively control the spread of fire within treatment units. The extent of disturbed soil would be limited to the minimum necessary to achieve fuel management objectives.

Soil Restoration Treatments on Roads and Logging Facilities

Under Alternative 2 and Alternative 3 soil restoration treatments may be applied with a self-drafting winged subsoiler to reclaim and stabilize detrimentally compacted soil on specific roads and some of the primary skid trails and log landings following post-harvest activities. Additional treatment options for improving soil quality on disturbed sites include redistributing topsoil in areas of soil displacement damage and pulling available logging slash and woody materials over the treated surface.

Soils within the project area are well suited for tillage treatments due to their naturally low bulk densities and the absence of rock fragments within soil profiles. These sandy-textured soils have little or no structural development within the principal root development zone (4 to 12 inches in depth) where changes in soil compaction (bulk density) are assessed according to Regional direction (FSM 2521.03). Although equipment traffic during harvest operations can decrease soil porosity on these soil materials, compacted sites can be mitigated physically by tillage with a winged subsoiler (Powers, 1999).

The winged subsoiling equipment used on the Deschutes National Forest has been shown to lift and shatter compacted soil layers in greater than 90 percent of the compacted zone with one equipment pass (Craigg, 2000). Subsoiling treatments have been implemented with good success due to the absence of rock fragments on the surface and within soil profiles. Although rock fragments can limit subsoiling opportunities on some landtypes, hydraulic tripping mechanisms on this specialized equipment help reduce the amount of subsurface rock that could potentially be brought to the surface by other tillage implements. Most of the surface organic matter remains in place because the equipment is designed to allow adequate clearance between the tool bar and the surface of the ground for allowing smaller logging slash to pass through without building up. Any mixing of soil and organic matter does not cause detrimental soil displacement because these materials are not removed off site. Since the winged subsoiler produces nearly complete loosening of compacted soil layers without causing substantial displacement, subsoiled areas on this forest are expected to reach full recovery within the short-term (less than 5 years) through natural recovery processes.

Although the biological significance of subsoiling is less certain, these restoration treatments likely improve subsurface habitat by restoring the soils ability to supply nutrients, moisture, and air that support soil microorganisms. Research studies on the Deschutes National Forest have shown that the composition of soil biota populations and distributions rebound back toward pre-impact conditions following subsoiling treatments on compacted skid trails and log landings (Moldenke et al., 2000). The subsoiling specialist and trained crew members work with the equipment operator to identify locations of detrimentally compacted soil. Implementation and effectiveness monitoring is then conducted on treatment areas to assure that soil resoration objectives have been met.

Direct, Indirect and Cumulative Effects

The magnitude and duration of potential effects, both physical and biological changes in soil productivity, depend on the intensity of site disturbance, the timing and location of activities, and the inherent properties of the volcanic ash-influenced soils within affected activity areas. Direct effects occur at essentially the same time and place as the actions that cause soil disturbance, such as soil displacement and compaction from equipment operations. Indirect effects occur sometime after or some distance away from the initial disturbance, such as increased runoff and surface erosion from previously compacted areas. Cumulative effects include all past, present, and reasonably foreseeable actions that cause soil disturbance within the same activity areas proposed with this project.

Alternative 1 (No Action) – Ecological Trends

Measure #1: Detrimental Soil Disturbance

Under Alternative 1 (No Action), the management activities proposed in this document would not take place. No additional land would be removed from production to build roads or log landings for harvest and yarding operations. There would be no cumulative increase in detrimental soil conditions above existing levels. Although disturbed soils would continue to recover naturally from the effects of past management, the current extent of detrimental soil conditions would likely remain unchanged for an extended period of time.

Soil productivity would not change appreciably unless future stand-replacing wildfires cause intense ground-level heating that results in severely burned soils. Detrimental changes to soil properties typically result from extreme surface temperatures of long duration, such as the consumption of large diameter logs on the forest floor. Soil monitoring in the recent B&B and Eyerly fires indicate that approxomatly 2 percent of the burned area showed detrimental changes to soil propoerties as a result wildfire. Although hazardous fuels have been reduced in some previously managed areas, fire exclusion has resulted in undesirable vegetation conditions and excessive fuel loadings in other portions of the project area (see Fire/Fuels Section). Alternative 1 would defer fuel reduction opportunities at this time.

If a large amount of fuel is present during a future wildfire, soil temperatures can remain high for an extended period of time and excessive soil heating would be expected to produce detrimental changes in soil chemical, physical, and biological properties. Severe burning may cause soils to repel water, thereby increasing surface runoff and subsequent erosion. The loss of protective ground cover would also increase the risk for accelerated wind erosion on the loose, sandy textured soils which are widespread throughout the project area.

Under Alternative 1 the extent of detrimental soil conditions would not increase above existing levels because no additional land would be removed from production to build temporary roads and logging facilities. The effects of past and current management activities were previously described under Existing Condition of the Soil Resource.

The primary sources of detrimental soil conditions from past management are associated with existing roads and ground-based logging facilities which were used for previous timber management activities.

Measure #2: Coarse Woody Debris (CWD) and Surface Organic Matter

In the short term, the amount of coarse woody debris and surface litter would gradually increase or remain the same. In forested areas, coarse woody materials will continue to increase through natural mortality, windfall, and recruitment of fallen snags over time. Short-term nutrient sources will also increase through the accumulation of small woody material from shrub and tree branches, annual leaf and needle fall, and decomposition of grass and forb plant materials.

In the long term, the accumulation of CWD and forest litter would increase the potential for intense wildland fires which may completely consume heavy concentrations of fuel and ground cover vegetation. High-to-extreme fire hazard and potential for excessive soil heating exists when downed woody debris exceeds 30 to 40 tons per acre (Brown et al., 2003). Intense ground-level fire would likely create areas of severely burned soil and increase the potential for accelerated wind erosion. The loss of organic matter would adversely affect ground cover conditions and the nutrient supply of affected sites. Over time, burned areas would have increased levels of CWD as fire killed trees are recruited to the forest floor.

Under Alternative 1, the amount of coarse woody debris and surface organic matter will gradually increase over time. In the long term, the accumulation of CWD and forest litter would increase the risk for wild land fires.

Measure #3: Project Design and Mitigation

Under Alternative 1, there would be no cumulative increase in detrimental soil conditions from the proposed management activities. Implementation of project design criteria and mitigation measures would not be necessary.

Alternative 2 (Proposed Action) – Direct and Indirect Effects

The proposed management activities are identified in the Alternative Descriptions (EA, Chapter 2). Alternative 2 is designed to improve forest health and reduce the potential for intense wildfires and their rates of spread by implementation of commercial and non-commercial tree thinning and a combination of various fuel reduction treatments. The nature of the effects to the soil resource has already been described under "Important Interactions" in the Environmental Effects section.

Measure #1: Detrimental Soil Disturbance

The use of ground-based equipment for vegetation management treatments (including the removal of both commercial logs and biomass) would increase the amount and distribution of soil impacts within the proposed activity areas. The development and use of temporary roads, log landings, and skid trail systems are the primary sources of new soil disturbance that would result in adverse changes to soil productivity. Most soil impacts would occur on and adjacent to these heavy-use areas where multiple equipment passes typically cause detrimental soil compaction. Mitigation and resource protection measures would be applied to avoid or minimize the extent of soil disturbance in random locations between main skid trails and away from log landings. Non-commercial thinning by hand felling small-diameter trees with chainsaws would not cause additional soil impacts because machinery would not be used for yarding activities.

Mechanical shrub and slash treatments would be accomplished using low ground-pressure machinery and soil disturbances from these activities are not expected to qualify as a detrimental soil condition. The depth of compaction from only one or two equipment passes would not reduce soil porosity to levels that would require subsoiling mitigation to restore soil physical properties. On gentle to moderately sloping terrain, the maneuvering of equipment generally does not remove soil surface layers in large enough areas to qualify as detrimental soil displacement (FSM 2520, R-6 Supplement). The dominant sandy-textured soils within the project area are not susceptible to soil puddling damage due to their lack of plasticity and cohesion. Prescribed underburns in timber stands are conducted under carefully controlled conditions that maximize benefits while reducing the risk of resource damage.

The amount of disturbed area associated with temporary roads and logging facilities would be limited to the minimum necessary to achieve management objectives. It is estimated that approximately 5 miles of temporary road would be needed to allow access into activity areas proposed for mechanical vegetation treatments. None of the temporary road locations would require excavation of cut-and-fill slopes because they are located on nearly level to gentle slopes (less than 5 percent gradient). These temporary road segments would be obliterated upon completion of the vegetation management activities.

Table 67 displays existing and predicted amounts of detrimental soil conditions in acres and percentages for each of activity areas. Surface area calculations (acres) of designated areas such as roads, main skid trails, and log landings were used to determine existing and expected areas of soil disturbance.

Table 67: Alternative 2: Estimates of Detrimental Soil Conditions following Mechanical Treatments by Activity Areas.

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
1	85	4	5%	12	14%
2	41	2	5%	6	15%
3	85	4	5%	13	15%
4	49	2	5%	7	15%
5	23	1	5%	4	15%
6	4	0	5%	1	15%
7	78	4	5%	12	15%
8	18	1	5%	3	15%
9	20	1	5%	3	15%
10	79	4	5%	12	15%
11	37	2	5%	6	15%
12	33	2	5%	5	15%
13	60	3	5%	9	15%
14	58	3	5%	9	15%
15	107	5	5%	16	15%
16	373	19	5%	56	15%
17	13	1	5%	1	9%
18	119	6	5%	18	15%
19	33	2	5%	2	5%
20	89	4	5%	9	10%
21	27	1	5%	1	5%
22	141	7	5%	19	14%
23	9	0	5%	1	15%
24	75	4	5%	4	5%
25	12	1	8%	2	15%
26	33	2	5%	5	15%
27	59	3	5%	4	7%
28	89	4	5%	4	5%
29	14	1	5%	1	10%
30	36	2	5%	2	5%
31	13	1	5%	2	15%
32	64	3	5%	4	6%
33	42	2	5%	4	9%
34	30	2	5%	5	15%
35	132	7	5%	7	5%
36	80	4	5%	12	15%
37	171	9	5%	11	6%
38	31	2	5%	5	15%
39	115	6	5%	16	14%

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
40	274	14	5%	14	5%
41	228	11	5%	11	5%
42	115	6	5%	17	15%
43	691	42	6%	45	7%
44	63	6	10%	8	13%
45	129	7	6%	10	8%
46	41	2	5%	6	15%
47	15	1	5%	2	15%
48	10	1	5%	2	15%
49	27	1	5%	3	13%
50	26	1	5%	4	15%
51	64	3	5%	6	9%
52	127	6	5%	19	15%
53	107	5	5%	11	10%
54	43	2	5%	7	15%
55	67	3	5%	8	12%
56	36	2	5%	4	11%
57	13	1	5%	2	15%
58	102	5	5%	14	13%
59	44	2	5%	3	7%
60	69	3	5%	8	12%
61	103	5	5%	11	11%
62	256	13	5%	20	8%
63	162	8	5%	15	9%
64	28	1	5%	4	13%
65	142	7	5%	21	15%
66	131	7	5%	13	10%
67	200	10	5%	25	13%
68	71	4	5%	7	9%
69	50	2	5%	2	5%
70	86	4	5%	13	15%
71	90	5	5%	9	10%
72	48	2	5%	7	15%
73	152	8	5%	23	15%
74	114	6	5%	12	10%
75	37	2	5%	6	15%
76	27	1	5%	4	15%
77	32	2	5%	2	5%
78	22	1	5%	3	15%
79	7	0	5%	0	2%
80	24	1	5%	3	12%
81	45	2	5%	6	13%
82	71	4	5%	11	15%

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
83	20	1	5%	3	15%
84	87	4	5%	13	15%
85	34	2	5%	2	5%
86	33	2	5%	5	15%
87	60	3	5%	9	15%
88	100	5	5%	11	11%
89	39	2	5%	2	6%
90	52	3	5%	3	5%
91	89	4	5%	11	12%
92	173	9	5%	12	7%
93	131	7	5%	16	12%
94	34	2	5%	5	15%
95	67	3	5%	10	15%
96	42	2	5%	6	15%
97	53	3	5%	3	5%
98	89	4	5%	13	15%
99	35	2	5%	5	15%
100	103	5	5%	15	14%
101	57	3	5%	9	15%
102	108	5	5%	5	5%
103	32	2	5%	5	15%
104	128	6	5%	13	10%
105	88	4	5%	8	9%
106	35	2	5%	5	15%
107	51	3	5%	7	14%
108	77	4	5%	10	13%
109	160	8	5%	21	13%
110	91	5	5%	10	11%
111	80	4	5%	4	5%
112	380	19	5%	50	13%
113	80	4	5%	4	5%
114	24	1	5%	4	15%
115	201	10	5%	29	14%
116	192	14	7%	18	10%
117	110	5	5%	14	13%
118	194	10	5%	19	10%
119	38	2	5%	6	15%
120	168	8	5%	15	9%
121	27	1	5%	4	15%
122	167	8	5%	16	10%
123	131	7	5%	13	10%
124	203	10	5%	30	15%
125	31	2	7%	5	15%

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
126	173	11	6%	26	15%
127	93	10	11%	12	13%
128	41	2	5%	3	7%
129	165	16	9%	25	15%
130	212	14	7%	32	15%
131	103	12	12%	15	15%
132	86	4	5%	13	15%
133	62	3	5%	9	15%
134	48	3	6%	7	15%
135	114	6	5%	17	15%
136	137	7	5%	20	15%
137	108	9	8%	16	15%
138	85	8	9%	13	15%
139	168	18	11%	20	12%
140	198	16	8%	30	15%
141	68	4	6%	10	15%
142	69	5	7%	10	15%
143	88	5	6%	13	15%
144	112	8	7%	8	7%
145	155	12	8%	23	15%
146	36	3	7%	5	15%
147	103	8	8%	15	15%
148	132	11	9%	20	15%
149	18	2	10%	3	15%
150	129	10	8%	19	15%
151	45	2	5%	2	5%
152	61	3	5%	3	5%
153	50	4	8%	8	15%
154	104	7	7%	16	15%
155	69	5	7%	10	15%
156	173	9	5%	26	15%
157	140	7	5%	8	5%
158	57	5	9%	8	15%
159	135	14	10%	16	12%
160	49	5	10%	7	15%
161	112	8	8%	8	8%
162	27	1	5%	1	5%
163	75	7	10%	11	15%
164	64	3	5%	10	15%
165	155	13	8%	13	9%
166	81	7	9%	12	15%
167	70	5	7%	10	15%
168	122	9	7%	17	14%

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
169	28	2	5%	4	15%
170	121	7	6%	18	14%
171	53	3	5%	3	5%
172	23	1	5%	1	5%
173	20	2	8%	3	15%
174	122	12	10%	13	10%
175	142	11	7%	11	7%
176	63	3	5%	3	6%
177	134	7	5%	7	5%
178	98	6	6%	6	6%
179	52	5	10%	7	14%
180	65	8	12%	8	13%
181	51	4	7%	8	15%
182	56	5	9%	8	15%
183	46	3	6%	7	15%
184	29	1	5%	4	15%
185	120	9	7%	9	8%
186	64	6	10%	6	10%
187	33	2	5%	5	15%
188	85	5	5%	13	15%
189	43	2	5%	6	15%
190	114	6	5%	17	15%
191	73	4	5%	11	15%
192	27	1	5%	4	15%
193	41	2	5%	6	15%
194	13	2	13%	2	15%
195	15	1	5%	2	12%
196	30	1	5%	4	15%
197	25	1	5%	4	15%
198	30	1	5%	4	15%
199	232	12	5%	25	11%
200	108	5	5%	14	13%
201	77	4	5%	11	15%
202	50	3	5%	8	15%
203	76	4	5%	11	15%
204	25	4	15%	4	15%
205	77	4	5%	12	15%
206	44	4	8%	7	15%
207	145	9	6%	22	15%
208	113	10	9%	14	13%
209	108	9	8%	16	15%
210	24	1	5%	4	15%
211	20	3	13%	3	15%

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
212	31	3	11%	5	15%
213	110	10	9%	16	15%
214	119	8	7%	16	14%
215	196	18	9%	29	15%
216	146	13	9%	14	9%
217	110	9	8%	16	15%
218	167	13	8%	25	15%
219	68	3	5%	3	5%
220	65	5	8%	10	15%
221	58	5	8%	9	15%
222	44	2	5%	7	15%
223	179	17	9%	27	15%
224	129	10	8%	10	8%
225	123	10	8%	10	8%
226	258	22	8%	39	15%
227	39	2	6%	6	15%
228	35	4	11%	5	15%
229	154	13	9%	13	8%
230	71	8	12%	10	14%
231	92	6	6%	14	15%
232	127	18	14%	19	15%
233	135	20	15%	20	15%
234	37	4	11%	6	15%
235	56	5	8%	8	15%
236	53	3	6%	3	6%
237	84	4	5%	4	5%
238	23	1	5%	2	10%
239	16	1	5%	2	10%
240	91	5	6%	14	15%
241	111	6	5%	6	5%
242	39	4	11%	6	15%
243	27	1	5%	1	5%
244	42	4	10%	6	15%
245	8	1	6%	1	15%
246	90	8	9%	13	15%
247	51	3	5%	8	15%
248	50	3	5%	7	15%
249	62	6	9%	8	13%
250	41	2	5%	5	13%
251	172	12	7%	26	15%
252	28	2	8%	4	15%
253	47	4	8%	7	15%
254	30	1	5%	4	13%

EA Unit Number	Unit Acres	Existing Detrimental Soil Conditions		Estimated Detrimental Soil Condition after Treatment	
		Acres	Percent of Unit	Acres	Percent of Unit
255	50	3	5%	7	15%
256	114	9	7%	17	15%
257	38	2	5%	5	13%
258	62	4	7%	9	14%
259	76	4	5%	9	12%
260	24	1	5%	4	15%
261	129	8	6%	19	15%
262	139	12	8%	21	15%
263	114	10	9%	17	15%
264	130	14	11%	18	14%
265	72	4	6%	11	15%
266	57	5	9%	9	15%
267	46	3	6%	7	15%
268	93	8	8%	9	9%
269	60	7	11%	9	15%
270	35	5	14%	5	14%
271	81	6	8%	12	15%
272	65	3	5%	10	15%
273	120	7	6%	18	15%
274	89	6	7%	13	15%
275	38	3	8%	6	15%
276	158	8	5%	10	6%
277	268	20	8%	35	13%
278	112	7	6%	17	15%
279	103	9	8%	15	15%
280	19	1	5%	3	14%
281	79	4	5%	6	8%
282	138	8	6%	21	15%
283	72	4	6%	11	15%
284	42	2	4%	4	10%
285	67	4	6%	10	15%
286	20	1	5%	3	15%
287	24	1	5%	3	13%
288	8	0	5%	1	15%
289	33	1	4%	3	8%
Total		1569		2968	

The following conclusions summarize the potential increases in detrimental soil conditions associated with temporary roads and logging facilities that would be needed to facilitate mechanical thinning and yarding operations in each of the 289 activity areas.

Under Alternative 2, an estimated total of approximately 1569 acres of soil is currently impacted by existing roads, log landings, and recreation trails. It is predicted that the direct effects of the proposed harvest and yarding activities would result in a total increase of approximately 2968 acres of additional soil impacts associated with skid trail systems and log landings. Soil compaction would account for the majority of these impacts. The proposed actions would, however, comply with LRMP standards and guidelines SL-3 and SL-4 and Regional policy (FSM 2520, R-6 Supplement No. 2500-98-1) for maintaining or enhancing soil productivity.

Sensitive Soils

Less than 5% of the planning area consist of land types that contain sensitive soils. None of the acres proposed for mechanical treatment are located on land types that contain sensitive soils. The sensitive portions of these land types are confined to areas with steep slopes (over 30 percent) or specific segments of the dominant landform, such as drainages, swales and depressions that contain potentially wet soils during certain times of the year.

Measure #2: Coarse Woody Debris (CWD) and Surface Organic Matter

The measure for CWD and surface organic matter was evaluated qualitatively based on the probable success of implementing appropriate Best Management Practices and recommended guidelines that address adequate retention of these important landscape components to meet soil productivity and wildlife habitat objectives (see Wildlife Section and Chapter 2 Mitigation). Maintain a level of CWD is consistent with the east side screens requirement of 20 to 40 lineal feet of down wood per acre for ponderosa pine sites and 100 to 140 lineal feet of down wood per acre for mixed conifer sites.

The proposed harvest activities would reduce potential sources of future CWD, especially where mechanized whole-tree yarding is used in activity areas. However, harvest activities also recruit CWD to the forest floor through breakage of limbs and tops during felling and skidding operations. Existing down woody debris that are not at levels which create a fuel hazard would be protected from disturbance and retained on site to the extent possible. Understory trees, damaged during harvest operations, would also contribute woody materials that provide ground cover protection and a source of nutrients on treated sites. It is expected that enough broken branches, unusable small-diameter trees, and other woody materials would likely be available after mechanical thinning activities to meet the recommended guidelines for CWD retention.

Fuel reduction treatments would potentially reduce CWD and some of the forest litter by burning logging slash and natural fuel accumulations. Most of the logging slash generated from commercial harvest would be machine piled and burned on log landings and/or main skid trails. Post-harvest review by fuel specialists would determine the need for prescribed underburn treatments, especially where fine fuel accumlations increase the risk of wildfire to unacceptable levels. When prescribed fire is implemented, burning would occur during moist conditions to help ensure adequate retention of CWD and surface organic matter following treatment. Fuel reductions achieved through planned ignitions usually burn with low-to-moderate intensities that increase nutrient availability in burned areas. Low intensity fire does not easily consume material much larger than 3 inches in diameter, and charring does not substantially interfere with the decomposition or function of coarse woody debris (Graham et al., 1994). Any dead trees killed from prescribed burn treatments will eventually fall to the ground and become additional sources of CWD. Depending on the rate of decay and local wind conditions, many of the small-diameter trees (less than 10 inches) would be expected to fall within the short-term (less than 5 years).

A cool-temperature prescribed burn would remove some of the surface litter and duff materials without exposing extensive areas of bare mineral soil. Some of the direct and indirect beneficial effects to the soil resource include: 1) a reduction of fuel loadings and wildfire potential, 2) increased nutrient availability in localized areas, and 3) maintenance of organic matter that supports biotic habitat for mycorrhizal fungi and microorganism populations.

Measure #3: Project Design Criteria and Mitigation

The management requirements, mitigation measures, and project design elements built into Alternative 2 are all designed to avoid, minimize, or rectify potentially adverse impacts to the soil resource from ground-disturbing management activities. Operational guidelines for equipment use are included in project design elements to provide options for limiting the amount of surface area covered by logging facilities and controlling equipment operations to locations and ground conditions that are less susceptible to soil impacts in random locations of activity areas. Existing logging facilities would be reutilized to the extent possible. The short-term effects of only two passes by specialized machinery off designated skid trails are not expected to qualify as a detrimental soil condition. If grapple skidders are used they would only be allowed to operate on designated skid trails spaced on average of 100 feet apart (11 percent of the unit area). Natural processes, such as frost heaving and freeze cycles, can offset soil compaction near the soil surface. Equipment operations would be avoided in random locations of activity areas that contain sensitive soils on steep slopes over 30 percent and potentially wet soils with seasonally high water tables. On gentle to moderately sloping terrain, the maneuvering of equipment generally does not remove soil surface layers in large enough areas to qualify as detrimental soil displacement (FSM 2520, R-6 Supplement). Other examples include avoiding equipment operations during periods of high soil moisture and operating equipment over frozen ground or a sufficient amount of compacted snow. The successful application of these management practices would help lower the estimated percentages of detrimental soil conditions displayed in (Table 65).

The project area is located on the eastern flanks of the Cascade Mountain Range where frozen ground and during some periods ample snowfall accumulations provide favorable winter logging conditions. While logging over snow or frozed ground is not a required mitigation measure in any of the treatment areas, it is expected that some of the operations will occur during these conditions. By skidding over frozen ground or compacted snow, the direct and indirect effects to soils is greatly reduced or eliminated.

Soil displacement and compaction are not a major concern when equipment is operated under conditions and in locations which are suitable for winter logging activities. There is no potential for soil puddling damage because dominant soils lack plasticity and cohesion, and equipment operations are discontinued during wet weather conditions. Best results are achieved by skidding over frozen ground (at least 6 inches in depth) or on a compacted snow base (at least 12 inches in depth) if the soil is not frozen. Skidding over shallower snow packs should only be considered during snow accumulation periods and not during melt periods. If the compacted snow base begins to melt due to warmer temperatures or rain-on-snow events, skidding operations would be discontinued until freezing temperatures and/or additional snowfall allows operations to continue. If project implementation includes the use of winter logging operations, it is anticipated that there would be very little or no visual evidence of soil compaction, rutting, displacement, or loss of protective plant and litter cover within activity areas.

A variety of Best Management Practices (BMPs) are available to control erosion on roads and logging facilities. The BMPs are tiered to the Soil and Water Conservation Practices Handbook (FSH 2509.22), which contains conservation practices that have proven effective in protecting and maintaining soil and water resource values. The Oregon Department of Forestry evaluated more than 3,000 individual practices and determined a 98 percent compliance rate for BMP implementation, with 5 percent of these practices exceeding forest practice rules (National Council for Air and Stream Improvement, 1999). All reasonable BMPs would be applied to minimize the effects of road systems and timber management activities on the soil resource. See soil mitigations in Chapter Two for a list of which BMPs will be utilized.

Soil moisture guidelines would be included in prescribed burn plans to minimize the potential for intense ground-level heating and adverse effects to soil properties. Under all action alternatives, guidelines for adequate retention of coarse woody debris and fine organic matter are included as management requirements to assure both short-term and long-term nutrient cycling on treated sites.

Alternative 2 (Proposed Action) – Cumulative Effects

Measure #1: Detrimental Soil Disturbance

Alternative 2 would cause some new soil disturbances where ground-based equipment is used for mechanical harvest and yarding activities during this entry. The combined effects of current disturbances and those anticipated from implementing the project activities were previously addressed in the discussion of direct and indirect effects. The majority of project-related soil impacts would be confined to known locations in heavy use areas (such as roads, log landings, and main skid trails) that can be reclaimed through soil restoration treatments. Estimates of existing and predicted amounts of detrimental soil conditions were previously displayed and summarized in (Table 65). None of the activity areas proposed for mechanical treatments would exceed the LRMP standard of 20 percent detrimental soil conditions..

Fuel reductions would be accomplished in some units by whole tree yarding and most of the logging slash would be machine piled and burned on log landings. This management practice would not cause cumulative increases in soil impacts because burning would occur on previously disturbed soils that already have detrimental conditions. In other areas mechanical shrub and slash treatments would be accomplished using low ground pressure machinery and soil disturbances from these activities are not expected to qualify as detrimental soil compaction due to the low ground pressure of the equipment, the limited amount of traffic, and the cushioning effect of surface organic matter. Monitoring results have shown that brush mowing activities would not increase the cumulative amount of detrimental soil conditions within activity areas (Soil Monitoring Report, 1997). Slash disposal by the hand pile and burn method would not cause a measurable increase in detrimental soil conditions because machinery would not be used and burning small concentrations of slash materials is not expected to cause severely burned soil. Fuel reductions achieved through prescribed underburning in timber stands are conducted at times and under conditions that result in low-to-moderate intensity burns that do not cause detrimental changes in soil properties.

Measure #2: Coarse Woody Debris (CWD) and Surface Organic Matter

As previously described for the direct and indirect effects, it is expected that Alternative 2 would comply with the recommended management guidelines that ensure adequate retention of snags, coarse woody debris, and fine organic matter for surface cover, biological activity, and nutrient supplies for maintaining soil productivity on treated sites.

Measure #3: Project Design Criteria and Mitigation

Under Alternative 2, project implementation includes the application of management requirements, project design elements and mitigation measures during and following project activities to meet stated objectives for protecting and maintaining soil productivity. Operational guidelines for equipment use provide options for limiting the amount of surface area covered by logging facilities and controlling equipment operations to locations and ground conditions that are less susceptible to detrimental soil impacts within activity areas.

The BMPs listed under the mitigations section in chapter two would be applied to minimize the effects of road systems, fuels and timber management activities on the soil resource. The BMPs are tiered to the Soil and Water Conservation Practices Handbook (FSH 2509.22), which contains conservation practices that have proven effective in protecting and maintaining soil and water resource values.

Alternative 3 – Direct and Indirect Effects

Management activities proposed in Alternative 3 are designed to reduced the potential for intense wildfires and their rates of spread by implementation of predonimatly non-commercial tree thinning and a combination of various fuel reduction treatments. As described in the alternative section of Chapter 2, areas treated are the same for both Alternatives 2 and 3. The difference is Alternative 2 has a 21 inch dbh diameter limit for the largest trees that may be removed while Alternative 3 has a 12 inch dbh diameter limit.

Measure #1: Detrimental Soil Disturbance

Amounts and distributution of soil impacts within the proposed activity areas are estimated to be very similar to that described in Alternative 2 (Proposed Action). This is based on the fact that effects are expected to result from the development of a necessary logging transportation system, regardless of the diamater of trees removed. Estimates are also based on the assumption that due to the small diamaters of the majority of trees being removed the difference in the number of stems removed between alternatives is relativly minor. Thus the estimates of detrimental soil disturbance in Table 67 are the same for both Alternative 2 and 3.

Measure #2: Coarse Woody Debris (CWD) and Surface Organic Matter

Effects on coarse woody debries are expected to be similar for both Alternatives 2 (Proposed Action) and 3.

Measure #3: Project Design Criteria and Mitigation

Project Design Criteria and Mitigation measures would be the same as described for alternative 2 (Proposed Action).

Alternative 3 – Cumulative Effects

Measure #1: Detrimental Soil Disturbance

Soil productivity monitoring on the Deschutes National Forest has shown that detrimental soil conditions increase each time a stand is treated with mechanical equipment (Deschutes Soil Monitoring Reports 1996, 1997, and 1999). Even with careful planning and implementation of project activities, the extent of detrimental soil conditions can be expected to increase by 5 to 10 percent with each successive entry into a stand (Craigg 2000). Therefore operations that minimize the number of entries into a stand, over the rotation of the stand, will reduce cumulative soil impacts over that rotation.

By placing an arbitrary small diameter limit on the size of trees that can be removed Alternative 3 does not allow for a robust silviculture based treatment prescription in areas proposed for thinning. By not allowing a robust silviculture treatment prescription Alternative 3 is expected to result in an increase in the required entries into stands over their long term rotation. Therefore Alternative 3 is expected to result in an increase in the cumulative soil impacts over that expected to result in Alternative 2 (Proposed Action).

Measure #2: Coarse Woody Debris (CWD) and Surface Organic Matter

As described for Alternative 2, it is expected that Alternative 3 would comply with the recommended management guidelines that ensure adequate retention of snags, coarse woody debris, and fine organic matter for surface cover, biologial activity, and nutrient supplies for maintaing soil productivity on treated sites.

Measure #3: Project Design Criteria and Mitigation

Under Alternative 3, project implementation includes the application of management requirements, project design elements and mitigation measures during and following project activities to meet stated objectives for protecting and maintaining soil productivity.

Hydrology

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Hydrology Report. Reference information is contained in the full specialist report.

Affected Environment

The SAFR project area is 33,272 acres and is located within portions of eight subwatersheds in the Whychus Creek and Deep Canyon Watersheds. It is primarily located southwest of Hwy 20, south of Glaze Meadow and east of the Northwest Forest Plan boundary. Private land is interspersed within the project area, although none of it will be treated with this project.

Although a portion of Deep Canyon, Fourmile Butte, Lower Indian Ford, Middle Whychus, and Upper Indian Ford Jefferson Creek subwatersheds are technically in the project boundary; these subwatersheds are not included in the hydrology analysis area. No streams within these subwatersheds are located within the project boundary and no proposed activities are adjacent to streams outside the project area within these subwatersheds. The northern boundary of the SAFR project is adjacent to the Indian Ford Creek Riparian Habitat Conservation Area (RHCA); however, that section is on private land and no actions are proposed in that area. Therefore, the hydrology analysis area for the SAFR project is comprised of 21,064 acres and includes the entire subwatershed area of Three Creek, Lower Trout Creek, and Upper Whychus Creek subwatersheds.

The existing condition and environmental effects for the hydrology analysis area are described in this document. In addition, all these subwatersheds were analyzed in the Sisters/Why-chus Watershed Analysis (U. S. Forest Service 1998b).

Table 68: Acres by subwatershed (SWS) that are within or partially within the SAFR project area. Subwatersheds in bold are within the SAFR hydrology analysis area.

Watershed (5th field)	Subwatershed (6th field)	SWS Acres	NF acres in SWS	Acres in Project Area Boundary
Deep Canyon	Deep Canyon	30,546	5,828	1,182
Deep Canyon	**Three Creek**	**18,761**	**13,853**	**2,126**
Whychus Creek	Fourmile Butte	17,544	15,988	694
Whychus Creek	Lower Indian Ford	23,661	17,156	3,051
Whychus Creek	**Lower Trout Creek**	**20,016**	**12,641**	**11,275**
Whychus Creek	Middle Whychus	14,981	5,857	6,737
Whychus Creek	Upper Indian Ford	12,103	8,016	544
Whychus Creek	**Upper Whychus**	**18291**	**17,025**	**7,663**
Total		**155,903**	**96,364**	**33,272**

Existing Condition

Management Direction

All federal land management activities in the SAFR project area must follow standards and guidelines (S&Gs) listed in the 1990 Deschutes National Forest Land and Resource Management Plan (LRMP), as amended by INFISH (USFS 1995) and in accordance with Best Management Practices (WT-5; U. S. Forest Service 1998a) and the Clean Water Act (WT-1). All National Forest lands in the SAFR project area fall under INFISH direction and 1222 acres within the project area fall within the Whychus Creek Wild and Scenic River corridor.

INFISH

The Deschutes National Forest LRMP was amended in 1995 by the Decision Notice and Finding of No Significant Impact for the Inland Native Fish Strategy (INFISH). The interim direction is in the form of riparian management objectives, standards and guidelines, and monitoring requirements. Riparian Management Objectives RMOs describe good habitat for inland native fish and anadromous fish and interim guidance would apply where Watershed Analysis has not been completed. The Sisters/Whychus Watershed Analysis applies to the SAFR project area but does not refine the interim RMOs. INFISH provides standards and guidelines for RHCAs that prohibit or regulate activities that retard the attainment of (RMOs) at a watershed scale. The design of the action alternatives in the SAFR Project complies with the standards and guidelines in INFISH. The primary focus of monitoring is to verify that the standards and guidelines were applied during the project implementation.

Priority watersheds were identified to help prioritize restoration, monitoring and watershed analysis for areas managed by INFISH. All portions of subwatersheds in the SAFR project boundary are "non-priority watersheds." Another essential element of INFISH is the delineation of Riparian Habitat Conservation Areas (RHCAs) which "include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of the aquatic ecosystems by (1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams, (2) providing root strength for channel stability, (3) shading the stream, and (4) protecting water quality" (USFS 1995). The Whychus Watershed Analysis refine Riparian Reserve widths under the Northwest Forest Plan based on average maximum tree height, 100 yr floodplain, extent of riparian vegetation, and unstable and potentially unstable lands. These same adjustments should be applied for subwatersheds in the Whychus analysis area that follow under the guidance of INFISH (Table 69).

Table 69: Riparian Habitat Conservation Area (RHCA) widths in the Whychus Watershed.

Category	Stream Class	Description	RHCA width (slope distance (ft) from edge of channel)
1	1 & 2	Fish-bearing streams	300 ft
2	3	Permanently flowing non-fish-bearing streams	150 ft
3	NA	Ponds, lakes, reservoirs, and wetlands > 1 ac	150 ft
4	4	Seasonally flowing or intermittent streams, wetlands < 1 ac, landslides, and landslide-prone areas	Priority = 140 ft Non-priority = 70 ft

Clean Water Act

The State of Oregon, as directed by the Clean Water Act (CWA) and the Environmental Protection Agency, is responsible for the protection of rivers and other bodies of water in the public interest. Beneficial uses as defined by the State of Oregon for the Whychus Creek and Deep Creek watersheds are listed in Table 70. To show that water quality is being protected, states are required by the CWA to adopt water quality standards which must be approved by the Environmental Protection Agency. Best Management Practices (BMP) and state-wide management plans are a requirement of the CWA and are used to meet water quality standards. Waterbodies that do not meet the State Standards for water quality are discussed in under Water Quality – 303(d) Listed Stream in this report.

Table 70: Beneficial uses for Deschutes River Basin (ODEQ 2003) and water quality parameters.

Beneficial Use	Water Quality Parameter
Public Domestic Water Supply	Turbidity, Flow
Private Domestic Water Supply	Sedimentation
Industrial Water Supply	Sedimentation
Irrigation	Flow
Livestock Watering	Flow
Anadromous Fish Passage	Dissolved Oxygen, Sedimentation, Temperature, Flow
Salmonid Fish Rearing	Dissolved Oxygen, Sedimentation, Temperature, Flow
Salmonid Fish Spawning	Same as Salmonid Fish Rearing
Fish and Aquatic Life	Same as Anadromous Fish Passage
Wildlife and Hunting	Flow
Fishing	Temperature
Boating	Flow
Water Contact Recreation	Dissolved Oxygen
Aesthetic Quality	Turbidity

Hydrology Wild and Scenic River Outstanding and Remarkable Values

Specifically the hydrology ORVs identified in the Whychus Creek Wild and Scenic River corridor is channel morphology and the long-term streamflow record. Neither of the ORVs would be affected by the SAFR project activities. Within the corridor no thinning, mowing or burning would occur within 300 feet of streambanks. In addition, no activities would affect the stream gauge and or the flow regime (see Hydrology section – Streamflow Effects).

Hydrologic Processes

Precipitation

Precipitation in the analysis area ranges from 120 inches a year at the Cascades to 14 inches a year in Sisters, Oregon. However, the range in precipitation in the project area is only 33 in/yr to 14 in/yr, with most of it occurring as rain. Within the project area, approximately two-thirds of the precipitation occurs between October and March and mostly falls as low-intensity rain. A secondary peak of precipitation occurs between May and June and falls as high, intensity thunder showers. Although portions of these subwatersheds experience a significant amount of precipitation and some high intensity storms, there is very little surface channel flow.

Overland Flow

The low drainage density in these subwatersheds is due to the soils and underlying geology. Soils in the analysis area are primarily volcanic ash with rapid infiltration rates.

In a significant portion of the analysis area, these soils overlie highly permeable fractured rock, cinders, and ash. These course materials allow water to move quickly through the soil and rock profile and down into the groundwater. In some areas, volcanic ash overlies less permeable glacial outwash and till. As water moves through the soil profile in these areas, it may become perched and move laterally across the outwash or till and emerge as springs. Permeability rates for the majority of soils in the analysis area exceed the 2 yr, 30 minute rainstorm intensities for the same area (permeability for most soils in project area = 20 in/hr, 2 yr, 30 min rain = 0.31 in/hr). As a result of rapid infiltration and high permeability rates, overland flow is rare in the analysis area.

Within the analysis area, overland flow does not generally occur from a reduction in evapo-transpiration when trees are harvested because infiltration and permeability rates often exceed precipitation rates. However, overland flow can occur in areas where infiltration rates are reduced, such as rain-on-snow zones and road surfaces. Within the analysis area, rain-on-snow events can occur in the upper portion of the Whychus Creek subwatershed, as a result of its elevation and higher precipitation. However, the greatest influence on overland flow in the analysis area is roads (U. S. Forest Service 1998b). Road densities in the subwatersheds within the analysis area are considered high, according to the document, “Determining Risk of Cumulative Watershed Effects Resulting from Multiple Activities” (U. S. Forest Service 1993). Although road density is high, only roads adjacent to streams, roads that cross streams, or roads that drain to streams have an influence on streamflow or water quality (Table 71) (U. S. Forest Service 1998b). Road miles in Riparian Habitat Conservation Areas (RHCAs) are high, with most of the road miles occurring in the lower portions of the subwatersheds (i.e. the project area). Many of the roads in the RHCAs are non-system roads. The Whychus Creek Riparian Protection Project, started in 2005 and is on-going, has been reducing effects from riparian roads and dispersed campsites by blocking access to these areas, some of which are fords. As these areas revegetate, overland flow will be reduced.

Table 71: Road density and stream crossings in the SAFR Planning

Subwatershed (6^{th} field)	Road Miles	Road density (mi/mi2)	RHCA roads (mi)	Number of stream crossings
Three Creek	141	4.8	10.6	41
Lower Trout Creek	204	6.5	13.0	14
Upper Whychus	135	4.7	22.6	29
Total in Project Area	**334**	**6.4**	**11.9**	**44**

Streamflow

Streams in the hydrology analysis area flow from southwest to northeast. Most streams are spring-fed and controlled by meadow releases of groundwater (Table 70). The exception to this is Whychus Creek, which is snow-melt driven with a flashy flow regime. Wet meadow systems or swamps in all these streams are extremely important for late season flows and compaction or diversion of flows in these areas can negatively impact water storage. There is only one wetland in the analysis area Whychus Creek Swamp; however, it is not within the project area.

Only six streams occur within the project area, and only Whychus Creek has a surface channel connection to a larger stream, the Deschutes River. Black Pine Spring Creek, Melvin Spring Creek, Trout Creek, and Cold Springs Creek all go sub-surface before reaching Indian Ford Creek or Whychus Creek due to the underlying soils and geology. Historically Pole Creek flowed perennially into Whychus Creek but now is mostly diverted during the summer low flow to serve as part of the water supply for the town of Sisters, OR. Although much of Pole Creek's flow is diverted most of the year, it still supplies some water to Pole Creek Swamp. Flow in all streams in the analysis area, except Melvin Springs Creek, have been influenced by diversion ditches. There are eight water right claims on Whychus Creek between the USGS gauging station and the town of Sisters, and six claims with the highest priority usually dewater the stream between Sisters and Camp Polk during the summer low flow period (U. S. Forest Service 1998b). Since then, water conservation efforts have been implemented such as improving the efficiency of diversions, transferring water rights, and leasing water rights with the goal of increasing low flow to at least 20cfs.

Table 72: Streams and their flow regime in the SAFR Analysis Area.

Subwatersheds	Perennial stream miles in SWS	Intermittent stream miles in SWS	Primary stream	Within Project Area	Flow Regime	Flow Type in Project Area
Three Creek	8.5	10.0	Melvin Spring Creek	Y	Spring-fed	perennial and intermittent
			Black Pine Spring Creek	Y	Spring-fed	intermittent
Upper Whychus	22.1	6.0	Whychus Creek	Y	Snow-melt	perennial
			Pole Creek	Y	Spring-fed	perennial
Lower Trout Creek	2.6	4.8	Trout Creek	Y	Spring-fed and snow-melt	intermittent
			Cold Spring Creek	Y	Spring-fed	intermittent
Total in Analysis Area	33.2	20.8				

Whychus Creek has the largest volume of surface flow in the analysis area and is the only gauged stream and snow-melt dominated stream. The Oregon Department of Water Resources measures stream flows on Whychus Creek at river mile 26.8 (gauge # 14075000), where Whychus Creek flows out of the steeper mountain terrain onto a flat plateau (above the town of Sisters, OR). Drainage area at this gage is 45.2 mi^2 and the period of record is from 1906 to the present. Whychus Creek is an extremely flashy stream and flow ranges from 14 cfs in the summer low flow period to 2000 cfs (maximum discharge ever recorded on Dec 25, 1980). A 500-year flood event at the gauge was estimated to be 3400 cfs in an Army Corps of Engineers floodplain study done in 1978. Mean annual discharge is 110 cfs, which is only 11% of the total precipitation that falls in the Whychus Creek Watershed per year. Some of the remaining precipitation is evapo-transpired and 67% infiltrates the ground and flows northeast as groundwater.

Channel Condition

Spring-fed streams in the analysis area are generally very stable, with little bank erosion, and intack riparian vegetation in perennial reaches. Roads have influenced some of these channels by altering channel dimensions and riparian vegetation at crossings, reducing floodplain area, and increasing sediment input. For example, Forest Road 1008-200 and various non-system spur roads cross the intermittent/ephemeral section of Cold Springs Creek multiple times, thus reducing streamside vegetation and channel stability. In addition, Forest Road 1620-140 is adjacent to the spring-fed channel emerging from Black Pine Springs. In places the road and/or dispersed campsites are within 20 ft of the stream, and it appears that erosion from the road is directed towards the stream. This could increase sedimentation in a system that cannot flush it.

In addition, all spring-fed streams in the analysis area, except Melvin Springs Creek, have reduced low flows as a result of irrigation diversions. This loss of flow has reduced riparian vegetation, especially in Indian Ford Creek. Channel erosion and incision has increased in Indian Ford Creek where riparian vegetation has been most impacted by reduced flows and floodplain development, although, not to the extent of Whychus Creek.

Whychus Creek is a flashy stream with a large bedload originating from glacial moraines and debris slides in the headwaters and from dry-ravel on the steep slopes of the canyons. Within the project area, landslides or debris flows do not contribute to Whychus Creek channel morphology. In general, reaches of Whychus Creek above the irrigation diversion (approximately, 1.5 miles below the USGS gauging station) is steeper and have the competency to move the bedload. In these reaches Whychus Creek is stable as a result of intact riparian vegetation, a properly functioning floodplain, and uninhibited streamflows.

Below the diversion, the stream gradient flattens and much of the bedload is deposited. Historically the channel below the diversion was a “C” channel or “D” channel (as defined by Rosgen (1996)) and meandered widely across the floodplain with various channels or side channels. The large floodplain covered in riparian vegetation helped dissipate stream energy and bank erosion. Sometime after 1943, the US Army Corps of Engineers straighten much of Whychus Creek below the Cloverdale irrigation diversion for irrigation purposes. This has dramatically reduced stream complexity as a result of a reduction in stream length by 1.4 miles, an increase in stream gradient of 15%, and a loss of sinuosity by 15% (U. S. Forest Service 1998b). In addition, irrigation diversions continue to significantly reduce low flows, thus exacerbating downstream bank erosion by dewatering riparian vegetation.

The reduction in instream flows and channel manipulation has made Whychus Creek extremely unstable, incised, and much straighter below the Cloverdale irrigation diversion. Due to reduced riparian vegetation and extensive bank erosion pools and large woody debris are lacking. In addition, width to depth ratios have increased (U. S. Forest Service 1998b). Development in the floodplain, channelization, roads, and water diversions have moved or are moving reaches of Whychus Creek below the diversion towards the "F" channel type. Although efforts are being made to reduce riparian roads and dispersed camping along Whychus Creek, many areas are still void of riparian vegetation, over-widened, and unstable from anthropogenic inputs.

Water Quality

The Whychus Watershed Analysis discusses how the State designated beneficial use of the Deschutes Basin applies to each waterbody in the Whychus analysis area (U. S. Forest Service 1998b). Water quality parameters associated with beneficial uses for waterbodies in the SAFR analysis area that have been altered from historic conditions are flow, temperature, dissolved oxygen, and sediment.

303(d) Listed Streams

The State of Oregon is required by the Clean Water Act, Section 303(d), to identify waters that do not meet water quality standards. The waterbodies in Table 71 are listed on the Oregon 2004 303(d) list where water quality exceeds the State standards. Indian Ford Creek is listed for temperature exceedence; however, neither the stream nor its tributaries run through the SAFR project boundary. Whychus Creek, which is within the project boundary, is also listed for temperature exceedence.

States are required to develop Total Maximum Daily Load (TMDL) allocations, which include Water Quality Management Plans (WQMP) for 303(d) listed waters. The Upper Deschutes River Subbasin TMDL and WQMP are scheduled for completion in 2007 and cover all the subwatersheds in the SAFR project boundary. A Memorandum of Understanding (MOU), signed May 2002, between Oregon Department of Environmental Quality and the U. S. Forest Service, designated the Forest Service as the management agency for the State on National Forest Service lands. To meet CWA responsibilities defined in the MOU, the Forest Service is responsible for developing a Water Quality Restoration Plan (WQRP), which is now in draft form (U. S. Forest Service 2004). Activities proposed in the SAFR Project are in compliance with the draft WQRP.

Table 73: Waterbodies in subwatersheds that are within or are partially within the SAFR project boundary that are listed on the State of Oregon 2004 303(d) list for water quality exceedences (ODEQ 2006).

Waterbodies	Parameter	Temperature Standard
Indian Ford Ck (entire length)	Temperature	18º C
Whychus Ck (entire length)	Temperature	18º C

Temperature

The Sisters/Whychus Watershed Analysis analyzed stream temperature data in the SAFR analysis area (U. S. Forest Service 1998b). In addition, temperature monitoring in the SAFR project area has continued on Whychus Creek and monitoring upstream of the project area has continued on Trout Creek. All streams in the hydrology analysis area meet State water temperature standards except Whychus Creek.

Water temperature in Whychus Creek above the diversion at river mile (RM) 21 has been consistently above the State water quality standard; however, the entire stream length is listed on the 2004 303(d) list because stream reaches for the 2004 303(d) list are designated by beneficial uses and not delineated based on temperature. This means that water temperature in Whychus Creek within the most of the project area is significantly below the State water temperature standard (≈ 14º C; Table 69). Stream temperatures in Whychus Creek progressively get warmer as water moves downstream from the 1514 rd (upstream of the SAFR project area) to the City Park in Sisters (northern project boundary). Approximately 0.5 miles of Whychus Creek in the northern portion of the project boundary below Forest Road 4606 has been consistently above the State Water Quality standard. Cold water springs 1.6 miles from the mouth of Whychus Creek lower water temperature in Whychus Creek below the 2003 temperature standard.

Insufficient in-stream flows have been the main reason for high water temperatures in Whychus Creek. Reduced low flows increase the amount of time water is exposed to solar radiation and reduces the amount of water available for riparian vegetation. The lack of sufficient riparian vegetation also exacerbates channel erosion and widening, leading warmer stream temperatures from increased surface area. Below the Whychus Creek Irrigation District Diversion, which is 1.5 miles downstream of the USGS gauge, low flow is significantly reduced, as is riparian vegetation. Above the diversion average low flow in August is 92 cfs, in 1998 only 1 cfs flowed below the diversion. In 2005 the minimum instream flow for Whychus Creek was 16 cfs.

Table 74: Water temperature monitoring in the SAFR Project Area.

Stream	Period of record	Max 7-day ave. max. temperature	2003 Water Temperature standard
Pole Creek @ 1514 rd	1989-1991, 1995, 1997	11.1º C	18º C
Whychus Ck @ 1514 rd*	1997-1999, 2002	13.0º C	18º C
Whychus Ck @ gaging station	1991, 1994-2001, 2002-2004	14.1º C	18º C
Whychus Ck @ 4606 rd foot bridge	1998 - 2004	18.8º C	18º C
Whychus Ck @ City Park	1997-2004	20.9º C	18º C
Trout Ck @ 1018 rd, Whispering Pines CG*	1996, 2000-2005	12.7º C	18º C

* upstream of SAFR project boundary

Dissolved Oxygen

Dissolved oxygen is directly related to water temperature and biological activity and was analyzed in the Whychus Watershed Analysis (U. S. Forest Service 1998b). Indian Ford Creek and Whychus Creek have reached dissolved oxygen levels as low as 8.1 and 8.8 in summer low flow months. Although dissolved oxygen in these streams has not been measured according to the State protocol, it could be below State standards (U.S. Forest Service 1998b).

Sedimentation

The amount of fine sediment transported to or eroded within a stream channel can affect the beneficial uses of water, and is frequently used as a measure of overall water quality. Oregon administration rules addresses sediment through a turbidity standard that states, "No more than 10 percent cumulative increases in natural streams turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity-causing activity" (OAR 340-041-0336; ODEQ 2003). For this report, sedimentation, including turbidity and fine sediment in substrate, will be analyzed because of the effects on channel morphology and aquatic species. The Sisters Ranger District has monitored turbidity, percent fine sediment in spawning gravels, cobble embeddness, and bank stability, all of which are parameters associated with fine sediment.

The Whychus Watershed Analysis analyzed sediment in streams within the SAFR analysis area (U. S. Forest Service 1998b). Turbidity was determined to not be a concern in the Whychus analysis area because all streams showed low turbidity values. Whychus Creek had short periods of high turbidity but this was a result of glacial runoff in the late summer. Percent fines in spawning gravels ranged from 22 to 28% in Whychus Creek below the irrigation diversion, most likely resulting from high bank erosion. Below the irrigation diversion, streambank erosion is as high as 13% as a result of reduced riparian vegetation and channelization. Above the irrigation diversion, percent fines on average are 15% and channel stability is 5%.

Most of the excess sedimentation in Whychus Creek is from in-channel erosion associated with reduced in-stream flows. In addition, overland flow can increase sedimentation, although in the SAFR hydrology analysis area it is rare due to high infiltration and permeability rates (see Overland Flow section). Certain roads in riparian areas, and primarily roads at stream crossings, were determined to be the only source of overland sediment input to streams in the SAFR hydrology analysis area. Riparian road miles are highest along Whychus Creek and efforts to reduce these are on-going (see "Hydrologic Processes –overland flow" section of this report).

Environmental Effects

Only activities in areas that contribute to streams or wetlands could cause a water quality or quantity effect; therefore, activities within the RHCA were analyzed. Activities occurring in RHCAs include 50 acres of underburning and 34 acres hand-thinning, piling and pile burning to reduce fuels (Table 75; Figure 31). Hauling on existing roads in RHCAs may occur, but effects would be mitigated. No mowing, road construction, or temporary road construction is proposed in RHCAs. Alternatives were compared by analyzing hydrology measures (Table 72).

Figure 30: Riparian Habitat Conservation Area Treatments in the SAFR Planning Area.

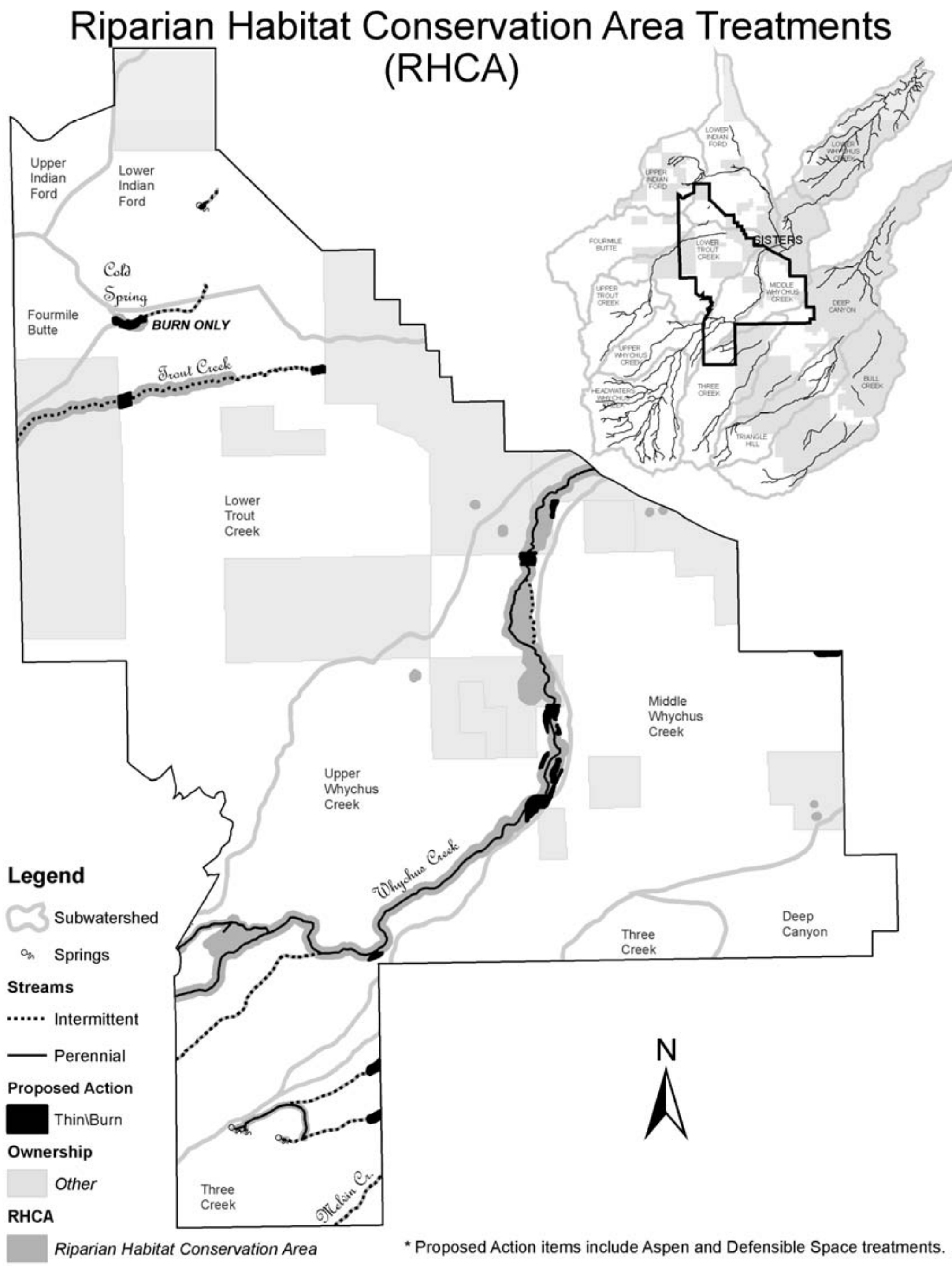


Table 75: Activities associated with the SAFR project in Riparian Habitat Conservation Areas.

Subwatersheds	**Under-burning (ac)**		**Thinning/ Burning (ac)**	**Total (ac)**
	Defensible Space	Fuels Treatment	Defensible Space	
Deep Canyon	0	0	0	0
Three Creek	0	0	0	0
Fourmile Butte	0	0	0	0
Lower Indian Ford	0	0	0	0
Lower Trout Creek	12	6	13	31
Middle Whychus	3	0	0	3
Upper Indian Ford	0	0	0	0
Upper Whychus	0	29	21	50
TOTAL	**15**	**35**	**34**	**84**

Underburning to reduce fuel loads is concentrated in areas outside of RHCAs; however, to mitigate effects of fire lines, existing roads would be used as fire lines. RHCAs with roads in the outer portion of the boundary would be used to define the prescribed burn boundary in areas where underburning is proposed. Only areas with upland vegetation would be burned.

Defensible space treatments in RHCAs would occur at two private land boundaries intersections with Trout Creek, at three private land boundary intersections with Whychus Creek, at the private land boundary along Watson Reservoir, and at the Cold Springs Campground. Activities would include hand-felling, hand piling, pile burning, and underburning. Only trees less than 9 inch dbh would be hand removed or burned and no ground-based equipment would be used for felling or removing trees. The defensible space treatments at Cold Springs would only be underburning, which is has been done several times in the past few years at the Cold Springs site.

Table 76: Comparison between alternatives in the SAFR project area by hydrology measures.

Hydrology Measures	No Action Alternative	Action Alternatives
Acres compacted in RHCAs	0	0
Acres of soil detrimentally impacted in RHCAs	0	0
Acres harvested within primary large wood recruitment area (100 ft from stream)	0	0
Number of trees felled in the primary shade zone	0	0

Alternative 1 (No Action) – Ecological Trends

Streamflow
Measure: acres of compaction in RHCA

No activities would take place in RHCAs; therefore, streamflow would be unaffected by this alternative. Water diversions would remain the primary human influence on instream flows.

Channel Condition
Measure: alteration of stream bank and bed stability measured by changes in streamflow, sedimentation, riparian vegetation, and large wood recruitment.

Specific measures include:

Parameters	Measures
Streamflow (see Streamflow Effects)	Acres compacted in RHCA
Sedimentation (see Sedimentation Effects)	Acres of soil detrimentally impacted in RHCA
Riparian vegetation	Trees killed along streambanks
Large wood recruitment	Acres harvested within primary wood recruitment area (100 ft of a stream)

No activities affecting streamflow, sedimentation, or large woody debris recruitment would occur. Although upland species would continue to encroach upon aspen stands and change riparian vegetation and complexity, this would not affect channel stability. Therefore, channel condition would be unaffected by this alternative and water diversions and riparian roads would remain the primary human influence on channel condition.

303 (d) Listed Streams / Temperature

Measure: Number of trees felled in the primary shade zone

Stream temperatures would be unaffected under the No Action Alternative and Indian Ford Creek and Whychus Creek would remain on the 303(d) list for temperature exceedences above the State Standard. In addition, improvements to forest health from thinning such as growing larger trees, healthier trees and reducing the risk of stand replacement fires would not occur; therefore, potential long-term increases in stream shade along Whychus Creek would not occur. Although increased shade along perennial streams could lower stream temperatures, temperatures in Trout Creek and at perennial springs are not compromised and are primarily controlled by cold water springs. In addition, instream flow and width-to-depth ratio are the limiting factors for stream temperature in Whychus Creek, therefore, improvements to future shade may not have a measurable effect.

Sedimentation

Measure: Acres of soil detrimentally impacted in RHCA

No activities would occur in this alternative; therefore, no additional acres would be detrimentally impacted and no log haul would occur. Detrimentally impacted soils associated with past activities would continue to recover (see Soils report). Sedimentation effects from roads would stay the same. Fuel loads would continue to increase as would the risk of stand replacement fire and associated sedimentation.

Cumulative hydrology trends were evaluated for all subwatershed that are within or are partially within the SAFR project boundary (Table 73) and subwatersheds that drain into or out of these subwatersheds (i.e. Upper Trout Creek, Headwaters of Whychus Creek, and Lower Whychus Creek subwatersheds). Cumulative hydrology effects different from natural conditions would continue as a result of past or on-going activities or events such as the Black Crater Fire, irrigation diversions, grazing in Upper and Lower Indian Ford subwatershed, roads in riparian areas, and compaction in riparian areas from past logging and recreation use (i.e. extensive dispersed camping in Whychus subwatersheds, off-road vehicle use in all subwatersheds). The Black Crater Fire predominately occurred outside of the SAFR project area in the summer of 2006 and burned approximately 9400 acres mostly in Upper and Lower Trout Creek subwatersheds. Approximately 932 acres of the fire occurred within the SAFR boundary and all except 70 acres were underburned and consistent with treatment proposed in the SAFR project. Seventy acres within the SAFR boundary experienced a stand replacement fire and these acres would be dropped from treatment. Streamflow and sedimentation, as a result of the fire, were expected to increase in the short-term until vegetation reestablishes.

In addition, beneficial hydrology cumulative effects would continue from the Black Crater BAER road treatments, the Trout Creek Swamp Restoration Project, and the on-going Whychus Creek Riparian Protection Project. The Black Crater BAER road treatments focused on increasing the capacity of fords and culverts that intersected Trout Creek or its tributaries within or downstream of the fire. Approximately 15 fords and culverts were improved to accommodate the predicted increase in flow from the fire. Flow in Trout Creek Swamp was channelized by ditches before the 1950s for pastureland. Restoration efforts began in 2004 to remove the channelization by plugging the ditches. By restoring the swamp, late season flows and cold water inputs in Trout Creek should improve. In addition, continued road closure and decommissioning as part of the Whychus Creek Riparian Protection Project would reduce overland flow and sedimentation in Whychus Creek.

Future projects in the hydrology cumulative effects analysis area are late season instream flow restoration, the Black Crater Fire Salvage, the Black Crater Danger Tree Removal Project, the West Trout Vegetation Management Project, and the Glaze Forest Restoration Project. Low flow in Whychus Creek could increase by proposed water rights purchasing, leasing, and conservation. This would have a beneficial effect for water quality, quality, and channel condition. Both the West Trout Vegetation Management Project and the Glaze Forest Restoration Project would focus on improving Forest health by promoting the growth of big trees and reducing catastrophic fire risk. The West Trout Project would be approximately 20,000 acres and located in Fourmile Butte, Lower Trout Creek, Upper Trout, and Upper Whychus Creek subwatersheds. The Glaze Forest Restoration Project would be approximately 1200 acres and located mostly in the Upper Indian Ford subwatershed, with only approximately 100 acres in the Lower Indian Ford subwatershed. The Black Crater Fire Salvage and Danger Tree Removal Projects would remove dead trees on approximately 300 acres within the Black Crater Fire Area. No ground-based treatments would occur within Riparian Reserves.

Alternatives 2 and 3 – Direct and Indirect Effects

Streamflow
Measure: Acres of compaction in RHCA

The Action Alternatives would not affect streamflow because no compaction would occur within RHCA and hydrophobic soils do not occur under burn piles in these soil types. Underburning would not affect streamflow because no new fire line would be constructed within RHCAs and burn severity would not be at a level to cause hydrophobic soils. In addition, mortality of brush and small trees from the underburn would not alter streamflows because geology and soils are the primary influence of overland flow in the project area and not evapotranspiration (see Existing Condition – Streamflow).

Thinning in defensible space would not cause compaction because conifers would be felled by hand and trees would be left on site. In addition, pile burning would be less than 100 ft^2 in size, as recommended in the Soils Handbook 2500, and would occur at 100 ft from the stream channel to mitigate any possible overland flow effects from burn piles (USFS and BLM 2003). Any hydrophobic soils that developed under burn piles would small in size, spread out between piles, and would be far enough from a stream to allow any overland flow to infiltrate before reaching the stream.

Channel Condition
Measure: Alteration of stream bank and bed stability measured by changes in streamflow, sedimentation, riparian vegetation, and large woody debris recruitment

The Action Alternatives would not affect channel condition because no effects to streamflow, sedimentation, riparian vegetation, and large woody debris recruitment would occur within RHCAs. Streamflow and sedimentation effects are discussed separately in the Effects section of this report. Channel stability would not be compromised because trees would not be felled within 30 ft of stream banks to protect the tree root influence area. In addition, large wood recruitment would not be affected because large wood (considered to be 12” diameter at the height of the tree that would reach the stream) would not be harvested within the primary wood recruitment area. In RHCAs only trees less than 9 “dbh would be hand removed or burned and they would all be at least 30 ft (60 ft along Whychus Ck) from the creek. Because there are no debris slide or landslide prone areas within the project area, the primary wood recruitment areas in the SAFR project area is approximately 100 ft on each side of a channel (Benda et al. 2002).

303 (d) Listed Streams / Temperature
Measure: Number of trees felled in the primary shade zone

The Action Alternatives would not affect water temperature because thinning and burning would not remove the shade component along any stream channels. For the same reason, there would be no effect on the 303(d) listing status of streams listed for temperature exceedences. Only 50 acres (29 of which are underburning) of activities would occur within the Whychus Creek RHCA and it would all be outside the shade producing area. All of Indian Ford Creek is outside of the SAFR boundary; therefore, no activities would occur within the Indian Ford RHCAs.

Although understory trees would be thinned in the Riparian Habitat Conservation Area, thinning and burning would not remove the primary shade component along any perennial streams. Treatments along Trout Creek would not affect stream temperature because shade is not the limiting factor given that Trout Creek in the project area is intermittent and dry during the hottest period of the year. Guidance, set forth by the Region with the support of Oregon Department of Environmental Quality (DEQ), would be followed to insure that trees within the primary shade producing zone along Whychus Creek would remain (USFS and BLM 2005). The temperature strategy put forth by the Region indicates that a 50 ft buffer would be adequate for protecting stream shade in conditions similar to the treatment areas along Whychus Creek. No trees would be removed within 60 ft of Whychus Creek and only trees less than or equal to 9” dbh would be removed in the RHCA beyond the 60 ft. In addition, no changes to channel condition are predicted; therefore, morphological channel changes which could affect stream temperature would not occur.

Sedimentation
Measure: Acres of soil detrimentally impacted in RHCA

Sedimentation from activities associated with the Action Alternatives would be negligible because no detrimental soil acres would occur in RHCAs and haul road effects would be mitigated. No ground-based equipment would be used off existing roads in RHCAs; therefore, no soil displacement or compaction would occur (i.e. not creating detrimentally compacted soils). Effects from road haul would be mitigated by improving road drainage, reducing road erosion, implementing seasonal restrictions, or prohibiting haul use on specific roads that cannot be mitigated by other means. Underburning, which kills much of the ground vegetation, would occur within the outer edges of some RHCAs in Whychus Creek and within the Cold Springs RHCA. Burn severity would not be a level to alter soil infiltration rates; therefore, overland flow would remain unlikely in these areas. In addition, there would be no soil displacement from firelines in RHCAs because existing roads would be used as fire breaks.

Alternatives 2 and 3 – Cumulative Effects

Hydrology effects from the activities proposed in the SAFR project would not incrementally add to cumulative effects because no effects to any hydrology parameters are predicted.

Cumulative hydrology effects from past activities would be the same as those discussed in the No Action Alternative. Although activities proposed in the SAFR project could occur in areas that have had past activities, the proposed activities are not predicted to cause any hydrology effects (see Effects Analysis). No future foreseeable activities would occur within the SAFR project boundary; however, some could occur within the hydrology analysis area. Subwatersheds that could have other ground-based activities (i.e. Black Crater Salvage, Black Crater Danger Tree Project, West Trout Project, Glaze Meadow Forest Restoration Project) besides those proposed in the SAFR project are primarily Lower Trout Creek and Upper Whychus Creek subwatersheds. As a result of the SAFR project, Black Crater Fire Salvage, Black Crater Danger Tree Project, West Trout project, and Glaze Forest Restoration Project, up to 36 percent of the Whychus watershed could receive vegetation removal treatments. Hydrology effects are not expected from these projects because activities are focused outside of Riparian Reserves or Riparian Habitat Conservation Areas, no new roads are proposed, and harvest would focus on small tree removal (i.e. thinning) or removal of dead trees (≈ 300 ac).

Although, evapotranspiration could be reduced in the watershed by the cutting of trees, it would not be at a magnitude or in a location that would have an effect on streamflow or sedimentation. Likewise, streamflow in these project areas is not highly sensitive to reduction in evapotranspiration due to high infiltration rates and low annual precipitation. This is evident by the low stream density. All cutting or harvest of trees would be for fuels reduction or small salvage, thereby leaving the majority of trees. Although greater than 75 percent of the subwatershed area in the Lower Trout and Upper Whychus subwatersheds could be treated by these projects, less than 2% of the RHCA area in these subwatersheds would be thinned and no compaction would occur in RHCAs; therefore, reducing the likelihood of any surface runoff reaching the stream network.

Botany

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Botany Report. Reference information is contained in the full specialist report.

Introduction

Elevations within the project area range from about 3160 feet along the northeastern edge of the project area (southeast of the community of Sisters) to about 4840 feet in the extreme southwest corner of the project area. The entire project area rather uniformly slopes downward toward the northeast. The Dry Ponderosa Pine Plant Association Group (PAG) occurs on 86% of the project area. Less common PAGs within the project area include Dry Mixed Conifer (8.5%), Wet Ponderosa Pine (3.9%) and Wet Mixed Conifer (0.6%). Given the prevalence of dry forest types within the project area, special plant habitats include riparian zones, seeps, springs and meadows.

Affected Environment

Threatened, Endangered or Sensitive (TES) Plants

There are no federally listed Threatened or Endangered plant species known to exist within or nearby the project area. Currently, the Deschutes National Forest Sensitive Plant List includes 31 taxa, either known or suspected to exist on the Forest. Only one of these taxa, *Penstemon peckii*, is known to occur within the project area. Another 15 are known from sites elsewhere on the Forest.

Invasive Plant Species

Invasive plant species are an undesirable presence in forest ecosystems because they tend to displace native plants, including, potentially, rare and protected species, degrade habitat for animal species, promote soil erosion, and lessen the value of recreational experiences. As chronically disturbed, often well-illuminated areas, roadsides are highly suitable habitats for many invasive species. Most of the invasive species sites within the project area are located along roadsides. Relating to this, motorized vehicles are probably the major vector for the introduction and/or spread of these plants within the project area. Such vehicles may include those associated with public recreational use or harvesting of special forest products (e.g., firewood, mushrooms), or general forest management operations including inventory, monitoring, road maintenance and fire suppression. Such vehicles have the potential to transport weed seeds included in soil and muck stuck in tire treads or upon undercarriages. Also, portions of whole, seed-bearing weed plants can become wedged in bumpers and within undercarriages when vehicles drive through patches of weeds. By these means, weed seed can be imported to the project area or moved about within the project area.

Existing Condition

Threatened, Endangered or Sensitive (TES) Plants

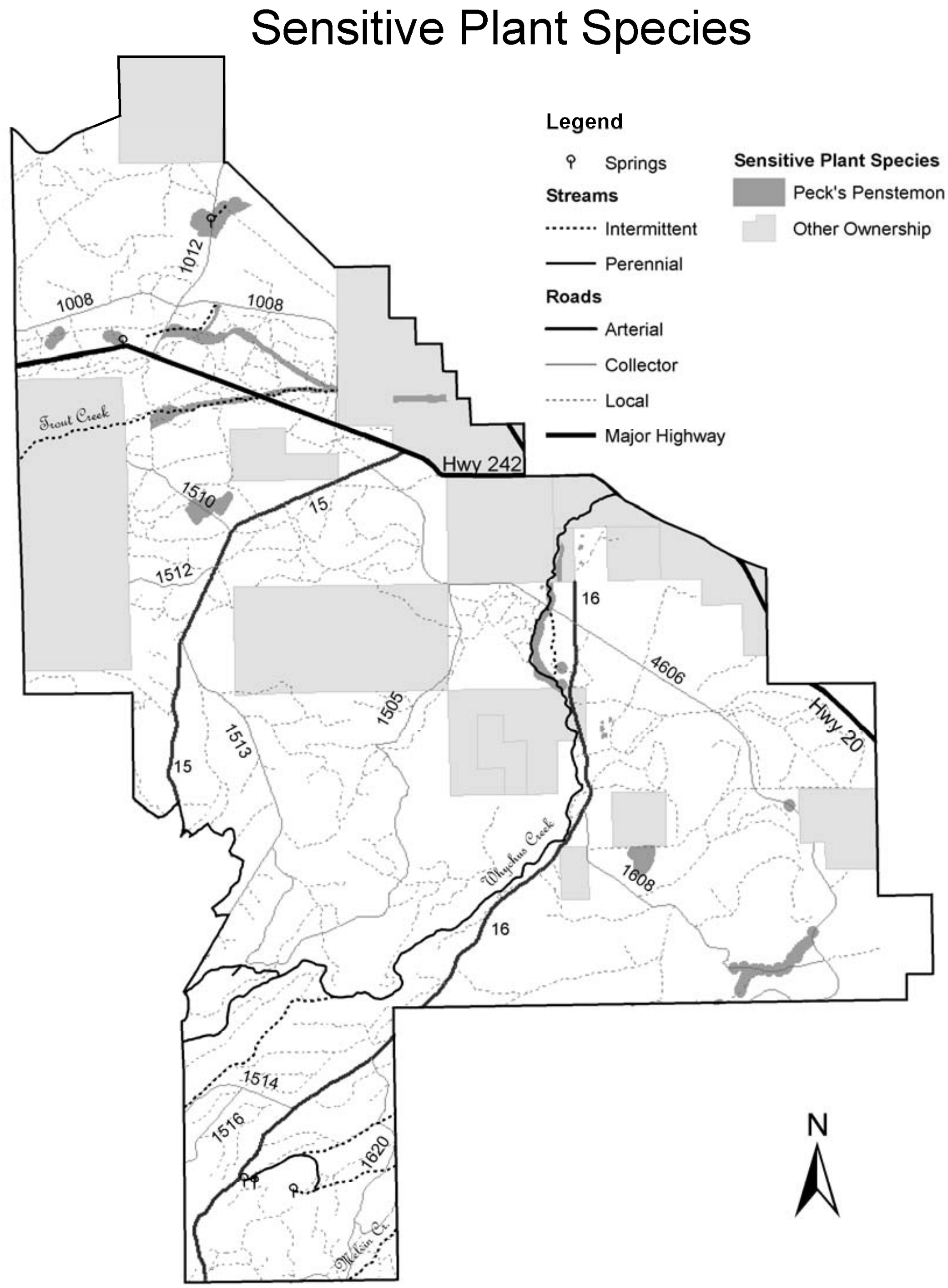
Only one TES plant species, Peck's penstemon (*Penstemon peckii*), is known to occur within the project area. No other taxa are considered to have a high probability of occurrence within the project area while only two species, agoseris (*Agoseris elata)* and paintbrush (*Castilleja chlorotica)*, are considered moderately likely to occur within the project area. Information relevant to management of Peck's penstemon is presented below.

Peck's penstemon is a central Oregon endemic, its range fully included in an area of about 325 square miles centered about Black Butte on the Sisters Ranger District. Plants are often found in swales or topographically subtle drainages where seasonal surface movement of water, and soil moisture accumulation, appear to promote both seed dispersal and germination. Occurrence of the species within the Metolius Basin shows a strong association with soil types 8 (bottomlands along drainages) and 30 (subject to high water tables during runoff periods) as described and mapped in Larsen and Klink (1976). The fact that the species is a native, herbaceous perennial, occupying lower elevation ponderosa pine and ponderosa pine-mixed conifer forest communities, suggests that may be well-adapted to frequent, low intensity fires. That the species is typically found in relatively open forest stands, forest openings, old clear cuts and along roadsides, further supports the understanding that it acts as an early seral species, benefiting from periodic disturbances. Field (1985) speculated that "silvicultural treatments which open closed canopies, reduce soil litter, reduce vegetative competition and retain penstemon parent plants will benefit the species in forested habitats." It is notable that periodic, low intensity fire can affect these same changes. Indeed, Field (1985) notes that fire enhances Peck's penstemon by 1) reducing canopy and increasing available sunlight, 2) reducing understory vegetation and exposing bare soil for germination and establishment and 3) increasing runoff and increasing available moisture in habitat areas.

It is not altogether clear, however, that disturbances that periodically reduce vegetative cover will always be beneficial or essential to the maintenance of habitat for this species. In the extreme southeastern corner of the project area, Peck's penstemon occurs in a very dry forest community associated with much juniper and sagebrush. Initial observations in this area suggest that Peck's penstemon tends to occupy microsites featuring shelter from prolonged, direct exposure to sunlight, and perhaps, wind. Notably though, Peck's penstemon also occurs in dry forest in Stephen's Canyon, approximately 6 miles NE beyond the project area. Here, the incidence of flowering stems in 1991 increased following fire earlier that year. A forest botanist revisiting this site in August of 2005 reported less vigor than that described in 1991, and suggested that the site would benefit from prescribed fire to reduce competition from grasses, shrubs, and young juniper.

The Species Conservation Strategy (1992) for Peck's penstemon includes all occurrences in two management categories, Protected and Managed. The Strategy identified 25 protected populations that should be managed "to achieve long-term species viability by maintaining existing genetic variance and promoting reproductive success." These populations were selected due to attributes such as 1) large population size and density, 2) a distinctive geographic setting, 3) relatively unfragmented structure, 4) inclusion in distinctive plant association, 5) distinctive flower color or degree of color polymorphism and 6) plant vigor. The Conservation Strategy recommends that no permanent habitat loss be allowed at these sites, and that loss of individual plants due to active resource management not exceed 0.2% in populations greater than 2000 individuals and 0% in populations less than 2000 individuals. Populations not given Protected status automatically assume the status of Managed populations. These populations are to be managed for the enhancement of Peck's penstemon habitat with existing or experimental forest management tools suspected to be of benefit to the species. Loss of more than 20% of a population that exceeds 500 individuals, or more than 10% of a population of less than 500 individuals is not recommended.

Figure 31: Sensitive Plant Species in the SAFR Planning Area.



Invasive Plant Species

Prefield review of the NRIS/Terra database and associated GIS indicated the presence within the SAFR project area of three invasive plant species. A brief description of these three invasive species is presented below. Invasive plant species of potential concern in this analysis are included on the Deschutes National Forest Invasive Plant Species List (Appendix B).

Knapweeds: There are two species of knapweed within the project area, spotted knapweed (*Centaurea biebersteinii*) and diffuse knapweed (*Centaurea diffusa*). These two species account for nearly all the invasive plant acreage within the project area. The knapweeds are understood to be the most aggressive noxious weeds, in upland settings, on Deschutes National Forest. Their abundance and frequency within the project area supports this understanding. Spotted knapweed is often referred to as a biennial or short-lived perennial. However, observations of this species in central Oregon indicate that it rarely behaves as a biennial, and can commonly live five or more years. Flowering and fruiting generally begins in the second year of growth, with the length and total number of flower-bearing branches per plant increasing with each year of growth. Hence, individual plants typically produce significantly more seeds with each year of age. Locally, it is tentatively thought that diffuse knapweed behaves more like a true biennial. Knapweed seeds appear to have too much mass to be readily transported by air currents, but circumstantial evidence suggests that humans and their various mechanical contrivances serve as very effective vectors for knapweed seed dispersal. The knapweeds are not especially tolerant of shade, and herbicide applications on the Forest since 1999 have significantly reduced population sizes at a number of sites. Both species appear capable of spreading from disturbed sites into adjacent, relatively undisturbed and open native plant communities.

St. Johnswort: St. Johnswort (*Hypericum perforatum*) is regarded as an emerging noxious weed threat within the Metolius Basin. This species occurs at only one of the 11 invasive species sites within the project area. St. Johnswort is a rhizomatous species that is currently causing local alarm, due to both its apparent high rate of spread and its resistance to manual, chemical and biological controls.

Threatened, Endangered or Sensitive (TES) Plants

All known Peck's penstemon sites on National Forest land within and adjacent to the project area were revisited during the 2005 season. Additionally, surveys were conducted in all moderate to high probability habitat for Peck's penstemon and tall agoseris meeting the following criteria: 1) project units including or adjacent to Peck's penstemon sites; 2) project units including soil types 08, 36, 37 and GS (a combination of soil types 37 and 64); 3) project units including low gradients and drainages. Approximately 12,500 acres were selected as potential habitat under these criteria. An "intuitive meander" survey methodology was employed on about 400 acres where the occurrence of Peck's penstemon was considered most likely (within and adjacent to known populations). The remaining acres were "field checked" for habitat or presence of Peck's penstemon. This typically involved inspection of 5-10% of each selected unit, for an estimated total of 600-1200 inspected acres. Where suitable habitat was evident, intuitive meander surveys were conducted. General plant lists were created for all surveyed areas.

Information concerning occurrences of Peck's penstemon within the project area, gathered from both prefield review and 2005 field surveys, is presented in Table 77 below.

Table 77: Occurrences of Peck's penstemon within the SAFR project area. "M" = "managed" population; "P" = "protected" population; "PP" = proposed Protected population.

Peck's Penstemon Stand #	**Status**	**Acres**	**Notes**
0500020	M	11.3	Population boundary reconfigured in 2005
0500023	M	23.8	Population boundary reconfigured in 2005; now contiguous with population 90
0500025	P	2.1 (in SAFR)	Large population on N border of project
0500035	P	103.6	
0500037	M	2.7	4 small subunits
0500038	M	14.6	Boundary repositioned in GIS in 2005
0500039	Private		
0500042	P	62.3	Trout Ck
0500058	M	1.1	4 small subunits
0500059	M	7.7	Squaw Ck
0500060	P	52.5	Squaw Ck
0500074	M	4.4	
0500090	M	4.0	Contiguous with 23
0500158	PP	52.6	Discovered in 2005
Total SAFR acres		**342.7**	
Total Protected		**273.1**	

Invasive Plant Species

Within the project area, surveys for invasive plant species were conducted 1) in portions of project units including or adjacent to know weed sites and 2) along arterial roads, and lesser roads with known weed sites. Data, current as of completion of the 2005 field season and available through NRIS/Terra database and associated GIS indicates the presence within the SAFR project area of three invasive plant species collectively occurring on 490 acres at 11 sites.

Table 78 below summarizes data concerning invasive plant species in the project area.

Table 78: Sites of invasive plant species within the SAFR project area. "CEBI2" = spotted knapweed; "CEDI3" = diffuse knapweed; "CENTA" = undetermined knapweed (CEBI2 or CEDI3); "HYPE" = St. Johnswort.

Weed Site #	Species	Gross Acres	Infested Acres
6150003	CEBI2, CEDI3	170.4	5.0
6150004	CEDI3	124.9	<0.1
6150010	CEBI2, CEDI3, HYPE	7.5	0.1
6150032	CEDI3	55.5	1.0
6150051	CEBI2, CEDI3	32.0	1.7
6150065	CEDI3	31.2	0.25
6150074	CEDI3	41.1	1.0
6150090	CEBI2	13.8	1.0
6150123	CEBI2	1.2	0.1
6150210	CEBI2	10.8	0.1
6150220	CENTA	1.5	0.1
Totals		**489.9**	**10.5**

Noxious Weed Risk Ranking Factors considered in determining the level of risk for the introduction or spread of noxious weeds is presented below.

High – An affirmative response to each of the following three questions:

1. Are there weeds in, or adjacent to, the project area? (YES)
2. Are any of vectors # 1-8 in the project area? (YES)
3. Will project operations occur in, or adjacent to, weed sites? (YES)

Moderate – Presence of any of vectors # 1-5 in project area.

Low – Presence of any of vectors # 6-8 in project area OR known weed sites in, or adjacent to project area, even in absence of listed vectors.

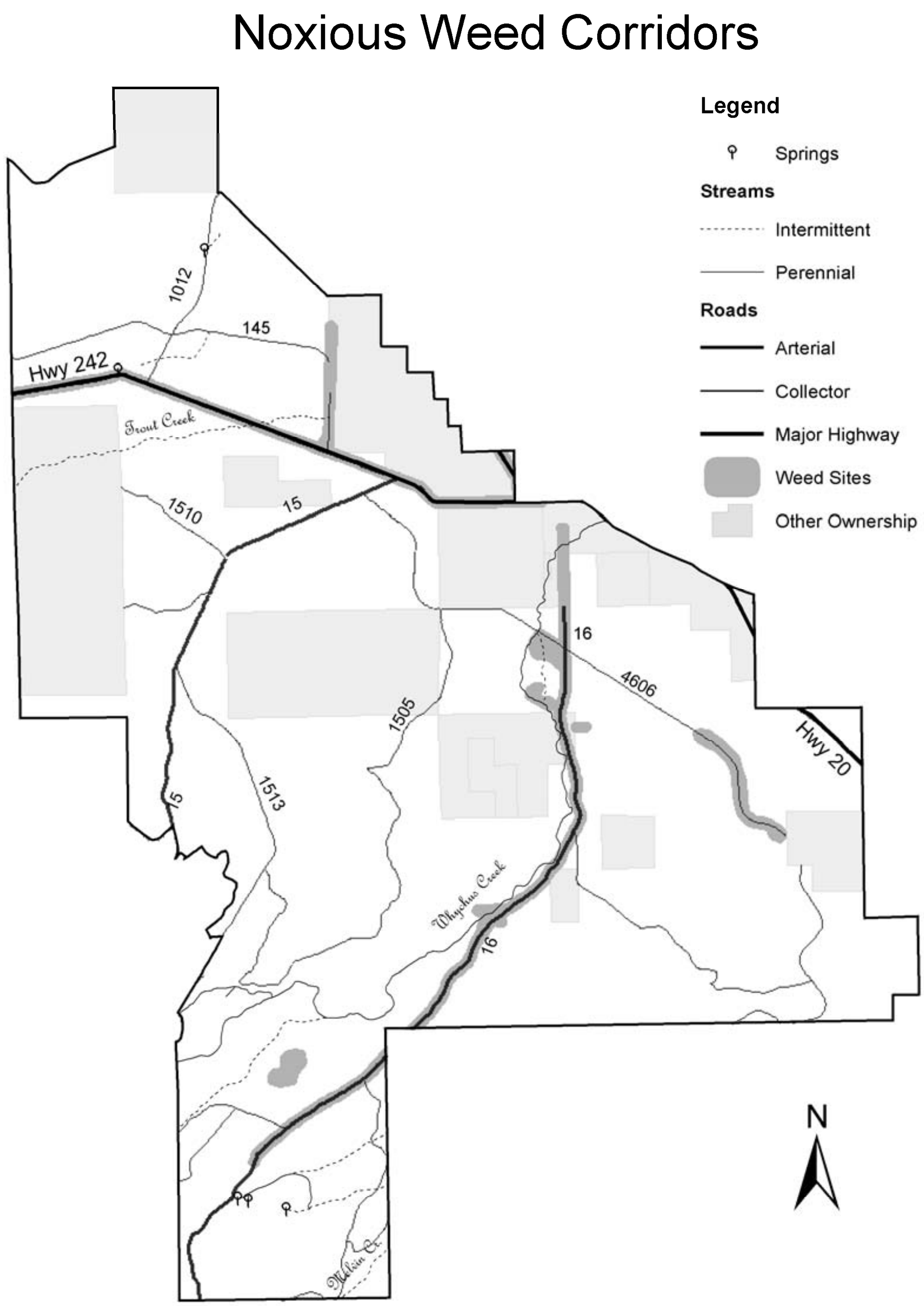
Vectors Ranked in Order of Weed Introduction Risk

1. Heavy equipment (implied ground disturbance) (YES)
2. Importing soil/cinders/gravel (NO)
3. Presence of OHVs (YES)
4. Grazing (long-term disturbance) (NO)
5. Pack animals (short-term disturbance) (NO)
6. Plant restoration (NO)
7. Recreational use involving other than OHVs and pack animals (hikers, mountain bikers, mushroom harvesters, etc.) (YES)
8. Forest Service project vehicles on site (YES)

Discussion of Ranking

This project has been given a HIGH risk ranking for the introduction and spread of noxious weeds because noxious weed sites exist within the project area and project operations will include heavy equipment working in areas adjacent to noxious weed sites.

Figure 32: Noxious Wed Corridors in the SAFR Planning Area



Environmental Consequences

Alternative 1 (No Action) – Ecological Trends

Threatened, Endangered or Sensitive (TES) Plants

Measure #1: Acres of treatment within identified populations of Penstemon Peckii.

In the absence of project-related activities, Peck's penstemon occurrences with the project area would experience no elevation in current short-term risk of either direct, disturbance-related mortality, or of introduction and spread of invasive plant species. Conversely, in the absence of proposed fuels reduction activities, Peck's penstemon habitat will, over time, be increasingly at risk of degradation due to increasing tree and shrub cover, loss of bare soil for seed germination and seedling establishment, and reduction in the collection of precipitation runoff in habitat areas.

Invasive Plant Species

Measure #2: Acres of treatment within identified populations of invasive plant species.

Under this Alternative, no actions will be undertaken that would promote the introduction and spread of invasive plant species. Hence, no elevation of existing weed risk is associated with this Alternative.

Alternative 2 – Direct and Indirect Effects

Threatened, Endangered or Sensitive (TES) Plants

Measure #1: Acres of treatment within identified populations of Penstemon Peckii.

Proposed fuels-reduction treatments in the SAFR project include mowing, mechanical and hand thinning and prescribed underburning. Previous formal and informal monitoring has indicated that the effects of mowing, hand-thinning and underburning in Peck's penstemon populations are compliant with the direct mortality limits established in the Peck's Penstemon Species Conservation Strategy. Mechanical thinning has also been observed to be compliant with Conservation Strategy direction for "managed" populations, when standard soil protection measures are followed. Mechanical thinning in "protected" populations of Peck's penstemon is highly likely to exceed the limits of direct mortality established in the Conservation Strategy. Hand-thinning, however, is an allowable option in "protected" populations.

Given the above information, and adherence to project design measures and mitigations the Action Alternatives pose acceptable negative direct effects to Peck's penstemon. Given the well-documented value to Peck's penstemon of periodic, low intensity fire or other cover-reducing phenomena, the Action Alternatives suggest positive indirect, long-term benefits to local Peck's penstemon populations.

However, the Action Alternatives pose indirect, long-term risk to Peck's penstemon plants and habitat through its promotion of the introduction and spread on invasive plant species. The ground disturbance and general reduction in native vegetation cover associated with this project will result in an increased risk of inadvertent introduction and dispersal of invasive plant species, and the modification of existing habitats will favor establishment of invasive plant species. However mitigation measures are provided to reduce the risk.

Invasive Plant Species

Measure #2: Acres of treatment within identified populations of invasive plant species.

Fuels reduction activities proposed in the Action Alternatives - mowing, thinning, and burning - could result in soil disturbance and a reduction in vegetative cover and litter. These habitat alterations could promote establishment of invasive plant species. The heavy equipment used in affecting these habitat alterations could cause a high risk of inadvertent dispersal of existing weed propagules within the project area. Mitigations have been developed to reduce, but not eliminate weed risks associated with this project.

Alternative 3 – Direct and Indirect Effects

Threatened, Endangered or Sensitive (TES) Plants

Measure #1: Acres of treatment within identified populations of Penstemon Peckii.

There are no differences between Alternatives 2 and 3 in the types and amounts of proposed treatments within the project area. Likewise, the amount of temporary road use is the same in each of these alternatives. Based on this information, it is anticipated that direct effects to TES plants (Peck's penstemon) will be similar under Alternatives 2 and 3.

However, as explained below, there is cause to anticipate that the risks of damaging indirect effects due to invasive plant introduction and spread will be somewhat greater under Alternative 3 than under Alternative 2.

Invasive Plant Species

Measure #2: Acres of treatment within identified populations of invasive plant species.

It has been projected (see Soil Productivity section of this chapter) that, under Alternative 3, failure to meet stated silvicultural objectives of this project will result in an increase in the number of treatment entries into stands over their rotation periods. It is anticipated that these additional entries will result in a higher risk of introduction and spread of invasive plants under Alternative 3 than under Alternative 2.

Alternatives 2 and 3 – Cumulative Effects

Threatened, Endangered or Sensitive (TES) Plants

Measure #1: Acres of treatment within identified populations of Penstemon Peckii.

Many decades of fire suppression has likely resulted in a general decline in quality of habitat for Peck's penstemon on Sisters Ranger District. Recent large fires on the District (Cache, Eyerly, Link and B&B complex fires of 2002 and 2003) have countered this general decline in habitat quality. Sixteen percent of all area occupied by Peck's penstemon on the District has been burned in these fires. Peck's penstemon plants observed after the B&B fire were responding positively by increasing in size and flowering density.

Prior to the establishment of the Conservation Strategy, many timber sales and overstory removals, were completed within Peck's penstemon populations and habitat. Although many plants were likely damaged or destroyed by ground disturbance at the time of the sales, plants are now often abundant in old sale units, clearcuts and landings, indicating that the plant is tolerant of disturbance and has recolonized the areas. Road and campground building permanently displaced some habitat areas, although plants are often found along roads and in campgrounds today.

Since protective guidelines for management of Peck's penstemon were established by the Conservation Strategy in 1992, numerous salvage sales, forest health thinning, watershed improvements (largely road and culvert maintenance) and recreational projects on the District have occurred within Peck's penstemon habitats and populations. Guidelines have been followed which limited expected detrimental disturbances within both managed and protected populations to levels unlikely to lead to a trend to Federal listing.

The major negative cumulative effect associated with past and current management activities, past and current human activities (including recreation and travel), and wildfires in the Metolius watershed, is the introduction of noxious weeds and creation of disturbed habitats for weed invasion. Risk of weed introduction and spread into rare and common habitats on the District has been increased by wildfire and past and current management activities. Mitigation measures and District Weed Control Programs, including monitoring, are in place and their effectiveness will rely of future Weed Program support.

Invasive Plant Species

Measure #2: Acres of treatment within identified populations of invasive plant species.

The SAFR project is joined by several other large-scale projects/events, recent or planned, that will increase the risk of the spread of invasive plant species on the Sisters District. The B&B Complex, Eyerly and Cache Mountain fires of 2002 and 2003 burned well over 100,000 acres of forest that receives light to moderate recreational use and is infested to varying degrees with noxious weeds. The Metolius Basin Forest Management Project, in the initial stages of implementation in the fall of 2004, will result in extensive forest thinning, in an area of approximately 12,000 acres. This area receives intensive recreation use and includes several noxious weed sites. Other large acreage, District-scale activities that will increase the opportunities for spread of noxious weeds include the Eyerly Fire Salvage and the McCache Vegetation Management Project. Numerous smaller ground-disturbing projects associated with the Canal 16 Prescribed Burn Project and the Underline Vegetation Management Project has occurred within the project area in recent years. In recent decades, wildfire has occurred over about 3000 acres within the SAFR project area boundary.

Fish

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Fish Report. Reference information is contained in the full specialist report.

Affected Environment

Fish species with habitat within the project area include the native bull trout, redband trout, Mid-Columbia steelhead trout, Mid-Columbia spring Chinook salmon, mountain whitefish, bridgelip sucker, various sculpins, long nose dace and speckeled dace. The redband trout of the Inland Columbia River drainage and Mid-Columbia spring chinook salmon are on the Forest Service Region 6 Sensitive species list, while the bull trout and Mid-Columbia steelhead trout are listed as a threatened species by the U.S. Fish and Wildlife Service and National Marine Fisheries Service, respectively. Chinook salmon habitat is listed as Essential Fish Habitat under the Magnuson Stevens Act. Introduced game fish species within the project area include, but are not limited to, brown trout, brook trout, and rainbow trout (non-native strains).

Within the project area, Whychus Creek has native redband trout and habitat for Chinook salmon and steelhead. Bull trout are present in the lower 1.5 miles of Whychus Creek but have not been reported within the project area in 50 years. Pole Creek is a fishless stream other than reported introduced trout from ponds on the ditch network downstream of Pole Creek Swamp. Trout Creek has native redband trout upstream of the project area, but is intermittent/ephemeral in the project boundary.

Riparian Management Objectives- INFISH

The Riparian Management Objectives (RMOs) from INFISH are listed below in Tables 79 and 80. Not all of the described features may occur within a specific stream segment of a stream within a watershed, but all generally should occur at the watershed scale for stream systems of moderate size.

Table 79: Interim Riparian Management Objectives (RMOs) (USDAa 1995)

Habitat Feature	Interim Objectives
Pool Frequency	Varies by channel width (See Table below)
Water Temperatures	No measurable increase in maximum water temperature (7-day moving average of daily maximum temperature measured as the average of the maximum daily temperature of the warmest consecutive 7-day period.) Maximum water temperatures below 59° F within adult holding habitat and below 48° F within spawning and rearing habitats.
Large Woody Debris (forested systems)	East of Cascade Crest in Oregon, Washington, Idaho, Nevada, and western Montana: >20 pieces/mile; >12” diameter; >35’ length.
Bank Stability (non-forested systems)	>80 percent stable.
Lower Bank Angle (non-forested systems)	>75 percent of banks with <90° angle (i.e., undercut).
Width/Depth Ratio	<10, mean wetted width divided by mean depth

Table 80: Interim objectives for pool frequency

Wetted width (feet)	10	20	25	50	75	100	125	150	200
Pools per mile	96	56	47	26	23	18	14	12	9

Existing Conditions

The proposed project would occur within 33,272 acres of the Whychus and Deep Canyon Watersheds. This watershed has habitat for bull trout (*Salvelinus confluentus),* a federally listed threatened species, and interior redband trout (*Oncorhynchus mykiss)*, which is on the Regional Forester's sensitive species list. Redband trout occur within the project boundary (Table 79) and bull trout occur downstream of the project area near the Whychus Creek confluence with the Deschutes River. Essential Chinook salmon *O. tshawytscha* habitat is also defined by National Marine Fisheries Service (NMFS) within the Whychus Watershed. Mid Columbia steelhead trout (listed threatened below Pelton Round Butte Dams, were also native to Whychus Creek and are planned for reintroduction starting in 2007. These species will be used to analyze the effects to aquatic fish habitats, including habitat of other native species associated with similar habitats.

Other fish species that occur within the project boundary, including: brook trout (*S. fontinalis)*, brown trout (*Salmo trutta)*, kokanee salmon (*O. nerka)*, mountian whitefish, (*Prosopium williamsoni)*, longnose dace (*Rhinichthys cataractae)*, speckeled dace (*Rhinichtys sp*.) and sculpin (*Cottus* sp.) (Fies et al 1996). All these species but kokanee salmon inhabit Whychus Creek within the project area.

The Deschutes River population of interior redband trout spawns from April to July (Fies et al 1996). The redband trout have been confirmed to be a native population with very little hatchery influence (Phelps et al. 1996). In 1997 a subset of habitat units were snorkeled and electrofished between the gauging station and Squaw Creek falls (Dachtler 1997). Species composition in this section was 93% redband trout and 7% brook trout. The estimated size of redband trout ranged from one to eleven inches with an average size of 6.6 inches. Fishing pressure in Squaw Creek is very light, with slightly more pressure around the gauging station. The stream offers excellent opportunities to catch small redband trout on a scenic stream with little to no competition from other anglers. Habitat for redband trout in Trout Creek is intermittent in the project area and flows approximately once every 5 years.

Chinook salmon and sockeye salmon have been released on an experimental basis into the Metolius River and selected tributaries. The upper Deschutes and Crooked River basins have been identified as Essential Fish Habitat under the Magnuson-Stevens Act. This act protects habitat important to commercial ocean fisheries. The listing included the Upper Deschutes Subbasin because of the plan for renewed fish passage for anadromous fish at Pelton Round Butte Dams. Under the new hydropower operating license for Pelton Round Butte Dams, fish passage will be a part of the new operation at the dam complex on the Deschutes River. This proposed reintroduction marks a return to anadromy to the watershed. Chinook salmon may be released for reintroduction as early as 2007 under the fish passage plan for Pelton Round Butte Dams. Returns of adult salmon to the watershed are not expected until at least 2012.

Steelhead trout were found in the project area prior to the construction of Round Butte Dam in 1964. The summer steelhead run ended in 1968 when the upstream passage was stopped at the Pelton Round Butte hydroelectric project. Today the Mid Columbia population is listed as threatened below the dams, but in the initial stages of renewed fish passage at the dams, marked fish will not be considered listed. Habitat in Whychus Creek may be important for steelhead trout upstream of the Pelton Round Butte Dams, with as many as 1000 spawners returning to Whychus Creek counted in the late 1950s, prior to Round Butte Dam Construction (Nehlsen 1995). Steelhead fry are scheduled for reintroduction into Whychus Creek downstream of the SAFR project area in June 2007. These fish will be considered listed as Threatened under the Endangered Speices Act.

Brook trout have been introduced in high mountain lakes, primarily in the wilderness areas. Fish introduced to the lakes in some cases are suspected to reduce native amphibian populations. These introduced brook trout populations could also be distributing downstream in the watersheds that contained native bull trout. Brook trout reside in Whychus Creek, primarily downstream of the project area or in the high elevation tributaries in the wilderness.

Brown trout were introduced in the 1930's (Fies et al. 1996). Brown trout populations are not monitored in Whychus Creek but tend to dominate the population of trout in lower reaches. Within the project area, brown trout are not common. Brown trout are found in the Deschutes River and in Lake Billy Chinook.

Table 81: Miles of fish habitat in Whychus Creek for each species of concern within the project area.

Species	Mile of existing habitat	Miles of potential habitat
bull trout	**-**	**10.5**
redband trout	**10.5**	**-**
chinook salmon	**-**	**10.5**
steelhead trout	**-**	**10.5**
Total fish habitat in project area	**10.5**	**10.5**

Water Temperature

Upstream of the Three Sisters Irrigation District diversion, water temperatures remain cold throughout the season because of the high elevation snow and glacier melt that feeds Whychus Creek and its many tributaries. The lower macroinvertebrate densities combined with cold temperatures and habitat fluctuations may help explain why fish are small and grow slowly in the Wild and Scenic River sections of Whychus Creek, with a seven day average max temperature of 14.1 ^{o}C. Below the main water diversions at the 4606 rd, Whychus Creek can reach 18.8 ^{o}C, above optimum temperature for redband trout production and above ODEQ temperature criteria for 303(d) listed streams (7 day average max =18 ^{o}C).

In winter, the stream is cooled by the wide channel profile and the high elevation source of water. Ice can form on the bottom of the streambed in cold periods (anchor ice) and ice dams can form from edge ice breaking loose during freeze thaw cycles. Frequent cycles of this ice formation process can reduce over wintering habitat quality for fish. Riparian cover along the stream banks could reduce this process but not eliminate it.

Streambed Embeddedness

Whychus Creek has not been sampled for embeddedness but during stream surveys, surface sediment was sampled using pebble count methods. Whychus Creek had more fine sediment in the two reaches just upstream of Sisters, reflecting some gravel embeddedness may be occurring there. Fine sediment in the upper reaches was nearly half that of that near Sisters. High embeddedness can restrict winter rearing habitat for juvenile trout and salmon by filling in spaces between rocks in the streambed that could be used as cover for fish. Also, macroinvertebrates use the gravel for hiding and feeding and the more fine sediment the fewer habitats for macroinvertebrates. Aquatic macroinvertebrate sampling results for Whychus Creek collected near the gauging station during 1989-1999 (Lovtang and Riehle 2000) showed the macroinvertebrate community was not very diverse but had a good representation of water quality sensitive taxa. Clean water taxa richness was reduced at the Forest Road 4606, likely a reflection of high temperatures and fine sediment.

Large Wood

Large wood is an important habitat feature for bull trout, Chinook salmon and other salmonids. It can create pools and form side channels. It is also used as cover for all stages of fish. Whychus Creek once had wood jams in the 2 reaches just upstream of Sisters but due to flooding during the 1964 flood, wood was removed to straighten the channel (USDA 1998). This alluvial reach was potentially the important spawning habitat for steelhead and Chinook salmon due to the lower gradient and pool riffle morphology. Wood may have played an important role in creating this habitat and the complex side channels that were important for rearing fish.

In 1997, wood densities in Whychus Creek of wood greater that 12 inches in diameter were from 11 to 48 pieces per mile. INFISH RMOs call for a minimum of 20 pieces/miles if no other criteria are developed through watershed analysis. In the lower reaches, just upstream of Sisters, the stream may be under that goal (USDA 1995a).

The primary wood recruitment zone for streams which gain most of their wood from tree mortality is within 100 foot slope distance from the stream bank (Benda et al. 2002). Benda and others studied wood recruitment rates for streams based on dominant process (ie. tree mortality, bank erosion or landslide). On Prairie Creek, a coastal stream in an old growth forest in the northern California, the primary source of wood was found to be bank erosion and mortality. Over 90% of the wood entered the channel from within 30 meters slope distance of the stream edge. In the Whychus watershed, the trees are much shorter but bank erosion is also active. Therefore wood recruitment is expected to approach the Benda et al. (2002) theoretical recruitment prediction for streams in which 100% of the wood is recruited to the channel in less than 30 m (Figure 6 of Benda et al. 2002,).

Riparian Habitat Conservation Areas (RHCA) contribute to fish habitat by providing shade, large wood and fine organic matter, stable vegetated floodplains and filtering from runoff from uplands. The RHCAs near Sisters along Whychus Creek had nearly 8% dominated by large trees and 29% in medium sized trees. Large trees are important for wood sources to Whychus Creek because of the flashy flow regime and the need for wood to be large to remain in channel. Nearly a quarter of the near stream RHCA (within 100 ft of channel) was in grass/shrub, water/rock, or developed/agriculture. This is a substantial amount of streamside that is not contributing to fish habitat by providing adequate large wood, functional floodplains, and runoff filtering.

Pool Frequency/ Pool Quality

Periodic high flows most likely change the locations and amounts of woody debris on a regular basis. This in turn can change the amount and location of slow water fish habitat. Pools per mile on Whychus Creek were between 4-16 pools/mile. The highest pools per mile on all of Whychus Creek are found in the Section 17, upstream of the 4606 road. This is a reach were flood flow can leave the main channel and overflow into a side channel (Dachtler 1997). It is also a low gradient reach with good riparian cover and mature riparian trees. This reach is considered a hot spot for fish production as improved water management improves summer water temperatures.

Average pool depth varied between 1.9 and 3.0 feet in Whychus Creek in the project area. Pool depth may be linked to stability of the channel and wood, both features that have been altered since the 1964 flood repair work by the Army Corps of Engineers. Without the wood and streambank stability, the stream may have a reduced potential to form stable deep pools. Pool habitat is important to fish production and critical to chinook habitat. Most deep pools were found in the reach just upstream of Sisters.

Pool frequency is low (Table 82) in many of the reaches of Whychus Creek when compared to INFISH RMOs. Pool quality for fish is described as large pools with greater than 3 ft in depth and pools with abundant cover from large wood. Reach 1 has good pool quality habitat in the project area.

Table 82: Inventoried pools, average residual pool depth, and number of pools with large wood in stream reaches of Whychus Creek within the project area. Reach 1 begins at the Sisters city limits and Reach 3 ends near the upstream project boundary to the west.

STREAM	REACH	Average residual pool depth ft	Pools / mile	Pool >3ft deep/mi	Pools with 1-3 large logs	Pools with > 3 large logs
Whychus Creek	1	2.3	16.1	10.4	9	3
	2	3.1	5.36	5.36	1	0
	3	2.9	5.41	5.21	2	2

Off-Channel Habitat

Off channel pool habitat varied in Whychus Creek in reach 1, near Sisters, depending on water flow. At 29 cfs, the reach had near 4000ft^2 of off channel habitat, and at 7 cfs the same reach had around 1400 ft^2(Dachtler 1997). Most off-channel habitat was in the form of alcove pools and secondly backwater pools. These habitats are important for fry and small juvenile fish for rearing habitat and also for all fish to escape the high velocities of high flows. Side channels made up less than 7 % of the habitat area of Whychus Creek. These off-channel habitats may have been reduced when the stream was channelized after the 1964 flood.

Spawning Gravel Quality

Quality spawning gravels exist in pockets and in pools throughout the canyon sections although it probably only comprises a small portion of the habitat because of the long riffle/rapid sections and the dominance of cobble, boulders and bedrock. The 2.1 mile section below the 1514 road is primarily gravel and cobble substrate with pools separated by long riffles. In the reaches near Sisters, gravel quality is reduced, with fines less than 6.4 mm (1/4 inch) in diameter making up 22 to 28% of the surface of the stream bed (Dachtler 1997). This may be a reflection of lower gradient and lowered stream bank stability.

Currently the Sisters Ranger District is implementing the Whychus Creek Riparian Protection Project to reduce RHCA impacts from intensive dispersed recreation along Whychus Creek. This project will reduce riparian user created roads, fords through the creek and floodplains. Boulders are being placed to restrict off road vehicle use and prevent vehicles from driving in the stream. This project will reduce some of the impacts to streamside vegetation and sources of sediment from riparian roads.

Fish Passage

There are no culverts that present fish passage barriers within the project area on Whychus Creek (USDA file data). All crossings of road are bridges or fords. Some bridges restrict floodplains and straighten channel meanders that may cause increased stream bank erosion downstream of these bridges. In particular, the old bridge at the Forest Road 4606 is a clear example of this problem.

Also, just outside of the project area and along the western boundary, the culvert on North Pole Creek is likely undersized and there are reports of fish being observed above this culvert. Although surveys in Pole Creek have found no fish, fish may have been introduced to North Pole Creek in the past.

Trout Creek has a native population of redband trout high in the watershed outside of the project area. The ephemeral connect of the Trout Creek through the project area to Indian Ford Creek may serve to connect the populations genetically, as fish move from Indian Ford Creek to Trout Creek, or the reverse, during floods. This connection is brief and may not occur very frequently. After the 400rd culvert is replaced and others are removed under the Black Crater BAER plan, it is unlikely that other culverts in the project area would prevent this connection.

Refugia

With improved water management in the reaches of Whychus Creek below the Three Sisters Irrigation District diversion, a link between the springs of Camp Polk and the upper reaches of Whychus can be made. The upper undiverted reaches of Whychus Creek serve as a summer time thermal refuge and the lower reach may serve as a winter refuge for deeper, slower water. The flats of the reaches near Sisters, and the spring fed reaches near Camp Polk and Alder Springs are considered refugia for spawing and rearing trout and salmon. Cold water enters Whychus Creek from Pole Creek Swamp may also reduce summer time temperatures and represent a contribution to the upper reach of Whychus Creek as a summer thermal refuge.

Stream Bank Condition and Floodplain Connectivity

Width to depth ratios of 16 to 22 are high in Whychus Creek and may reflect instability and channel alterations from the past (Dachtler 1997). Water withdrawals reduce the wetted width of the channel and increase stream bank erosion due to a lack of consistent water to support good riparian vegetative cover. Due to the dry, loose soil inherent in the glacial and volcanic deposits of the stream valley, and the flashy flow regime, the stream has some inherent stream bank erosion potential. Restriction of the channel and reduced access to floodplains may have been reduced through the channel deepening during the channelization that occurred after the 1964 flood.

Floodplains of Whychus Creek may have been broad and may have included a large area where flood channels carried water in short periods. These flood channels may have served to relief the energy of peak flows and reduced overall stream bank erosion on the main channel. Examples of this are just upstream of the 4606 road and Camp Polk Road. Most of the flood side channels have been cut off or the channel elevation has been lowered during the channelization. These impacts serve to confine the floods to the main channel and concentrate peak flows in the one main channel.

Environmental Effects

A Fish Biological Assessment (BA) was prepared to document and review the findings of the Sisters Area Fuels Reduction Project for potential effects on species that are: listed or proposed for listing by the US Fish and Wildlife Service as Threatened or Endangered; or designated by the Pacific Northwest Regional Forester as Sensitive; or required consultation with the National Marine Fisheries Service under the Endangered Species Act or Magnuson-Stevens Fishery Conservation Act. It was prepared in compliance with the requirements of Forest Service Manual (FSM) 2630.3, FSM 2672.4, and the Endangered Species Act of 1973, as amended (Subpart B; 402.12, Section 7 Consultation).

The effects of the Sisters Area Fuels Reduction Project will be assessed using bull trout, redband trout/steelhead trout and Chinook salmon habitat requirements. Other fish species that are sympatric with these species will have similar habitat requirements associated with the listed species. Listed species will be surrogates for the other species and their habitat needs. Effects to fish and fish habitat were considered for the proposed activities, together with past projects, present and the reasonably foreseeable projects listed on page 66-67. When appropriate, particular projects that are specifically related to the effects analysis are discussed in more detail. The timing of the effects of the project effects are in the range of decades after the project is implemented. In the example of sedimentation, the effects of past projects and future projects may last until adequate flows occur to move the substrate.

Alternative 1 (No Action) – Ecological Trends

Measure #1: Water Temperature (maintain stream shade as measured by solar pathfinder)

For Essential Fish Habitat for Chinook salmon, and Mid Columbia steelhead trout, water temperature criteria is between 10 and 13.8^{o}C for an appropriately functioning system (NOAA criteria, programmatic Biological Assessment, USDA and USDI 2003a).

Under the No Action Alternative no shade will be removed and no change in flood plains will occur. Riparian trees will continue to grow. There are no direct or indirect effects from this alternative because no shade will be removed, no measurable change in shade will occur and therefore no cumulative effects are expected.

No effect will occur from no action to water temperature on Trout Creek because it is intermittent and no change to Pole Creek will occur because no change to the riparian zone vegetation will occur.

Measure #2: Streambed Embeddedness (percent gravel/cobble embeddedness)

There will be no Direct, Indirect or Cumulative effects to streambed enbeddeness under the No Action Alternative. The effects of the Whychus Creek Riparian Protection Project will continue and reduce riparian roads and fords, but the no action alternative of the SAFR project will not contribute any cumulative effects. No effect to sediment will occur from no action on Trout Creek and Pole Creek because no change will occur to the riparian zone vegetation or channel processes.

Measure #3: Large Wood (number of large wood pieces per mile)

No direct or indirect effects to fish habitat would occur as a result of the No Action Alternative allowing natural processes to occur without treatments. No direct or indirect effects to wood recruitment would occur that would affect fish habitat in water bodies within or downstream of the project area because no trees will be removed. Wood would be allowed to fall into the stream as it does now and no change in the number of large wood pieces per mile would occur. There would be no effects to fish habitat and therefore there will be no cumulative effects to Whychus Creek at the watershed scale. No effect to large wood will occur from no action on Trout Creek and Pole Creek because no change will occur to the riparian zone vegetation or channel processes

Measure #4: Pool Frequency/ Pool Quality (pools per mile, pool depth, pools with large wood)

There will be no Direct, Indirect or Cumulative effects to pool frequency and quality. No wood will be removed from channel of flood channels. Pools will not change because no actions will be taken to change wood recruitment or in stream wood. Alternative one would not change fine sediment delivery from current levels because roads would not be closed or decommissioned under this alternative. Current levels of fine sediment are not filling pools, nor would it affect pool temperature. No direct, indirect of cumulative effects of no action are expected. No effect to pools will occur from no action on Trout Creek and Pole Creek because no change will occur to the riparian zone vegetation or channel processes

Measure #5: Off-Channel Habitat (percent side channels and off-channel pools)

There will be no Direct, Indirect, or Cumulative effects to off-channel habitats will result from no action because floodplains and streamside areas will not be treated. Therefore, no direct, indirect or cumulative effects will result. No effect to off channel habitat will occur from no action on Trout Creek and Pole Creek because no change will occur to the riparian zone vegetation or channel processes

Measure #6: Spawning Gravel Quality (percent fine sediment in spawning gravel)

Fine sediment will not be affected in the No Action Alternative because current sedimentation rates will not be changed. Since no new projects will occur, no Direct or

Indirect effects to sediment are expected. No Cumulative effects will result from any action. The improvements to riparian filtering from reducing stream ford and riparian user roads from the Whychus Creek Riparian Protection Project will continue under no action. No effect to spawning gravel will occur from no action on Trout Creek and Pole Creek because no spawning habitat exist in these reaches.

Measure #7: Fish Passage (number of fish bearing stream crossings with fish passage improved)

There will be no Direct, Indirect, or Cumulative effects to fish passage will not be changed. Fish barriers in the form of irrigation dams will not be changed in this alternative and therefore no effect to fish passage will occur, either directly, indirectly or cumulatively. No effect to fish passage will occur from no action on Trout Creek and Pole Creek because no change will occur to culverts in this alternative.

Measure #8: Refugia (fish passage, water temperature, spawning and rearing habitat quality)

There will be no Direct, Indirect, or Cumulative effects to fish habitat refugee because stream temperature will not be impacted, spring fed reaches will not be changed, off channel habitats will not be changed and pools will not be changed. Because no action will have no effect on these habitat features, there is no direct effect, indirect effect or cumulative effects of any alternative on fish habitat refugee. No effect to refugia will occur from no action on Trout Creek and Pole Creek because no change will occur to habitats under this alternative.

Measure #9: Stream bank Condition (percent stream bank instability, channel width to depth ratio)

There will be no Direct, Indirect, or Cumulative effects to stream banks by this alternative because road use or prescribed fire will not occur along stream banks of Whychus Creek. Stream stability will not be affected because flow regime of Whychus Creek will not be impacted and floodplains complexity will be retained in no action. No change to width to depth ratios will occur for similar reasons. Therefore, no direct or indirect effects will occur to stream bank condition. No cumulative effects from this project will contribute to that of other projects (page 66) to alter stream bank condition. No effect to streambank condition will occur from no action on Trout Creek and Pole Creek because no change will occur to the riparian zone vegetation or channel processes

Measure #10: Floodplain Connectivity (distance of road fill restricting floodplain)

There will be no Direct, Indirect, or Cumulative effect on Whychus Creek floodplains during floods because there will be no actions that will occur in floodplains. In those reaches that have restricted floodplains, no change will occur under this alternative. No effect to floodplain connectivity will occur from no action on Trout Creek and Pole Creek because no change will occur to the riparian zone vegetation or channel processes

Measure #11: Wild and Scenic River - Fisheries ORV

Whychus Creek upstream of the flow gage and all water diversions has been identified as having outstandingly remarkable value for fisheries based on the stream having a native redband trout population (listed as Sensitive) that is genetically pure and has been isolated for 100 years. It is historic steelhead and bull trout habitat and the aquatic habitat and riparian habitat is in excellent condition (Dachtler 2005). The No Action alternative will not affect this condition and the Outstanding and Remarkable Values will be protected. No effect to fish populations will occur from no action on Trout Creek and Pole Creek because no fish occur in these reaches in the project area.and no change will occur to the riparian zone vegetation or channel processes

Alternatives 2 and 3 – Direct, Indirect and Cumulative Effects

Measure #1: Water Temperature (maintain stream shade as measured by solar pathfinder)

The project proposes to thin 34 acres in the RHCA in areas of Defensible Space along Whychus Creek and Trout Creek. There is an 11.8 acres aspen underburn at Cold Springs that is proposed without thinning. Prescribed burning will not effect the Whychus Creek water temperature because the treatments are outside of the shade zone of Whychus Creek.

Defensible space treatments are not expected to change shade in Whychus Creek because of no cut buffers intended to protect shade and large wood. Unit layout for hand thinning in the aspen stands within the RCHA of Whychus Creek will be off set from the channel at least be 60 foot. Conifers cut, burned or removed by hand from these units are small, less than 9 inches DBH, and are those that do not contribute to shade of the creek. The trees cut will be piled and burned or removed by hand. There is no direct effect of proposed treatments on shade because of the buffer distance and only small trees will be removed. No indirect effects will occur because shade producing trees will not be removed. There will be no cumulative effects on shade or stream temperature from this project and fish habitat will be protected.

Measure #2: Streambed Embeddedness (percent gravel/cobble embeddedness)

Some roads in RHCA will be used in this project for thinning operations and prescribed burns. These roads will have mitigations (see page 55) to prevent any runoff from affecting fish habitat such as water bars/dips and wet condition restrictions. No off road equipment will be allowed in RHCA and therefore no increases in sediment or runoff are expected. Roads may be used as fire lines in RHCAs but this is allowed to avoid constructing fire line at the edge of the RHCA, leading to less soil disturbance and reducing the risk of sedimentation to fish habitat. No direct effects to sediment in Whychus Creek are expected because the roads used in RHCAs are selected to avoid increasing sedimentation or runoff by using low gradient roads and those not in direct proximity to the stream channel.

No indirect effects from burning or upland treatments are expected because prescribed burns along the outside edge of the RHCAs will use existing firebreaks as much as possible. Cumulative effects, with the existing recreation use and the Whychus Riparian Protection Project, are not expected to contribute to measurable cumulative effects to sediment in Whychus Creek or the fish habitat it provides because the effects of the SAFR project will not be measureable.

Measure #3: Large Wood (number of large wood pieces per mile)

RHCA treatments will only remove conifers less than 9 inch DBH and only 60ft or more from Whychus Creek. Therefore no large wood will be removed from the primary recruitment zone. Within the floodplain, wood than could contribute to floodplain function in flood channels will be left on site. Some wood will be removed by hand from the RHCA that will not contribute to the RMOs either by moving wood to existing roads for removal or by burning. Wood in floodplain side channels and boles of large trees in floodplains will be left on site. Since no large wood that contributes to instream habitat will be removed, and no wood will be removed from active flood channels, there will be no effect directly or indirectly on instream wood and habitat for fish. Aspen treatments and upland treatments, together with riparian projects and other recreational activities, will not combine to have cumulative effects on instream wood and fish habitat for the same reasons. No change in instream wood per mile will result from the aspen treatments. Trees removed will not change wood recruitment because of the setback from the stream channel.

Measure #4: Pool Frequency/ Pool Quality (pools per mile, pool depth, pools with large wood)

Pools or pool quality will not be affected by the aspen treatments, burning or upland treatments because instream wood will not be changed because of set backs (page 56), flow regime will not be changed (see hydrology section) and stream stability will not be changed (see hydrology section). Pool formation processes will not be changed in the action alternative and therefore pools will not be directly or indirectly affected. No cumulative effects to pools or pool quality are expected for this and other projects in the watershed because no effects are expected.

Measure #5: Off-Channel Habitat (percent side channels and off-channel pools)

No measurable no direct, indirect or cumulative effects will occur to side channel formation or off channel pool development from the burning and road use. In channel projects will not be done and aspen thinning of smaller trees and the retention of wood in flood channels will protect floodplain and instream wood.

Measure #6: Spawning Gravel Quality (percent fine sediment in spawning gravel)

Sedimentation to fish habitat from prescribed burning, hand thinning and road use in the RHCA will not have a measurable effect on Whychus Creek because no increased in compacted soil will occur and no fire line will be dug in the Whychus Creek RHCA . Roads used in the RHCA will not increase runoff and sedimentation because they will be used in dry conditions, with waterbars installed and under infrequent use. Because of the flat terrain and low erosion risk to the soil, no measurable increases in sediment reaching the stream will occur. Direct and indirect effects are expected to be negligible and the combined effects with other projects will not contribute to cumulative effects because other projects will not increase sediment on a watershed scale. Whychus Riparian Protection Project will reduce overall runoff to the stream from disperse recreation activities.

Measure #7: Fish Passage (number of fish bearing stream crossings with fish passage improved)
There is no change to fish passage culverts proposed in the action alteratives, and there will be no direct, indirect or cumulative effects to fish passage.

Measure #8: Refugia (fish passage, water temperature, spawning and rearing habitat quality)
There is no change to refugia proposed in the action alteratives, and there will be no direct, indirect or cumulative effects. Refugia will not change because there is no change is proposed for sediment, shade, fish passage or other habitat features.

Measure #9: Streambank Condition (percent stream bank instability, channel width to depth ratio)
There is no change to streambank condition proposed in the action alteratives, and there will be no direct, indirect or cumulative effects to streambanks. Streambanks will not be burned in fuel treatments and no change to flow regime or channel width will result from upland treatments (see hydrology section).

Measure #10: Floodplain Connectivity (distance of road fill restricting floodplain)

Under the proposed action, defensible space treatments along Whychus Creek will maintain wood in flood channels, and maintain wood that could potentially fall into the stream channel on Whychus Creek. These treatments will not change the frequency of flooding in the floodplain and will not change the exchange of wood between the main channel and the floodplain. Because these floodplains are forested, little change to the contribution of wood to the main channel will result because of trapping of floodplain wood in the floodplain by standing trees. Floodplain complexity will be maintained by this retention of floodplain wood. Access to flooded areas will not be changed by this alternative since no roads will be removed or added that restrict the floodplain. No direct effects will result, nor will any indirect or cumulative effects be expected.

Measure #11: Wild and Scenic River - Fisheries ORV

Some upland treatments will occur in the Wild and Scenic Corridor along Whychus Creek. These treatments include 364 acres of thinning, mowing and burning in upland areas, outside of RHCA and using existing roads in the corridor for haul and fireline. Within RHCA in the W&S Corridor, but at the outer edge of the corridor, 1.2 acres will be prescribed for burning.

These treatments will not cause changes to fish habitat which was determined to be outstandingly remarkable because sediment and runoff is unlikely to reach the creek because of their distance from the stream and RHCAs. In many cases, the treatments are on the outside edge of the corridor and therefore adequate filtering will occur. Only main roads will be used and riparian roads that were causing problems for riparian and floodplain function are being addressed in the separate project of the Whychus Creek Riparian Protection Project. No measurable sedimentation will reach the stream and impact fish habitat. Stream temperature will not be affected and large wood, flood plains and unique habitats will be protected. The Fisheries ORV will be protected and maintained in the action alternatives.

Scenic

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Scenic Report. Reference information is contained in the full specialist report.

Introduction

The Forest Service established a Scenery Management System (SMS--USDA FS 1995) to protect and enhance scenic resources which may be diminished by human activities, such as vegetation management, recreation and/or administrative facility development. The analysis takes into consideration the balance between social (human) and ecological (natural) needs within the project area. The SMS will be used in conjunction with the Deschutes National Forest Land and Resource Management Plan (LRMP 1990) to analyze the effects of the alternatives on scenic quality.

The Forest Service implementing regulations, currently establish a variety of Scenic Quality Standards (SQO's) for Scenic View Management Areas (MA-9). These standards include:

- Natural Appearing Landscape with High Scenic Integrity Level (formerly Retention, MA-9, SV-1),
- Slightly Altered Landscape with Medium Scenic Integrity Level (formerly Partial Retention, MA-9, SV-2),
- Altered Landscape with Low Scenic Integrity Level (formerly Modification or General Forest, MA-8, GFO) within the Foreground as well as in the Middleground landscape.

Please refer to the 1998 Deschutes National Forest LRMP, MA-9, Scenic Views Allocation and the Handbook for Scenery Management System (SMS--USDA FS 1995) for more detail.

Scenic Quality

High-density vegetation obscures views of areas with high natural scenic quality, including distant views and geological features of lava flows and rock outcroppings, designated scenic corridors, and recreation sites. There is a need to maintain, enhance, and promote the inherent scenic qualities of open park-like stands of ponderosa pine, views of the Cascade Range, and the Whychus Creek Wild and Scenic River.

Scenic View Allocations

Within the project area there are about 6, 253 acres (25%) within Scenic Views (LRMP, MA-9) allocation areas and about 1,222 acres (4.9%) are within the Whychus Creek Wild and Scenic River.

Highway 242, Forest Road 15, Forest Road 16, Metolius/Windego Trail, and Squaw Creek are the primarily scenic view corridors and travel routes through the planning area. Highway 242, Metolius/Windego Trail, and Squaw Creek scenic corridors have been allocated as Natural Appearing Landscape with High Scenic Integrity Level (Retention Foreground Scenic View, LRMP, MA-9, SV-1). Forest Roads 15 and 16 have been allocated as Slightly Altered Landscape with Medium Scenic Integrity Level (Partial Retention Foreground Scenic View, LRMP, MA-9, SV-2).

Distance Zone

There are two primary distance zones that occur within the project area as viewed from a viewer location or a travel corridor, such as an access or travel route. The area is primarily viewed as Foreground (0-1/2 mile) and Middleground (1/2-5 miles) landscape area.

Existing Condition

In general, the planning area may seem a “natural appearing landscape” to the casual forest visitors. However, the current condition is far from being “natural.” Decades of timber harvest and fire suppression have led to a current condition of a highly stocked forest landscape. The area consist of mostly second growth black bark ponderosa pine stands of various age and size classes at lower elevations. There are occasional stands of old-yellow bark ponderosa pine trees existing along scenic and travel corridors. The mixed pine forests dominate areas at a higher elevation, where lodgepole pine forests are mixed with ponderosa pine stands.

Older trees are being suppressed by densely stocked newly regenerated stands due to the changes in the fire regime and other natural disturbance traditionally found through out the project area. The densely stocked forest and canopy closure, due to the lack of low intensity fire regime, has led to the exclusion of the open park-like stands historically found within the project area. Overstock and high density stands in part of the analysis area have led to serious fire risk and degraded scenic quality along scenic and travel corridors and along the Whychus Creek Wild and Scenic River corridor.

The depth-of-field view deep into the forest is restricted to mostly within the immediate foreground area of the landscape due to the high level of vegetation density.

Existing Landscape Character

The planning area encompasses a very dynamic landscape located in the foothill of the Oregon's Cascade mountain range. Within Central Oregon, in general, large wildfires and other forest disturbance processes are highly visible to the forest visitor along major travel corridors. These include Forest Road 18 and Bessie Butte Fires along Highway 97, the Skeleton Fire on Highway 20, and Awbrey Hall Fire on Highway 46 near Bend, The B & B, Eyerly, Cache Mountain and Link Fire along Highway 20 near Sisters, and insect infestation with associated tree mortality on Santiam Pass along Highway 20. These events tend to alter the existing landscape character and scenic quality and integrity from mostly a "natural appearing" to a more "distinctive" landscape, changing the scenery to a degree that is perceived by many to deviate from a landscape character that people value for their aesthetic quality (i.e., it no longer appears as natural, or whole).

Along primary scenic corridor routes, such as Highway 242, Forest Roads 15 and 16, natural disturbances such as past wildfires, insect and disease infestation, wind and snow damage trees are evident. The views along the scenic and travel corridors, in general, are one of a high dense forest within the foreground landscape. Although such forests may visually appear "natural" to some forest visitors, many perceive that the landscape no longer contains the components of healthy landscape, such as open park-like pine stands as a strong characteristic landscape of Central Oregon. Landscapes are primarily viewed by two types of constituents: casual forest visitors who mainly are from outside the central Oregon area, and local residents who tend to be more familiar with forest structure succession and processes.

Pine forests, including Ponderosa and Lodgepole pine, dominate the existing landscape within the project area. Juniper trees intermingle in areas to the east at lower elevations, primarily dryer sites, where annual precipitation ranges between 8 and 12 inches. Sage brush, bitter brush, and Idaho fescue dominate the forest floor. At higher elevations, to the west, where annual precipitation ranges between 12 and 30 inches, dense stands of ponderosa pine are dominate.

Desired Future Condition

The Desired Scenic Condition is to achieve and maintain visual and species diversity in the landscape through variations of vegetation or stand densities, age, and size classes (Deschutes National Forest LRMP, MA-9).

Landscape Character Goals

The goal for the project area is to achieve a natural appearing landscape, such as open park-like ponderosa pine stands, where management direction, the desired future condition, and social and ecological conditions of the management areas are achieved (LRMP MA-9 and MA-19 through MA-28).

Scenic Integrity Objectives

Scenic integrity for project area would be a natural appearing landscape character where various line, form, color, and texture elements can be found throughout the landscape.

Scenic Quality Objectives

Scenic quality for the project area would be a natural appearing character where various line, form, color, and texture elements can be found throughout the landscape. Human alterations, in general, would be subordinate and conform to natural appearing landscape characteristics. Character trees, snags, and small openings, to highlight special features within the landscape, are desirable and encouraged. Where ecologically feasible, diversity in vegetation species, age and size classes would be encouraged (Deschutes NF LRMP MA-9).

Ponderosa Pine-Foreground

Ponderosa pine in Foreground Scenic Views (MA 9-4) will be managed to maintain or create a visual mosaic of numerous, large diameter, yellow-barked trees with stands of younger trees offering scenic diversity as seen from sensitive viewer locations, such as from a travel corridor.

Lodgepole Pine-Foreground

Lodgepole pine in Foreground landscape (M9-51) management will not emphasize large diameter, older trees. Instead, the emphasis will be on managing healthier, fuller crowned, younger trees. A mosaic of even-aged stands and natural-appearing openings of various sizes are desirable.

Ponderosa Pine-Middleground

Ponderosa pine viewed as Middleground (M9-15) will be managed to provide a strong textural element. The present of a few individual large trees with full crowns is an important part of this landscape element. Immature stands are an essential component in the landscape because they help provided strong color contrasts, and eventually become replacements for the larger, old growth trees that perpetuate the desired coarsely-textured character. Visible untimbered openings are desirable where the natural landscape contains similar openings, or where natural-appearing openings can provide additional diversity in the landscape where it is lacking.

Lodgepole Pine-Middleground

Lodgepole pine in the Middleground viewing distances (M9-64) provides a primarily textural landscape element. Constant and often uniform texture and color the trees provide is more important than individual trees and size of trees. For this reason, the mosaic of relatively uniform textures created by maintaining tree canopy closure is an essential part of quality scenery. Natural appearing openings are desirable as long as their shape and size do not dominate the landscape with soil color contrasts.

Mixed Conifer-Foreground

Mixed conifer stands in the Foreground Scenic Views landscape areas (M9-20) will be managed to perpetuate or enhance the characteristic (or natural) landscape. The characteristic landscape normally contains stands that are visually dense, though not necessary continuous. Diversity in tree and shrub species, various age and size classes produce the desired scenic character in the landscape.

Mixed Conifer-Middleground

Mixed conifer stands view as Middleground (M9-34) will be managed to maintain or create a mosaic of stands with essentially continuous tree canopies with scenic diversity provided by natural appearing openings which resemble those found within the natural landscape. Species and size class diversity are an essential part of these viewing distances.

Environmental Effects

The proposed activities assume vegetative management and management activities that upon implementation would create an altered and different forest character that is expected to be more healthy, enhance long-term scenery, and improve the recreational experience.

The effect on scenic resources from the proposed actions, specifically on landscape character, scenic quality, and scenic integrity level, can be classified into two specific categories. The first is short-term effect (0-5 years), and the other is long-term effect (5 years and beyond). The effect from the proposed management activities would be most evident to the visiting public within the foreground landscape (0-1/2 mile corridor) and some part of the Middleground landscape (1/2 to 5 miles).

The unit of measure for the environmental effects, specifically on scenic resources from the proposed management activities, can be categorized into two distinctive areas. They are: 1. Acre (or percentage) of improved or enhanced scenery; and 2. Acre (or percentage) of impacted on short-term scenic quality within the Foreground and Middleground landscape as viewed from a travel corridor or a viewpoint, following implementation. This effect analysis is takes into consideration both short and long-term affects.

Alternative 1 (No Action) – Ecological Trends

Under the No Action alternative an estimated 24, 964 acres within the project area (including 6, 253 acres within Scenic Views (LRMP, MA-9) and 1,222 acres within the Whychus Creek Wild and Scenic River (LRMP, MA-17)) would not be received hazardious fuels treatments. Ecological processes, such as insects and diseases, wind thrown, snow damage/break, dead and down trees, would continue. The area could be at risk of losing key scenic elements to wildfires.

Current management direction would continue (management of recreation use and services, fire suppression, hazard trees removal, standard road maintenance and re-closure of breached roads, etc.). No action would be taken to reduce risk at a landscape-scale level, reduce vegetation density, or reduce heavy fuel loadings that could lead to serious wildfires.

Under this alternative, the area's landscape character, scenic quality, and scenic integrity level would remain essentially the same during the short-term. The long-term landscape character, scenic qulality, and scenic integrity level are expected to change through time as vegetation under goes sucession, altering project area scenery, health and vigor.

Under the No Action alterntive, the Desired Future Condition for Scenic Views (LRMP, MA-9) will not be achieved.

Alternatives 2 and 3 – Direct and Indirect Effects

Under the action alternatives, about 8,338 acres within the scenic view allocation will be treated as part of a fuels reduction and forest health restoration strategy. The proposed treatment activities, which include mowing, underburning, and thinning of timber stands, are expected to alter the existing landscape character from a highly dense forest to a more open condition.

The effect on existing landscape character, scenic quality, and scenic integrity level will be noticeable to the casual forest visitors during the short-term period (0-5 years time) as they travel through along a scenic corridor, such as roads, trails, or the river corridor. The short-term effect(s) is expected to alter existing condition from a densely stocked forest to a more open forest that offers "filtered" views deep into the foreground landscape. Such short-term effect(s) may appear to be a dramatic alteration (to the existing conditions) to both local residents and casual visitors, until stands recover from silvicultural treatments and prescribed burning. Since the proposed treatment areas are within good to excellent growing sites, this process is expected to take between one or two growing seasons.

The long-term (5 years and beyond) effect(s) is expected to be of considerable enhancement and beneficial to the landscape character, scenic quality, and scenic integrity level as silvicultural treatments are expected to improve forest health, increase tree growth rate, and enhance large tree components across the landscape.

Additionally, the various fuels treatment activities, such as mowing and under burning of forest floor, are expected to increase the ground cover components, which add more values to the scenic quality, landscape character, and scenic integrity level within the foreground landscape.

The proposed treatments border with or are adjacent to the following scenic corridors:

- Highway 242
- Forest Road 16
- Forest Road 15
- Metolius Windigo Trail
- Whychus Creek Wild and Scenic River

The proposed actions will provide:

- “Filtered” views deep into the foreground landscape would occur. Rock outcroppings and views of distance buttes will be exposed. The existing landscape character, scenic integrity levels, and scenic quality are expected to be altered and enhanced.

- “Open park-like stands" would be created, primarily through thinning of small trees and mowing and/or under burning of groundcover. This will show case large-yellow bark Ponderosa pine and/or other large tree species, in areas along scenic travel corridors.

- Following treatment the "sequential scenic experience" is expected to enhance a visitor's experience along scenic travel corridors.

- The residual stumps, slashes and debris, following fuels treatment activities, are expected to be minimal and blend well with existing environment. Treatments will not be highly noticeable visible to the “casual visitors” after clean-up treatment activities are completed.

- Prescribed burn scars, mowing, and other fuels treatment activities could be noticeable. The effect(s) of underburning on scenic views can be effectively mitigated to reduce short-term impact on scenery.

- The effect(s) of smoke on local residents in and around Sisters area could be a serious concern as it could cumulatively affect scenic views.

- With effective post treatment activities in place and preservation of residual vegetation, any visual effect(s) encountered under the action alternatives are expect to be subordinate to the existing landscape character. Additionally, mitigation measures will help move the project area closer to meet the desired future scenic quality, expected landscape characteristics of Central Oregon, and maintain and enhance scenic integrity.

Under the action alternatives the Desired Future Condition for Scenic Views (LRMP, MA-9) is expected to meet scenic standards and guidelines.

Wild and Scenic River

An analysis of the action alternatives was conducted to determine consistency with standards and guidelines for scenic rivers (M17-4) in the LRMP (1990). Approximately 1222 acres within the SAFR Project boundary are within the "scenic" corridor, and only 366 acres would be treated by thinning, mowing, or burning. In addition, some existing roads in this corridor would be used for haul. All these actions meet the Standards and Guidelines by maintaining scenic quality of the landscape and by only allowing timber management activates that would enhance scenic, recreational, wildlife, fisheries or hydrologic resources. All activities in the corridor are associated with fuels reduction and forest health.

Alternatives 2 and 3 – Cumulative Effects

Central Oregon is a very dynamic landscape. Whether by way of natural or man-made processes, activities have a cumulative and altering effect on landscape character, scenic quality, and scenic integrity level to various degrees. Individually and cumulatively, these man made and natural processes have created a landscape characterized as "distinctive" or "unique". These man made and natural disturbances have deviated from the previous "natural appearing" Central Oregon's characteristic landscape.

Over the past decade forest management activities in the project area have been planned and designed to help make this fire prone forest environment more resilience. As a result, the cumulative effect on scenery can be classified as one of altering the landscape from an existing densely stocked forest to a more open park-like stand of healthy green forest that helps meet the Desired Future Scenic Condition as defined for Scenic Views (MA-9).

All of the past, present, and future planning projects in the area are expected to contribute toward a more desired forest conditions that meet both short and long-term scenic views.

Heritage Resources

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Heritage Resources Report. Reference information is contained in the full specialist report.

Affected Environment

The scope of the analysis is confined to the project area. There are no other on-going or reasonably foreseeable activities that would affect cultural resources.

Existing Conditions

Thirty two previous projects have been inventoried for cultural resources within the project area. Twenty of them were conducted and documented sufficiently to be used as satisfactory surveys. These previous surveys varied in size from one acre to about 6000 acres. Total area surveyed is approximately 7,360 acres of the 24,970 acre project analysis area.

Current survey in August and September of 2005 covered 800 acres of the project area by pedestrian transects of 30 meter or less intervals. Surveys from several past cancelled projects that were conducted to adequate standards will be utilized in this project, including surveys done in 2000 for the South Trout Vegetation Treatment project and the 1992 Robo Timber Sale project. These surveys included 1000 acres of the project area. Overall, past and current surveys consisted of a sample of the entire project analysis area including all high probability areas (1000 acres) and 34 percent of the low probability areas (8160 acres).

Through these past and present surveys, 79 heritage sites have been located and recorded. Sites are defined by having ten or more artifacts or the presence of features such as a cave, rock art, fire pit remains, or structures. Isolates are defined as not having any features and less than ten artifacts. Recorded sites include historic and prehistoric properties. Six of these sites are considered significant and eligible for inclusion on the National Register of Historic Places. Two sites are considered not significant. The 67 remaining sites are unevaluated and considered to be potentially eligible until an evaluation is completed. The site evaluations completed were done by applying the criteria for eligibility in 36/CFR/60.4.

No use of tribal plants is known for the project area. The Warm Springs, Paiute, and Wasco Tribes from The Confederated Tribes of the Warm Springs Reservation of Oregon are the known tribes with historic associations to this area. The project area is within lands ceded to the Federal Government by The Confederated Tribes of the Warm Springs Reservation of Oregon under treaty in 1855 and ratified by Congress in 1859.

Environmental Effects

Alternative 1 (No Action) – Ecological Trends

Under the no action alternative, no sites would be affected because no actions would be undertaken.

Alternatives 2 and 3 – Direct and Indirect Effects

Under the action alternatives, a combination of fuels treatments by thinning trees, thinning in plantations, mechanical treatment by mowing, and areas of underburning are proposed in various combinations depending on the conditions in different parts of the project area. Overall, the action alternatives includes treatment at the location of 55 different heritage resource sites. Two of these 55 sites are not eligible and do not require any further protection from project impacts. The remaining 53 are either eligible (8) or unevaluated (45) and are required to be protected from impacts that would detract or destroy the characteristics of the resource that does or may contribute to eligibility for the National Register of Historic Places. Sites will be protected through project mitigations.

Since no traditional use plants are known to be utilized from the project area and no traditional, ceremonial, or religious sites have been identified, there will be no effect on tradional uses, religious uses, or treaty right plant or animal gathering practices.

Alternatives 2 and 3 – Cumulative Effects

Under this project, any and all effects are expected to be avoided or mitigated (see mitigation and monitoring) resulting in no cumulative effects. Past effects to heritage resources in the projectd area that could be identified are discussed below.

Many of these sites are found adjacent to rivers and streams. A number of sites have been impacted by recreation sites along these waterways, and by dispersed recreation such as hiking trails, fishing locations, and dispersed camping sites. Other sites in the project area have been identified and damaged by roads established in historic and recent times, past fires and firefighting efforts, past vegetation management activities, or non-recreational development of buildings or utilities. Several sites have undetermined source disturbances or natural disturbances. Overall, approximately 64 of the 79 known sites have existing disturbance from one or more of these sources.

Thirty three of the significant or unevaluated sites have been affected by a road being present in the site that has damaged or disturbed historic or prehistoric materials. Fourteen sites have some type of recreation use or development that has affected the site. These include developed campgrounds, trails, summer homes, and dispersed camping sites. Thirty sites have been affected by past vegetation treatment through commercial logging, precommercial thinning, revegetation, or other past vegetation treatments. At least twelve sites have been affected in the past by natural causes such as rodent or insect burrowing or natural deterioration of historic components. Two sites have been identified that have been impacted by past development other than recreation including utility installation or building construction. At least eight sites have been affected by past wildfires, controlled burns, and/or firefighting activities.

Many of the sites have more than one impacting agent so the numbers of "impacts" above exceed the number of sites impacted. Only a few (six) of the sites appear to not have any impacts from past human activity or natural causes. Six of the sites have some disturbance from unknown or unidentified sources.

Recreation

The section below summarizes the existing condition information, along with the direct, indirect and cumulative effects as analyzed in the SAFR Recreation Report. Reference information is contained in the full specialist report.

Affected Environment

The types of proposed activities that may affect recreation use in the planning area are harvest, prescribed burning, and mowing that may occur in or near developed trail or trailhead facilities or traditional dispersed use areas, and large-scale disturbances (wildfire, insect or disease).

Existing Condition

Recreation resources include portions of the Metolius-Windigo Horse Trail, Sisters Mountain Bike Trail, Peterson Ridge Trail and Sisters Community trails (which incorporated several level 1 and 2 roads into the system). The area is also widely used for dispersed recreation, much of it concentrated along Whychus Creek.

Environmental Effects

Tree harvest and fuel reduction activities may displace recreationists in the short-term, particularly those who cannot tolerate changes to their traditional recreation setting. Displacement may be due to physically closing access to areas during vegetation management activities and, indirectly by altering the setting. Harvest and post-harvest activities would have the longest duration effect on use by recreationists (several months to 1 year), while prescribed burning and mowing would only physically prevent recreationists from visiting areas during implementation of the activity (one day to several weeks).

Timber harvest and prescribed burning activities can also impact trails if heavy equipment travels across trail treads or harvest debris falls across the trails. Mitigation measures can minimize these impacts and reduce the duration of the effect. In addition, hauling timber along forest roads may also affect visitors by increasing the perceived hazard of traveling along narrow forest roads with log trucks. Tree harvest and fuel reduction activities that occur during seasons other than summer would impact fewer recreationists.

Removal of hazard trees along haul routes and recreation sites would have a positive effect on both the actual and perceived safety of recreation sites and travel routes. An indirect effect from opening dense stands in this project area is the increased ability for people to drive vehicles through the open forest (the project area is relatively flat). There may be an increased risk of off road vehicle use if the forest is easier to drive through. Noise and visibility of timber harvest and post-sale activities adjacent to popular recreation areas could impact opportunities for solitude and isolation from sights and sounds of humans close to recreation sites.

Large-scale disturbances from wildfire, insect or disease, can result in broad changes in recreation settings, particularly by altering the aesthetic quality of settings, the quality of riparian habitat that supports fishing, and by reducing the thermal cover from high summer temperatures and exposure (Evers 2000, Omi 1997). Recreationists would also not be able to visit forest areas during wildfire suppression activities.

Alternative 1 (No Action) – Direct and Indirect Effects

Measure #1: Acres of proposed treatments including thinning, mowing, and underburning.

Under the no action Alternative there would be no impacts on recreationists and forest recreation settings from restoration activities, and there would be no timber hauling from National Forest lands to conflict with recreational traffic. Forest trails would not be impacted.

Impacts associated with no action are a continued high number of acres at risk from severe disturbances from fire, insect or disease, which may reduce the amount of area suitable for recreation activities, and recreation trails could be negatively impacted.

Alternatives 2 and 3 – Direct and Indirect Effects

Measure #1: Acres of proposed treatments including thinning, mowing, and underburning.

Tree harvest and fuel reduction activities would occur under each of the action alternatives, the therefore would result in some level of changes to the recreation setting. Short-term impacts, such as displacement of recreation from areas during restoration activities, and conflicts between recreation and timber hauling along forest roads may have effects on recreation users.

Proposed activities are predicted to reduce the risk of severe disturbances on the acres they occur, and thus would reduce the potential impacts to forest settings for recreation by maintaining more sustainable thermal cover and aesthetic background for recreation activities, and protecting trails.

Alternatives 2 and 3 – Cumulative Effects

Measure #1: Acres of proposed treatments including thinning, mowing, and underburning.

Actions under this project are expected to contribute to the increased perceived and actual safety of recreationists from wildfire on the Deschutes National Forest.

Whychus (Squaw) Creek Wild and Scenic River

The Whychus (officially still Squaw) Creek Wild and Scenic River was designated by Congress in the 1988 Omnibus Wild and Scenic Rivers Act. The designated river extends for approximately 15.4 miles, and has an interim boundary of 1/4 mile either side of the designated river pending completion of a management plan. The river is classified as Wild and Scenic. About 3.5 miles of the Scenic section of the river is located in the SAFR planning area. Until the management plan is completed, the river will be managed according to the objectives, standards, and guidelines in MA-17 of the Deschutes National Forest Land and Resource Management Plan. There are approximately 364 acres in the interim boundary that fall within proposed treatment areas for the SAFR project. These proposed treatment areas are all located within the Scenic classification. According to the 2007 Resource Assessment Geology, Hydrology, Fish, Scenery, and Cultural-Prehistory/Traditional Use are considered "Outstandingly Remarkable Values" (ORVs) under the Wild and Scenic Rivers Act.

The following is a summary of project effects to the Outstanding Remarkable Values of the Whychus Wild and Scenic River.

Geology

Though not specifically addressed in the EA, there will be no project activities, such as temporary or new road construction in the Scenic river corridor, which will affect the Geology Outstandingly Remarkable Value.

Hydrology

Channel morphology and long-term stream flow will not be affected by any project activities. No thinning, mowing or burning will occur within 300 feet of streambanks. In addition, no activities will affect the stream gauge or the flow regime (EA, page 275).

Fish

There will be about 364 acres of upland treatments within the river corridor. These treatments will not cause changes to fish habitat because sediment and runoff is unlikely to reach Whychus Creek. The Fish Outstandingly Remarkable Value will be protected (EA, pages 315-316).

Scenery

The project activities are consistent with Management Area 17-4 standards and guidelines for Vegetation Management in Scenic river corridors. The Scenic Outstandingly Remarkable Value will be maintained (EA, page 323).

Cultural-Prehistory/Traditional Use

Of the 20 significant or unevaluated sites within the W&S interim boundary, three are within treatment units. Avoiding impacts to these three sites as identified in the heritage mitigation plan will protect the outstanding remarkable Wild and Scenic value of prehistoric resources. Protecting these sites as well as the measures to protect the hydrology and fish resources will preserve the Traditional use outstanding remarkable values.

Economics

This discussion examines the alternatives for altering forest fuels at a landscape scale that is intended to affect a change in future fire behavior and forest health. Such a change would improve the chances of protecting valuable resources during future fire events and would likely reduce the costs of management. This section will discuss the financial aspects of this proposed investment.

Important Interactions

Activities associated with the action alternatives may generate various economic benefits and costs, depending on design. However, the economic values provided under these alternatives may be less than associated costs. Agency costs associated with planning and administration are not included in the analysis, but are expected to be similar under the different action alternatives.

Management activities, which incur costs and generate impacts, are also expected to change the risk and intensity of wildfires and their associated costs and impacts. Cost and benefits associated with reducing the risk of moderate to high severity wildfire were not assigned a dollar value. There would, however, likely be changes in resource values such as increases or decreases in wildlife habitat, recreation use and other ecosystem services, and costs associated with wildfire suppression. Non-market values are also briefly discussed.

Market Values

Factors that can affect economic value are the amount of saw timber versus chip/pulpwood, the volume available for sale, and the costs of required brush disposal and road reconstruction. The market value for pulp and chip is considerably lower than for saw logs, and could deter potential purchasers. It is estimated, depending on the alternative, that a majority of the trees proposed for removal from the project area would not be considered suitable for milling into saw logs, but only suitable for pulp and chips.

This project does not have the same objectives as a traditional timber sale, which primarily would be to offer wood products in the most cost efficient manner. The objectives are fire hazard reduction and forest health restoration, or “forest stewardship.” Cost efficiency is desirable, but should not drive the project. Much of the work done on National Forests, other than traditional timber sales, are funded through a variety of means, including appropriated funds, partnerships with other agencies or private entities, and service or stewardship contracts. Those options would be considered as ways to fund the restoration work under this project, as well as through viable timber sales.

There are opportunities to use timber sales to remove material when receipts from sale of the material cover the costs for conducting the timber sale operation. However, since a majority of the trees proposed for removal to meet restoration objectives have very low market value (pulp), a timber sale may not be the most cost efficient way for removing that material. Consequently, alternative funding methods are recommended.

Assumptions regarding values of possible wood products were based on estimated market value in the spring of 2006 for various sizes for ponderosa pine, the primary species to be removed. If the market improves the values would increase, and conversely, if the markets go down, the values would be less. The following assumptions were used in appraising the value of products under the different alternatives:

- Logging costs were based on similar recent offerings.
- Ponderosa pine would be the primary species harvested.
- Total logging costs under Alternative 2 would be 5% higher to allow for the removal of trees between 12” and 21” dbh.
- Hauling costs were based on a haul to Gilchrist, Oregon.
- Chip prices were assumed to be $25/ton.

Table 83: Average selling value for logs delivered to the mill assuming ponderosa pine is the primary species harvested.

Size (dbh)	Value / MBF
<12”	$325
12” to 14.9”	$340
15” to 17.9”	$400

Non-Market Values

The preceding economic analysis was presented from the view of resource utilization, where wood-fiber is a market commodity. The economic principles are fairly well understood and are an important consideration in overall project design and resulting consequences.

Another economic aspect of resource management consideration is the values of "ecosystem services". Ecosystem services can include purification of air and water, generation and preservation of soils and renewal of their fertility, protection of stream channels and banks from erosion during high water, and provision of aesthetic beauty and intellectual stimulation that lift the human spirit. Direct relationships and clear principles for accounting for such things are only beginning to be developed, including how to quantify the value of the forest in its current condition, or the value of standing timber as a form of "natural capital", the biophysical structure that provides ecosystem services (Hawken et al. 1999).

While some ecosystem services may be on a much larger scale than would be measurably affected by this project (e.g. partial stabilization of climate) some of the proposed actions, on a local-scale, can affect certain ecosystem services, and are discussed under the other resources in this Chapter.

Wildfire Costs

The purpose of the action alternatives is to reduce fire hazard and thus the risks from wildfire. It is important to understand there would be costs associated with impacts from a potential wildfire (to people, property and resources) and related wildfire suppression expenditures. Costs to ecosystem services are described qualitatively under the other sections on effects to resources in this Chapter. The average costs of wildfire suppression were estimated by reviewing the average per acre costs of suppression activities in Central Oregon over the last few years.

There is a considerable range to suppression costs, and expenditures are dependent on a variety of factors. Assumptions were made that the more fuel that is removed from the landscape, particularly relating to crown bulk densities, the less severe a wildfire would be and the lower the suppression costs. However, there are many factors that affect suppression costs that cannot be determined at this time; including conditions under which a wildfire may burn (wind speed and direction, fuel moistures, terrain, immediate risks to people, etc…). The average suppression cost should only be used for comparison purposes, and may not reflect actual costs of suppressing a future wildfire in the project area.

The costs for suppressing small wildfires can be significantly greater than the costs for suppressing large wildfires, but clearly the total costs would be less for smaller fires than for large ones (Table 84). It is assumed that firefighters would be better able to control wildfires under the alternatives that reduce surface and ladder fuels and crown bulk densities the most, thus keeping the overall size of wildfires smaller and resulting in lower total costs for wildfire suppression.

Table 84: Average Costs per Acre for Wildfire Suppression from 1987-1997.

Size of Wildfire	Deschutes National Forest Average costs	Sisters Ranger District Average Costs
0.0-0.25 acres	$6,575/acre	$3,290/acre
0.26-9.9 acres	$4,101/acre	$3,305/acre
10 – 99 acres	$3,065/acre	$2,808/acre
100-299 acres	$1,954/acre	$1,886/acre
300-999 acres	$2,133/acre	$2,133/acre
1,000-4,999 acres	$825/acre	$825/acre
5,000 + acres	$286/acre	$286/acre

The estimated costs per acre for the suppression of three of the most recent (2002 and 2003) wildfires on the Sisters Ranger District were about double the average cost over the last decade for their size class. Suppression of the Eyerly Fire (23,573 acres) was estimated at about $454/acre, suppression of the Cache Mtn. Fire (4,200 acres) was estimated at about $1,667/acre and suppression of the B&B fire was estimated at about $420/acre. This may indicate a trend of rising costs for local wildfires.

Employment

The primary effect on local communities would be in terms of employment provided by preparation, implementation and administration of fuel reduction and forest health activities by alternative. The alternatives provide a variety of activities that would require widely varying equipment and skills. The level of benefit to local communities would depend on the capacity of existing contractors residing in the area in terms of skills and equipment, the labor force available to these contractors, the amount of existing work they have under contract, their desire to acquire larger contracts, new contractors seeking opportunities, and other contracting requirements such as programs for small businesses.

The level would also depend on the amount of funding received for activities over the next 5+ years. It is unknown how many and what type of jobs could be created by stewardship contracting opportunities in Central Oregon, or the extent to which they could support or enhance the social well-being and economies of rural communities. However, forest health and fuel reduction employment could help diversify the local economy some, and help increase the community capacity or resiliency (Committee of Scientists 1999).

Another economic benefit from fuel reduction and forest health activities in the SAFR Project area is a supply of wood products to mills in Eastern and Central Oregon and the Willamette Valley. Secondary benefits to employment in the wood products industry could result over the 10+ years during which the project is implemented.

Effects of Alternative 1 – No Action

The main economic ramification of the No Action alternative is that, in the long run, funds that would be spent in the SAFR Planning Area would be for emergency fire suppression, and not for treatments that would reduce the potential for large-scale uncharacteristic fires. Non-market values, or ecosystem services, would not be directly affected under this alternative; however, there would be an increased risk of impacts to many of the local services due to the current extensive areas at risk of high severity uncharacteristic wildfire, insects and disease. There would be no potential net savings in wildfire-related costs and benefits. See descriptions under Alternative 1 (No Action) under the other resources addressed in this chapter for an understanding of non-market values as they currently exist.

Effects Common to the Action Alternatives

Non-market values of ecosystem services would be enhanced under the action alternatives, though short-term impacts would be expected on many of the services (e.g. visual impacts during the project implementation). See discussions under the other resources in this Chapter for an understanding of effects on relevant local ecosystem services.

The action alternatives are compared in terms of total costs and total product values. Table 85 summarizes the estimated costs of vegetation and fuels treatments. Table 81 summarizes the volume and value of products produced. Table 87 summarizes the net value of each alternative (total costs minus total product values). Both of the action alternatives have net values that are “in the red” (costs exceed the value of products), due to the large number of acres identified for prescribed burning, mowing, plantation thinning, small tree thinning and other treatments with little or no product value.

The estimated costs of vegetation and fuels treatments is displayed in Table 85. The costs of the vegetation and fuel treatments were estimated based on recent treatments in projects on the Sisters Ranger District. Mechanical thinning costs were estimated for thinning/harvesting systems such as to cut-to-length and feller-buncher systems. Hand/Mechanical thinning costs were estimated for hand thinning both with and without the use of a small mechanical thinning system such as an ASV or Bobcat with a shear. Hand/mechanical thinning was used for acres with very little potential for product recovery.

The volume and value of products produced is displayed in Table 86 by potential sawlog volume and chip/pulp volume. Sawlog volume is displayed based on the potential volume per acre. Mechanical thinning 1 (MT1) acres are where volumes/acre are predicted to be greater than 1.5 mbf (thousand board feet) and are assumed to be where the value of the products harvested will generally exceed the costs to harvest them. Mechanical thinning 3 (MT3) acres are where volumes/acre are predicted to be less than 0.5 mbf and are assumed to be were the value of the products removed will be less than the costs to remove them. Mechanical thinning 2 (MT2) acres are where volumes per acre are predicted to be between 0.5 and 1.5 and are assumed to be where the value of the products removed may, or may not, exceed the costs to remove them. These assumptions related to volumes/acre are dependent on the value of the products at the time of removal and the size of the material removed.

Table 85: Costs of Vegetation and Fuels Treatments by Alternative.

Treatment	Cost/Acre	Alternative 2		Alternative 3	
		Acres	Costs	Acres	Costs
Thin Plantations + Fuels Clean-up	$270	3,464	$935,280	3,464	$935,280
Dwarf Mistletoe Pruning + Fuels Clean-up	$550	1,941	$1,067,550	1,941	$1,067,550
Mechanical Thinning +Fuels Clean-up	$760	11,897	$9,041,720	11,897	$8,589.634*
Hand / Mechanical Thinning + Fuels Clean-up	$600	1,644	$986,400	1,644	$986,400
Prescribed Underburn	$200	15,320	$3,064,000	15,320	$3,064,000
Masticate (e.g., mowing)	$85	16,055	$1,364,675	16,055	$1,364,675
Total			**$16,479,425**		**$16,027,339**

*The costs for this treatment under alternative 3 is estimated at 5% less than for alternative 2 because alternative 3 does not cut any trees between 12" and 21" dbh.

Table 86: Product Volumes and Values by Alternatives.

Treatments that produce Sawlogs	Alternative 2		Alternative 3	
	Acres	Total Sawlog Volume (mbf*)	Acres	Total Sawlog Volume (mbf)
Mechanical Thinning 1 (≥1.5 mbf/ac)	3,082	6,452	254	446
Mechanical Thinning 2 (0.5-1.5 mbf/ac)	5,612	5,660	5,777	4,584
Mechanical Thinning 3 (<0.5 mbf/ac)*	3,203	782	5,866	1,450
Totals	**11,897**	**12,894**	**11,897**	**6,480**
Total Log Selling Value		**$4,259,000**		**$2,106,000**
Treatments that produce chip/pulp	**Acres**	**Chip / Pulp Tons**	**Acres**	**Chip / Pulp Tons**
Chip / Pulp Material	11,897	59,485	11,897	59,485
Total Chip Selling Value		**$1,487,000**		**$1,487,000**
TOTAL PRODUCT VALUE		**$5,746,000**		**$3,593,000**

*mbf = 1000 board feet

Table 87: Summary of Costs and Values for Alternatives 2, and 3.

Activity	Alternative 2	Alternative 3
Total Costs	$16,479,425	$16,027,339
Total Product Values	$5,746,000	$3,593,000
Net Value	-$10,733,425	-$12,434,339

Effects of Alternative 2

Alternative 2 would be more effective at reducing crown bulk densities than would Alternatives 1 and 3. Thus Alternative 2 thus would be the most effective Alternative for reducing the risk of moderate and high severity wildfire and at reducing the costs of wildfire suppression in treated stands.

Under alternative 2, total costs are estimated at $16,479,425 and total product values estimated at $5,746,000, resulting in an estimated net value of -$10,733,425. Of the 11,879 acres proposed for mechanical thinning, 26% of the acres (3,082) are mechanical thinning 1 (MT1), 47% of the acres (5,612) are mechanical thinning 2 (MT2) and 26% of the acres (3203) are mechanical thinning 3 (MT3). Consequently, under alternative 2, approximately 26% of the acres (MT1) are predicted to yield product values that would exceed harvest costs, approximately 27% of the acres (MT3) are predicted to yield product values that would be less than harvest costs and approximately 47% of the acres (MT2) are predicted to yield product values that may, or may not, exceed harvest costs (i.e., marginal acres)

Effects of Alternative 3

The main economic consideration in alternative 3 is the 12" diameter limit on trees that could be thinned and harvested. In terms of costs for management, alternative 3 would harvest trees only up to the 12" diameter limit, so under current markets and demand for wood products, there would be limited product value. The total cost of vegetation and fuels clean-up treatment is less than Alternative 2 because it is assumed that the cost of mechanical thinning/logging would be slightly lower (perhaps as much as 5% lower) than under Alternative 2.

However, since no trees above 12" dbh can be thinned and harvested, the product value of the material that can be thinned/harvested under alternative 3 is much less than under Alternative 2. Consequently, of the two action alternatives, this alternative has the lowest net value (or highest deficit) at -$12,434,339. Of the 11,879 acres proposed for mechanical thinning, 2% of the acres (254) are mechanical thinning 1 (MT1), 49% of the acres (5,777) are mechanical thinning 2 (MT2) and 49% of the acres (5,539) are mechanical thinning 3 (MT3). Consequently, under alternative 2, approximately 2% of the acres (MT1) are predicted to yield product values that would exceed harvest costs, approximately 49% of the acres (MT3) are predicted to yield product values that would be less than harvest costs and approximately 49% of the acres (MT2) are predicted to yield product values that may, or may not, exceed harvest costs (i.e., marginal acres).

It is assumed that the costs of wildfire suppression in stand conditions created under Alternative 3 would be considerably less than under the no-action alternative, but more than under Alternative 2, because it would not reduce crown bulk densities significantly compared to Alternative 2 (an important factor in crown fires). Consequently, the risk of moderate and high severity wildfire would be less than the no action alternative but more than that for Alternative 2.

Other Disclosures

Civil Rights and Environmental Justice

Government-to-government consultation with the Confederated Tribes of Warm Springs occurred in the form of a scoping letter describing the project area and proposed action. The Confederated Tribes of Warm Springs were also briefed on the project in April of 2005. No special concerns about Tribal resources were identified.

There are no known direct, indirect, or cumulative effects on Native Americans, minority groups, women, or civil rights beyond effects disclosed in the Deschutes LRMP.

Executive Order 12898 on environmental justice requires federal agencies to identify and address any disproportionately high and adverse human health or environmental effects on minority and low income populations. The action alternatives, there would be no disproportionately high or adverse effects to minority or disadvantaged groups qualifying under the environmental justice order.

Congressionally Designated Areas

No Wilderness, Wilderness Study Areas, National Recreation Areas, Old Growth Stands, or Wild and Scenic Rivers would be adversely affected by the proposed activities. No significant irreversible or irretrievable commitment of resources would occur under Alternative 2 (Proposed Action) or Alternative 3.

Prime Farm Land and Forest Lands

The Secretary of Agriculture issued Memorandum 1827 which is intended to protect prime farm lands and range lands. The project area does not contain any prime farmlands or rangelands. Prime forestland is not applicable to lands within the National Forest System. National Forest System lands would be managed with consideration of the impacts on adjacent private lands. Prime forestlands on adjacent private lands would benefit indirectly from a decreased risk of impacts from wildfire. There would be no direct, indirect, or cumulative adverse effects to these resources and thus are in compliance with the Farmland Protection Act and Departmental Regulation 9500-3, "Land Use Policy."

Compliance with Other Polices, Plans Jurisdictions

The alternatives are consistent with the goals, objectives and direction contained in the Deschutes National Forest Land and Resource Management Plan and accompanying Final Environmental Impact Statement and Record of Decision dated August 27, 1990 as amended by the Regional Forester's Forest Plan Amendment #2 (6/95) and Inland Native Fish Strategy, and as provided by the provisions of 36 CFR 219.35 (f) (2005), which address Management Indicator Species.

Implementation of Alternative 1 (No Action), Alternative 2 (Proposed Acton), or Alternative 3 would be consistent with relevant federal, state and local laws, regulations, and requirements designed for the protection of the environment including the Clean Air and Clean Water Act. Effects meet or exceed state water and air quality standards.

Irretrievable and Irreversible Commitment of Resources

NEPA requires that environmental analysis include identification of "…any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. No significant irreversible or irretrievable commitment of resources would occur under Alternative 2 (Proposed Action) or Alternative 3.

- Irreversible: Those resources that have been lost forever, such as the extinction of a species or the removal of mined ore. The proposed activities would result in a commitment of rock for road reconstruction.
- Irretrievable: Those resources that is lost for a period of time, such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of way or road.

CHAPTER 4. CONSULTATION WITH OTHERS

Collaborative efforts began with the development of the Greater Sisters Country Community Wildfire Protection Plan (GSC CWPP) signed in March 2006. The Proposed Action was developed by the ID team with input from the GSC CWPP committee. The Proposed Action was mailed to 500 individuals, organizations, agencies, Tribes, and businesses.

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USDA Forest Service. 1990. Deschutes National Forest Land and Resource Management Plan. Deschutes National Forest, Supervisors Office, Bend, OR.

USDA Forest Service. 1995. unpublished data night snorkel surveys. Deschutes National Forest. Sisters Ranger District. Sisters, OR.

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USDA Forest Service. 1998. Sisters/Why-chus watershed analysis. Deschutes National Forest. Sisters Ranger District. Sisters, OR.

USDA and USDI. 2003. Joint Aquatic and Terrestrial Programmatic Biological Assessment for Lands within the Deschutes Basin Administered by Bureau of Land Management Prineville Office and the Deschutes and Ochoco National Forests. Deschutes National Forest. Bend, Oregon.

Sisters Area Fuels Reduction Project
Environmental Assessment

Appendix A

Scientific Literature Review

Introduction

During the public comment period on the environmental assessment the interdisciplinary team received 64 scientific articles dealing with various aspects of the SAFR project. These articles were reviewed by project team members to determine their relevancy to the project. Each scientific article determined to be relevant to the project was summarized and a response prepared. Some of the materials supplied by the public were newspaper articles or opinion papers not considered to be scientific literature, and were therefore not included in this appendix. For ease of reference articles are organized by resource topic and are not arranged alphabetically. A complete list of received literature, including news articles and opinion pieces not included in this review, is located in the project record, Sisters Ranger District, Sisters, Oregon.

Vegetation Management

Talbert, Cheryl and Marshall, David. 2005. Plantation productivity in the Douglas-Fir Region Under Intensive Silvicultural Practices: Results from Research and Operations. Journal of Forestry. Pages 65-70.

Overview
This paper reviews major plantation silvicultural practices used in the west-side Douglas-fir region of Oregon and Washington: origin, growth and yield impacts, and the region's global competitive status for productivity, tree-growing costs, and returns."

Response
This reference is not relevant to the SAFR project because it is about "…major plantation silvicultural practices used in the west-side Douglas-fir region of Oregon and Washington…" which are completely different forest types than those found in the SAFR project.

Shinneman, Douglas J. and Baker William L. 1997. Nonequilibrium Dynamics between Catastrophic Disturbances and Old-Growth Forests in Ponderosa Pine Landscapes of the Black Hills. Conservation Biology, Vol. 11, No. 6. Pages 1276-1288.

Overview
This paper examines two different views of ponderosa pine landscapes in the Black Hills. "The prevailing "equilibrium" view of ponderosa pine forest landscapes……holds that frequent, low-intensity surface fires maintained open, park-like forests of large, old trees.

Yet a contrasting "non-equilibrium" view suggests that some forest ecosystems are subject to unpredictable catastrophic disturbances that dramatically alter these ecosystems." "We suggest that the ….central and northern Black Hills and topographically protected areas may have been dominated by….a relative state of non-equilibrium." The southern Black Hills, south facing slopes, and exposed areas may have been dominated by….a relative state of equilibrium."

Response
The research for this reference is based in the Black Hills of South Dakota, consequently, the results of this research do not have application to the SAFR project. However, the concepts of equilibrium versus non-equilibrium views of ponderosa pine landscapes may be worth studying in other ponderosa pine ecosystems such as those found in the SAFR project.

Hessburg, Paul.F., Agee, James K., Franklin, Jerry F. 2005. Dry forests and wildland fires of the inland Northwest USA: Contrasting the landscape ecology of the pre-settlement and modern eras. Forest Ecology and Management 211. Pages 117-139.

Overview
This paper "….characterized recent historical and current vegetation composition and structure of a representative sample of subwatersheds on all ownerships within the interior Columbia River basin and portions of the Klamath and Great Basins." "….then translate[s] change in vegetation patterns to change in patterns of vulnerability to wildfires, smoke production, and 21 major forest pathogen and insect disturbances."

Response
The Whychus Watershed analysis is referenced extensively in the SAFR environmental assessment and recognizes many of the changes described in this paper.

Hessburg, P.F., Smith B.G., Salter, R.B., Ottmar, R.D., Alvarado, E. 2000. Recent changes (1930's-1990s) in spatial patterns of interior northwest forests, USA. Forest Ecology and Management 136. Pages 53-83.

Overview
This paper "….describe[s] the key landscape pattern and process changes wrought by the sum of the settlement and management influences to date, and …point[s] to an uncertain future for ecosystem management." "An uncertain future for ecosystem management is based on the lack of current and improbable future social consensus concerning desired outcomes for public forestlands, the need for significant financial investment in ecosystem restoration, a lack of integrated planning and decision tools, and mismatches between the existing planning process, Congressional appropriations, and complex management and restoration problems."

Response
The Whychus Watershed Analysis (USDA, 1998)(EA page 21) is referenced extensively in the SAFR EA and recognizes many of the "…key landscape pattern and process changes wrought by the sum of the settlement and management influences to date…." described in this paper. The SAFR EA also acknowledges "….the need for significant financial investment in ecosystem restoration…" in the economic analysis (EA pages 328-326).

Hessburg, Paul.F., Salter, R. Brion, James, Kevin M. 2007. Re-examining fire severity relations in pre-management era mixed conifer forests: inferences from landscape patterns of forest structure. Landscape Ecology, 22. Pages 5-24.

Overview
This paper "….used forest structure to predict pre-management era fire severity across three bio-geoclimatic zones in eastern Washington State, USA, that contained extensive mixed conifer forests." "The relatively low abundance of old, park-like or similar forest patches, high abundance of young and intermediate-aged patches, and widespread evidence of partial stand and stand-replacing fire suggested that variable fire severity and non-equilibrium patch dynamics were primarily at work."

Response
The research for this reference is based in eastern Washington State mixed conifer forests, consequently, the results of this research do not have direct application to the SAFR project, especially since only approximately 8% of the SAFR project is considered mixed conifer. However, the concepts of equilibrium versus non-equilibrium patch dynamics of mixed conifer plant associations/landscapes may be worth studying in other mixed conifer ecosystems such as those found on the Sisters Ranger District.

British Columbia Ministry of Forests Research Program. 1998. Seral Stages across Forested Landscapes: Relationships to Biodiversity, Part 7 of 7. Extension Note 18. 8 pages.

Overview
This extension note is "….designed to raise awareness of landscape ecology concepts and to provide background for the ecologically based forest management approach recommended in the Biodiversity Guidebook. The focus here is seral stages."

Response
The SAFR project was proposed and based upon landscape ecology concepts by tiering to the Whychus Watershed Analysis (USDA, 1998)(EA page 21) and using the historic range of variability (HRV) concept (EA pages 91 and 92).

Wimberly, Michael C., Spies, Thomas A., Long, Colin J., Whitlock, Cathy. 2000. Simulating Historical Variability in the amount of Old Forests in the Oregon coast Range. Conservation Biology, Vol. 14, No. 1. Pages 167-180.

Overview
This research modeled the "….historical variability in the amount of old-growth and late-successional forest in the Oregon Coast Range over the past 3,000 years."

Response
This reference is not relevant to the SAFR project because it's geographic location is in the Oregon Coast Range, which is composed of completely different forest types than those found in the SAFR project.

Nonaka, Etsuko, Spies, Thomas, Wimberly Michael, Ohmann, Janet. 2004. Historical range of variability in biomass dynamics and stand disturbance history: A simulation approach. ESA 2004 Annual Meeting, Portland, Oregon. Poster Session 37: Forest Ecology. Poster Abstract.

Overview
The objective of this study was to characterize the HRV in live and dead wood biomass in the Oregon coast Range and to examine variability in stand development history."

Response
This reference is not relevant to the SAFR project because its geographic location is in the Oregon Coast Range, which is composed of completely different forest types than those found in the SAFR project.

Nonaka, Etsuko and Spies, Thomas A, . 2005. Historical Range of Variability in Landscape Structure: A Simulation Study in Oregon, USA. Ecological Applications, 15(5). Pages 1727-1746.

Overview
This study "….estimated the historical range of variability (HRV) of forest landscape structure under natural disturbance regimes at the scale of a phsiographic province (Oregon Coast Range, 2 million ha) and evaluated the similarity to HRV of current and future landscapes under alternative management scenarios.

Response
This reference is not relevant to the SAFR project because its geographic location is in the Oregon Coast Range, which is composed of completely different forest types than those found in the SAFR project.

Schowalter, Timothy D., and Withgott, Jay. 2001. Rethinking Insects, what would an ecosystem approach look like? Conservation Biology in Practice. Vol. 2, No. 4. 6 pages.

Overview
This paper is the same paper summarized in the news article that is reference #34. This paper proposes a new paradigm for "….the way land managers approach[ed] insects." "….many mangers and policymakers have not moved beyond a paradigm that views

insects as unconditionally threatening forces." "So what would an ecosystem approach to the most abundant and diverse animals on Earth look like? For one thing, insects would emerge as major architects of the plant world in terms of both structure and function. We would recognize their ability to regulate plant populations and community dynamics." "The challenge for conservation-minded managers is determining under what circumstances plants can take care of themselves versus knowing when to fall back on traditional methods of pest control." "when you have a highly destructive insect epidemic, what that really should be telling us is not that we have an insect problem, but that we have a forest health problem…"

Response
One of the objectives of the SAFR project is to "Improve forest health, sustainability, and resiliency….", consequently, the SAFR project proposes to address the root problem of forest health to avoid uncharacteristic/unwanted insect activity as suggested in this paper.

Pollet, Jolie and Omi, Philip N. 2002. Effect of Thinning and Prescribed Burning on Crown Fire Severity in Ponderosa Pine Forests. International Journal of Wildland Fire, Vol.11. Pages 1-10.

Overview
"This research quantitatively examined fire effects in treated and untreated stands in western United States National Forests. Four ponderosa pine sites….were selected for study." "We found that crown fire severity was mitigated in stands that had some type of fuel treatment compared to stands without any treatment. At all four of the sites, the fire severity and crown scorch were significantly lower at the treated sites. Results from this research indicate that fuel treatments, which remove small diameter trees, may be beneficial for reducing crown fire hazard in ponderosa pine sites." "Our findings indicate that fuel treatments do mitigate fire severity."

Response
The SAFR project proposes fuel treatments similar to those examined in this research (i.e., combinations of small tree thinning and prescribed fire) to do just what this research concludes: "…mitigate fire severity." and "…reduce crown fire hazard in ponderosa pine sites."

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 Society for invertebrate Conservation, Portland, OR. 82 pages.

Overview
The purpose of this paper is twofold: The primary goal of this research compilation is to bring together pertinent, peer-reviewed information for use by forest conservationists, managers, media personnel, and scientists regarding the management of insect pests in the temperate forests of western North America. Second, this paper dispels many commonly held misconceptions about forest insect pests." "Key findings include: 1) native forest pests have been part of our forests for millennia…. 2) fire suppression and

logging have led to simplified forests that may increase the risk of insect outbreaks, 3) forests with diverse tree species and age classes are less likely to develop large insect outbreaks, 4) there is no evidence that logging can control bark beetles or forest defoliators once an outbreak has started and 5) although thinning has been touted as a long-term solution to controlling bark beetles, the evidence is mixed as to its effectiveness."

Response
Without having used this reference, the SAFR project proposes to implement many of the guidelines recommended in this paper including: 1) maintain and restore high-quality late-successional and old-growth forest conditions; 2) ensure structural and species diversity when logging, including the retention of large trees and snags, downed wood; and canopy closure; 3) minimize soil compaction and harm to trees and tree roots when doing any thinning or logging; and 4) utilize prescribed fire to promote more natural forest conditions. Additionally, one of the objectives of the SAFR project is to "Improve forest health, sustainability and resiliency …..by reducing the uncharacteristically high levels of competing live vegetation…"; however, the project is not being done to address a current insect outbreak.

Hindmarch, Trevor D. and Reid, Mary L. 2001. Thinning of mature lodgepole pine stands increases scolyted bark beetle abundance and diversity. Can. J. Fore. Res. Vol. 31. Pages 1502-1512.

Overview
This research studied the "….abundance and diversity of secondary bark beetles in mature thinned and unthinned lodgepole pine, Pinus contorta Dougl. Ex Loud., stands (ca. 840 and 2500 trees/ha, respectively) near Whitecourt, Alberta." Their "….data suggest that the persistent changes in micro climate following thinning, especially increased wind, were partly responsible for thinned stands having more secondary bark beetles than unthinned stands."

Response
This study does not apply directly to the SAFR project as there are no lodgepole pine stands within the project area.

Baker, William L. 1994. Restoration of Landscape Structure Altered by Fire Suppression. Conservation Biology, Vol. 8, No. 3. Pages 763-769.

Overview
This research "….use[s] a spatial GIS-based simulation model to analyze the effects of reinstating a natural fire regime in the Boundary Waters Canoe Area, Minnesota, after 82 years of fire suppression.

Response
The research for this reference is based in the Boundary Waters Canoe Area, Minnesota, consequently, the results of this research do not have application to the SAFR project.

However, the concepts of reinstating a natural fire regime to an area that has experienced many years of fire suppression may be worth studying in ecosystems such as those found in the SAFR project area.

Metlen, Kerry L, Fieldler Carl E. 2006. Restoration treatment effects on the understory of ponderosa pine/Douglas-fir forests in western Montana, USA. Forest Ecology and Management 222. Pages 355-369.

Overview
This research "….focused on how restoration treatments influence the associated understory plant communities, particularly in the northern Rocky Mountains of the USA." "Taken collectively, results from our study suggest that all active treatments promote a more open overstory and diverse understory community - characteristics commonly associated with historically sustainable conditions."

Response
The SAFR project proposes to implement the same treatments conducted in this research, primarily thin and burn treatments, but also, burn only and thin only treatments. Since this research was conducted in ponderosa pine/Douglas-fir forests in Montana, we may not experience the same results as was found under this research project. However, if we have the same results on the SAFR project that was experienced under this research, then we could expect that our treatments will promote greater understory community diversity that was commonly associated with historically sustainable conditions.

Hanson, Chad T. and Odion, Dennis C. 2006. Fire Severity in Mechanically thinned versus unthinned forests of the Sierra Nevada, California. In: Proceedings of the 3rd International Fire Ecology and Management Congress, November 13-17, 2006, San Diego, CA. 3 pages.

Overview
Introduction: "The hypothesis of this study was that mechanically thinned areas on national forests would not differ in mortality from unthinned areas." Summary and Conclusions: "Mechanical thinning increased fire severity on the sites currently available for study on national forests of the Sierra Nevada. More study is needed to determine which factors, such as slash debris, midflame windspeeds, and brush growth, best explain this occurrence. Future studies may also explore whether there is a temporal aspect to this effect, as understory vegetation grows over time in response to reductions in forest canopy cover."

Response
The SAFR project proposes treatments similar to those recommended in reference 84 (also submitted for consideration), as scientific principles for fire-resilient forests. The results of this study suggest that mechanical thinning results in higher mortality than not thinning. It is not discussed or known whether the fuel treatments studied under this research followed the "scientific principles for fire-resilient, consequently, the SAFR

project is using the some of the most current treatments to reduce fire hazard and create fire-resilient forests.

Stephens, Scott L. and Moghaddas, Jason J. 2005. Silvicultural and reserve impacts on potential fire behavior and forest conservation: Twenty-five years of experience from Sierra Nevada mixed conifer forests. Forest Ecology and Management 125. Pages 369-379.

Overview
This research studied "….the efficacy of seven traditional silvicultural systems and two types of reserves used in the Sierra Nevada mixed conifer forests is evaluated in terms of vegetation structure, fuel bed characteristics, modeled fire behavior, and potential wildfire related mortality." "Overall, thinning from below, and old-growth and young-growth reserves were more effective at reducing predicted tree mortality."

Response
This research was conduced in mixed conifer forests in the Sierra Nevada, consequently, the application of the results to the SAFR project may be limited since the SAFR project is primarily ponderosa pine forests (91%) with minor amounts of mixed conifer (8%) and other forest types (1%). However, one of the primary silviculture treatments proposed for the SAFR project is thinning from below which was the most effective treatment at reducing predicted tree mortality of all the traditional silvicultural systems modeled in this research. In addition, all thinning from below treatments will be followed up with treatment of the thinning slash and the majority of the acres will also be treated with a combination of brush mastication and/or prescribed burning to address uncharacteristic levels of live and dead ground fuels. Under this study, "….all plantation treatments…did not effectively reduce potential fire behavior and effects, especially wildfire induced mortality at high and extreme fire weather conditions." The plantation treatments proposed in the SAFR project are being "….done with the objective to create or advance more structural complexity and to emulate natural/historical stand conditions.", and to "….emulate natural stand conditions that exist in older stands and will help produce more fire-resistant stands for the future."

Stephens, Scott L. 1998. Evaluation of the effects of silvicultural and fuels treatments on potential fire behavior in Sierra Nevada mixed-conifer forests. Forest Ecology and Management, Volume 105. Pages 21-35.

Overview
This paper models fire behavior in a mixed-conifer forest and investigates how silvicultural and fuels treatments affect potential fire behavior."

Response
The last sentence of the abstract of this paper supports the SAFR project as follows: “Combinations of prescribed fire and / or mechanical treatments can be used to reduce wild fire hazard.”

Peterson, D.L., Johnson, M.C., Agee, J.K., Jain, T.B., McKenzie, D., and Reinhardt, E.D. 2005. Forest structure and fire hazard in dry forests of the western United States. USDA Forest Service, Pacific Northwest Research Station. General Technical Report, PNW-FTR-628. 30 pp.

Overview
This document synthesizes the relevant scientific knowledge that can assist fuel-treatment projects on national forests and other public lands and contribute to National Environmental Policy Act (NEPA) analyses and other assessments."

Response
The second to the last sentence of the abstract of this paper supports the SAFR project as follows: “Effective fuel treatments in forest stands with high fuel accumulations will typically require thinning to increase canopy base height, reduce canopy bulk density, reduce canopy continuity, and require a substantial reduction in surface fuel through prescribed fire or mechanical treatment or both.” Additionally, the SAFR project will utilize the following scientific principles for fire-resilient forests outlined in this paper as follows: (1) reduce surface fuel, (2) increase canopy base height, (3) reduce canopy density, and (4) retain larger trees.

Fire

Noss RF, Franklin JF, Baker WL, Schoennagel T, Moyle PB (2006) Managing fire-prone forests in the western United States. Frontiers in Ecology and the Environment: Vol. 4, No. 9 pp. 481–487

Overview

Article originates from the unpublished report of a scientific panel to review issues related to the ecology and management of fire-prone forests partially in response to the Healthy Forests Restoration Act (HFRA). The article: describes complexity created by variability in fire regimes, that restoration is warranted where fire exclusion has led to substantial alterations in ecosystem qualities, cautions against post-fire logging and seeding, and advocates that a common sense conservation goal is to achieve forests that are low maintenance and require minimal repeated treatments.

Response
The SAFR project is essentially consistent with the principles stated in this article: the natural role of fire as a disturbance process and departure from historic conditions is described and, variability across the landscape is discussed in the EA. The SAFR project has no post-fire logging. The effects on forest vegetation and fuels from the actions proposed in SAFR will create more sustainable conditions.

Finney, M.A.; Cohen, J.D. 2002. Expectation and evaluation of fuel management objectives. In: fire, fuel treatments, and ecological restoration: conference proceedings. Gen. Tec. Rep RMRS-P-29. Missoula MT: USDA Forest Service, Rocky Mountain Research Station. p 353 – 366.

Overview
This report describes evaluating fuel management at multiple scales: a local/stand scale where treatments may influence fire behavior within the domain of the treated unit, and corresponding to the physics of home ignition, and a landscape scale which where the movement and intensity of wildfire is modeled spatially.

Response
The spatial effects of the SAFR alternatives are modeled and described at the landscape scale and risk of loss is used as one of the measures to describe effects. The SAFR project uses several of the points in this paper to describe effects of the alternatives.

Westerling, A.L., H. G. Hidalgo, D. R. Cayan, T. W. Swetnam 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity. Science 18 August 2006:Vol. 313. no. 5789, pp. 940 – 943.

Overview
Correlates wildfire activity and fire size to warming and earlier onset of spring conditions since the mid-1980's.

Response
The effects of the SAFR project proposed actions would allow wildfire occurrence to increase without increased risk to resource values.

Raymond, Crystal L. 2004. The Effects of Fuel Treatments on Fire Severity in a Mixed-Evergreen Forest of Southwestern Oregon. Masters Thesis, University of Washington.

Overview
A study of the relationship between fuel structure and fire severity. Fire behavior potential including crown fire is influenced by both crown and surface fuels characteristics.

Response
Treatments proposed in the SAFR project reduce surface fuel loading, increase canopy base height and reduce crown density while maintaining forest species resistant to damage from fire. Activity fuels are treated in the proposed actions.

Baker, William L., Veblen, Thomas T., Sherriff, Rosemary L. (2007). Fire, fuels and restoration of ponderosa pine-Douglas-fir forests in the Rocky Mountains, USA. Journal of Biogeography 34 (2), 251-269.

Overview
The aim of this article is to elaborate a new variable-severity fire model and evaluate the applicability of this model, along with the low-severity model, for the ponderosa pine-Douglas fir forests of the Rocky Mountains.

Response
This article introduces uncertainty into the discussion of fire regimes. Though the research applies to the Colorado Rocky Mountains, the notion that historic fire return intervals and severity is uncertain should be discussed. The SAFR project recognizes this variation and uses HRV as a reference point rather than a specific objective. The FRCC process, used in the SAFR project, allows for variation in each fire regime by allowing up to 33% departure from reference conditions for a condition class 1.

Schoennagel, Tonia, Veblen, Thomas T., Romme, William H. (2004). The interaction of fire, fuels, and climate across Rocky Mountain Forests. BioScience, July 2004, Volume 54, Issue 7, pp. 661-676.

Overview
This article addresses effectiveness of vegetation and fuels treatments in high, mixed and low severity fire regimes. Treatments are most effective in restoring low severity regimes, and least effective in high severity regimes. Mixed severity fire regimes are most variable and complex.

Response
Most treatments proposed in the SAFR project occur in the low severity fire regimes, where vegetation and fuels treatments are most effective in restoring historic conditions and reducing potential intense fire behavior.

Rhodes, Jonathan 2007. The Watershed Impacts Of Forest Treatments To Reduce Fuels And Modify Fire Behavior. Prepared for Pacific Rivers Council, P.O. Box 10798, Eugene, OR 97440. 541-345-0119. February, 2007.

Overview
This paper focuses on the impacts of mechanical fuel treatments and their effects on watershed and aquatic values. Includes recommendations for reducing fuel treatment effects.

Response
The SAFR project proposes thinning and some mechanical fuel treatment aimed at modifying forest vegetation and surface fuels in order to restore conditions that will allow the future use of fire to maintain desired conditions. Repeated mechanical treatments would be avoided.

Whitlock, Cathy 2004. Forests, fire and climate. Nature, Vol. 432, November 2004.

Overview
This article describes author's opinion regarding the complexity of fire regime determination and that time scale and long-term changes in climate are a factor in fire occurrence. Article suggests that one-size-fits-all treatments that do not consider long-term changes in climate may be in error.

Response
Proposed actions in the SAFR project are variable based on individual stand conditions. A one-size-fits-all approach is not proposed in the SAFR project.

Hessburg, Paul F., Salter, Brion R., James, Kevin M. (2004). Evidence for mixed severity fires in pre-management era dry forests of the inland northwest, USA. In Proceedings, Mixed Severity Fire Conference, Washington State University, Pullman, Washington.

Overview
This paper provides some evidence that mixed severity fires may have been much more common than currently believed, particularly in dry ponderosa pine forests.

Response
Conditions which would support fires of mixed severity are recognized in the SAFR project. The focus of proposed actions is to reduce conditions with potential to support high intensity fire behavior, to protect resource and adjacent land values.

Kotliar NB, Haire SL, Key CH. 2003. Lessons from the fires of 2000: Post-fire heterogeneity in Ponderosa pine forests. In: Omi PN, Joyce LA, Eds. Fire, fuel treatments, and ecological restoration. US Forest Service, Rocky Mountain Research Station, Ft. Collins. pp 277–79

Overview
This paper displays results from post-fire evaluations of several fires in 2000. Compares burn severity mapping from BAER (Burned Area Emergency Rehabilitation) and NBR (Normalized Burn Ratio) sources. Results show that a much of these fires burned at severities consistent with historic fire regimes.

Response
Restoring conditions consistent with historic fire regimes is considered in the SAFR project. The focus of treatment is to reduce fuel hazard, or those conditions which would support intense fire behavior in order to protect resource values.

USDA Forest Service (2001). Review and Update of the 1995 Federal Wildland Fire Management Policy.

Response
The SAFR project is consistent with findings and recommendations described in this document.

Westerling A.L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam (18 August 2006) Warming and Earlier Spring Increase Western US Forest Wildfire Activity, Science 313 (5789), 940. [DOI: 10.1126/science.1128834]

Overview
This research article showing that large wildfire activity increased in the mid-1980s, with higher large-wildfire frequency, longer wildfire durations, and longer wildfire seasons.

Response
The reduction in fuel hazard conditions proposed in the SAFR project would be effective with increased wildfire frequency, duration and longer fire seasons.

Rogers, Heather K. (2003). Investigation of Alternative Fuel Removal Strategies, Masters Thesis, College of Forest Resources, University of Washington.

Overview
This thesis looks at the potential for commercial value from forest vegetation treatments for fuel objectives. Findings are that positive revenue may be generated from forest vegetation treatments. High and moderate risk stands may be substantially lowered by thin-from-below treatments.

Response
Thin from below is the primary thinning prescription applied in the SAFR project.

Institute for Natural Resources. 2004. Report of the Forest Fuels and Hazard Committee to the Oregon Department of Forestry Oregon Fire Program Review. December 2004. Oregon State University, 140 pages.

Overview
This is a lengthy report to the Oregon Department of Forestry, Oregon Fire Program Review. The citation in the comments to the SAFR project, refer to the now familiar chart (originally from Agee, 2002) as shown below, Principles of Fire-Resilient Forests:

Reduce surface fuels
Increase height to live crown
Decrease crown bulk density
Keep larger trees

Response
The proposed actions in the SAFR project are consistent with these principles.

Rutherford V. Platt, Thomas T. Veblen, Rosemary L. Sherriff (2006) Are Wildfire Mitigation and Restoration of Historic Forest Structure Compatible? A Spatial Modeling Assessment Annals of the Association of American Geographers 96 (3) , 455–470 doi:10.1111/j.1467-8306.2006.00700.x

Overview
This article and others question the validity of restoring forest structure through thinning as an effective means to reduce or mitigate fire hazard. Reducing forest canopy cover via thinning can increase effective wind speed, and lead to dryer fuels.

Response
Thinning alone is not proposed in the SAFR project. Thinning is proposed in combination with treatments such as mowing and prewcribed burning that reduce surface fuel loading, so that the combined effect is a lower potential for surface fire intensity, increased crown base height and lower crown density. Large fire resilient trees are retained.

Finney, M.A, Cohen, J.D. (2003). Expectation and evaluation of fuel management objectives. USDA Forest Service Proceedings RMRS-P-29 2003.

Overview
This citation is used as a supporting article to the theme above, that canopy fuel reduction through crown thinning should be the least emphasized fuel treatment. This article supports that point. However the article does include the treatment in the following priority order:

Reduce surface fuels
Thin smallest trees to elevate the base of aerial fuels
Thin crowns to make difficult the transition to active crowning.

Response
The Alternatives 2 and 3 included in the SAFR EA, focus the analysis to provide the decision maker with information aimed at this point. Specifically, how does limiting crown thinning affect fuel reduction objectives. The sequence of treatments proposed reduces impact to the ground. It is more efficient and less impacting to soils to do commercial thinning (if prescribed) first, then precommercial thinning, and follow up with the fuels treatment done last. This ensures that any increase in surface fuels due to the thinning operations can be reduced with the fuels treatment.

Scott, Joe. 2003. Canopy fuels treatment standards for the wildland-urban interface. USDA Forest Service Proceedings RMRS-P-29. 2003.

Overview
This article describes canopy fuels treatment standards only, aimed at reducing crowning potential. The article contains the caution that using the described method for modifying

canopy fuels may lead to increased surface fire intensity due to increased wind and lower fine dead fuel moisture content.

Response
Canopy fuel reduction alone, is not proposed in the SAFR project. All thinning treatments are followed up with a surface fuel treatment which reduces fuel loading and results in lower potential fire intensity even at increased wind speeds and lower fuel moistures.

Omi, Philip N., Martinson, Erik J. (2002). Effect of fuels treatment on wildfire severity. Final Report, Western Forest Fire Research Center, Colorado State University, Joint Fire Science Program Governing Board march 25, 2002.

Overview
An investigation of the severity of four recent wildfires that burned into existing fuel treatment areas. Treatments included repeated prescribed fires, single prescribed fires, debris removal, and mechanical thinning both with and without slash removal. Results unanimously indicate that treated stands experience lower fire severity than untreated stands that burn under similar weather and topographic conditions.

Response
This study is part of a continuing effort to understand the interaction of weather, vegetation, fuels, and topography on wildland fire. The problem is complex but this study provides some useful data. The study supports the idea that modifying vegetation and fuels can have an effect on wildfire behavior as will be accomplished with the SAFR project.

Martinson, Erik J., Omi, Philip N. (2003) Fire behavior, fuel treatments, and fire suppression on the Hayman Fire, Part 3 Effects of Fuel Treatments on Fire Severity. Hayman Fire Case Study, pp. 96-126, USDA Forest Service, Rocky Mountain Research Station Gen. Tech. Rep. RMRS-GTR-114. Ogden UT.

Overview
This is a study of the relationship between fuels treatments and fire severity experienced in the Hayman Fire which occurred in Colorado 2002. The role played by the fuel conditions within the Hayman Fire severity was complex and does not lend itself to a single conclusion or simple summary. Nevertheless, each of the different types of fuel modification encountered by the Hayman Fire had instances of success as well as failure in terms of altering fire spread or severity. Fuel treatments can be expected to change fire behavior but not stop fires from burning.

Response
The implications of the results of this study that apply to the SAFR project include:

Under moderate wind and humidity conditions, recent prescribed burns appeared to have lower fire severity than older burns.

Landscape effects of treatment units and previous wildfires were important in changing the progress of the fire.

Fuel treatment size relative to the size of a wildfire is probably important to the impact on both progress and severity within the treatment unit. Large areas were more effective than small fuel breaks. Under extreme conditions, spotting easily breached narrow treatments and the rapid movement of the fire circumvented small units.

Fuel treatments may have been more effective in changing fire behavior if they were encountered earlier in the progression of the Hayman Fire.

Few fuel modifications had been performed recently, leaving most of the landscape within the final fire perimeter with no treatment or only older modifications. This is significant because the high degree of continuity in age and patch structure of fuels and vegetation facilitates development of large fires that, in turn, limit the effectiveness of isolated treatments encountered by the large fire.

USDA, USDI (2000). A Report to the President In Response to the Wildfires of 2000, Managing the Impact of Wildfires on Communities and the Environment. September 8, 2000.

Response
The report responds to the President's request on how best to respond to the severe wildfires of 2000, reduce the impacts of wildfires on rural communities, and ensure sufficient firefighting resources in the future. Short-term actions are also described to reduce immediate hazards to communities in the wildland-urban interface.

Carey, Henry, Schumann, Martha (2003). Modifying Wildfire Behavior – The Effectiveness of Fuel Treatments, The Status of Our Knowledge. National Community Forestry Center, Southwest Region Working Paper, April 2003.

Overview
This paper assesses existing research on the effectiveness of hazardous fuel reduction in changing wildfire behavior. The paper has an emphasis on whether commercial logging can be used to treat dense forest fuels. Lack of research addressing the effects of fuel treatments on fire severity is recognized in the paper.

Response
Key findings of the paper supporting the proposed treatments in the SAFR project include:

The literature leaves little doubt that fuel treatments can modify fire behavior. Factors such as distance from the ground to the base of the tree crown, surface vegetation and dead material play a key role.

Substantial evidence supports the effectiveness of prescribed fire, a treatment that addresses all of the factors mentioned above. Significantly, several empirical studies demonstrate the effectiveness of prescribed fire in altering wildfire behavior.

Finney, Mark A. 2001. Design of regular landscape fuel treatment patterns for modifying fire growth and behavior. Forest Science 47(2) 2001.

Overview
This paper describes how patterns of disconnected fuel treatment patches that overlap in the heading fire spread direction are theoretically effective in changing forward fire spread rate.

Response
The concept of the paper is included in the SAFR analysis through fire modeling. The fire modeling approach is restricted to surface and crown fire behavior. Assumptions in the model include no fire suppression, and spotting is excluded from the analysis.

Tiedemann, Arthur R., Klemmedson, James O., Bull, Evelyn L. (1999). 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.

Overview
This paper questions how well pre-settlement forest conditions are understood and the feasibility and desirability of conversion to a seral state that represents those conditions. The paper focuses on the effects of wide spread prescribed fire on forest productivity and wildlife habitat.

Response
The SAFR environmental assessment includes a thorough discussion of the effects of the alternatives on soil productivity and wildlife habitat.

Agee, James K., Skinner, Carl N. (2005). Basic principles of forest fuel reduction treatments. Forest Ecology and Management 211 (2005) 83-96, Elsevier.

Overview
This paper summarizes a set of simple principles important to address in fuel treatment: reduction of surface fuels, increasing the height to live crown, decreasing the crown density, and retaining large trees of fire-resistant species. Thinning and prescribed fire can be useful tools to achieve these objectives. Low thinning will be more effective than crown or selection thinning, and management of surface fuels will increase the likelihood that the stand will survive a wildfire.

Response
Treatments proposed in the SAFR project are consistent with the principles described in this paper. The effects of two types of thinning (Alternatives 2 and 3) are analyzed in detail in the SAFR environmental assessment.

Mason, C. L., Cedar, K., Rogers, H., Bloxton, T., Comnick, J., Lippke, B., McCarter, J., and K. Zobrist. 2003. Investigations of Alternative Strategies for Design, Layout and Administration of Fuel Removal Projects. Rural Technology Initiative. July 2003.

Overview

This report develops analysis components for effective fire risk reduction strategies to help professionals, publics, and policy-makers gain a better understanding of the current circumstances and alternatives. A range of thinning strategies were simulated and evaluated for the Okanogan and Freemont National Forests providing a set of results for comparative climatic and infrastructure conditions. Measures of fire risk reduction, economic cost, habitat protection, and carbon sequestration were evaluated, to develop the basis for characterizing both market and non-market values resulting from forest fires and fire risk reduction activities. The market cost of removing enough small diameter material to reduce fire risk sometimes exceeds the market value for the material removed. However, non-market benefits of reduced fire fighting and rehabilitation costs, facility losses and fatalities, protected habitats, sequestered carbon, saved water and other public values appear to more than offset treatment costs. Contracting alternatives and infrastructure needs are also evaluated. Treatment strategies can be customized to local forest and market conditions, providing the basis for management training as well as public education.

This report provides parametric data on treatments that reduce fire risk, including their costs, market values, non-market values, and contracting issues. Specific examples can be used to customize strategies for a wide range of forest, infrastructure and market conditions. The information is also useful in training operators on how to design and layout fuel reduction treatments.

This report also demonstrates how an integrated forestry software package can assist federal agencies and other interested users in gaining greater efficiencies in planning fire risk reduction treatments to achieve multiple values with less conflict and less cost. The Landscape Management System (LMS) provides a sophisticated user-friendly software environment from which professional and public users with little training can participate in analysis of complex data to better understand the consequences of management alternatives. The results from case study analysis of two National Forests, presented in this report, demonstrate that fire risk can be effectively reduced while creating and protecting other positive environmental, economic, and social values.

Response
The Landscape Management System (LMS) described in the above paper was not used for the SAFR project. Thinning regimes were analyzed in the SAFR environmental assessment in relation to the Upper Management Zone, reduction of crown bulk density, and the affects of thinning on insects and disease.

Irwin, L. L., and T. Bently Wigley. 2005. Relative risk assessments for decision-making related to uncharacteristic wildfire. Forest Ecology and Management 211 (2005) 1-2.

Overview
This volume is a special issue of Forest Ecology and Management that stems from a November 2003 conference in Portland, Oregon. The conference was held to advance tools and procedures for relative risk assessments. Specifically, the conference addressed tools and information necessary to assess short-term risks and benefits associated with ecological restoration to prevent uncharacteristic wildfires, and the long-term risks and benefits of no such restoration. Managers often take positions based on a precautionary principle because of short-term affects on various resources, including possible impacts to species managed under the Endangered Species Act. The conference notes that tools are lacking to define short-term risk thresholds as well as assessing the long-term effects of not taking action. In such situations short-term risk-adverse positions prevail.

Response
The risk of wildfire to at risk communities is outlined in depth in the Greater Sisters Country Community Wildfire Protection Plan. The Plan was developed under the auspices of the Healthy Forest Restoration Act, and included the delineation of a Wildland-Urban Interface to guide the treatment of hazardous fuels in relation to at-risk communities. The environmental assessment describes the short-term risk of no-action (Alterntive1) and the various effects to resources in the two action alternatives (Alternative 2 and 3). Short risks and long term benefits are outlined in Chapter 3 of the environmental assessment.

Finney, M. A. and J. D. Cohen. 2003. Expectation and Evaluation of Fuel Management Objectives. USDA Forest Service Proceedings RMRS-P-29.

Overview
This paper proposes a methodology to provide realistic expectations in regards to solving specific problems regarding fuel management objectives. The benefits of treatments can only be realized when applied at the appropriate scale to the appropriate source of the problem. Scales range from site or stand-level to the landscape-level, but apply differently for the purposes of benefiting wildland values than for increasing home survivability. This process to finding solutions is framed in terms of “fire risk management” or the reduction of “expected loss.” This conceptually depicts the way treatments can influence fire behavior and thus produce benefits by reducing losses and it avoids the unrealistic expectations that fuel management will stop wildfires and prevent homes from burning. The paper outlines expectations of fuel treatments and the reality often associated with them. The responsibility of home owners who live in the forest interface is also discussed.

Response
The methodology described in this paper was not used directly to design the SAFR project but many of the concepts outlined in this paper were incorporated into project

design. The SAFR project looked at both stand-level treatments and the combination of treatments at the landscape level (i. e. the Wildland-Urban Interface). The project will change fuel attributes such as lower crown bulk density across the landscape, which was identified as vital in this paper, as well as creation defensible space adjacent to housing developments. These activities will not remove fire from the landscape but in combination should help wildland fire fighters with fire suppression activities and provide for safe egress of the public in the event of a wildfire event.

Westerling, H. G., Hildalgo, D. R., Cayan, D. R., and T. W. Swetnam. 2006. Warming and Earlier Spring increase Western U. S. Forest Wildfire Activity. Science 313 (5789), 940.

Overview
This article investigates the role of climate change in relation to the increase in the Western United States forest wildfire activity. The authors complied a comprehensive database of large wildfires in the western United States since 1970 and compared it with hydoclimatic and land surface data. They show that large wildfire activity increased suddenly and markedly in the mid-1980s, with higher large-wildfire frequency, longer wildfire durations, and longer wildfire seasons. The greatest increases occurred in mid-elevation, Northern Rocky Mountain forests, where land-use histories have relatively little effect on fire risks and are strongly associated with increased spring temperatures and an earlier snowmelt. They conclude that the overall importance of climate change in wildfire activity underscores the urgency of ecological restoration and fuels management to reduce wildfire hazard to human communities and to mitigate ecological impacts of climate change to forests that have undergone substantial alterations due to past land uses.

Response
The purpose and need of the SAFR project and project design reflects the conclusions arrived at in the article. The project will reduce hazardous fuels adjacent to communities at risk while at the same time reintroducing the historic role that fire played in the landscape. The project will reduce stand densities in second growth and Late and Old Structure conifer stands in order to return stands to the Historic Range of Variability, helping to meet ecological restoration goals over the short and long term. Thinning from below will leave the largest trees at any specific location and density management should help redistribute site resource such as nutrients and water to better help individual trees and forest stands withstand changes in climate that are predicted for the future.

Fish

Huston, M., Gomezdelcampo, E., and R. S. Nestruck. Linking Topography, hydrology and biodiversity to understand terrestrial Impacts on Aquatic Systems. (No date). Interdisciplinary Solutions for Environmental Sustainability (ISEIS).

Overview
The paper reviews general relationships between disturbances in a watershed and erosion rates, productivity and diversity of species. Some references related to wildfire as a disturbance agent and effects of clearcutting.

Response
The large scale disturbances reviewed in this paper may not be directly applicable to SAFR because the scale of disturbance of thinning small trees is not to the magnitude of wildfire or clearcutting. The watershed does not have a large wildfire that overshadows or causes cumulative effects to Whychus Creek. The removal of vegetative cover is not that drastic over existing conditions that would lead to such large scale changes that are generalized in this paper. The watershed is not prone to landslides, especially in the project area and the disturbances caused by thinning and burning will not increase the risk of landslides.

The disturbance patterns reviewed in this paper were taken into account both in the watershed analysis and in the SAFR EA effects analysis. Due to the high infiltration rates and flat topography of the soils of the project area, these potential changes to watershed condition were reviewed and discounted in the EA. There is little to no runoff in the project area and the disturbance and removal of small trees were not found to cause the watershed scale effects reviewed in this paper. Also, buffers on cutting large trees were part of the PDFs of the EA and these would protect natural inputs of wood for fish habitat.

The ecological concepts in this paper are general and not new to watershed management. Some of the conclusions a over generalized and may not account for ecosystems that are regulated by natural disturbance patterns and would degrade from a lack of disturbance, such as wildfire. The papers scope is broad and does not offer details for changed management approaches. The paper offers to increase the recognition of these disturbance processes, which we already have addressed in the EA and far as flood and fire regimes.

The paper adds to the knowledge of fish response to wildfire in the aspect of growth and temperature. It does not change the conclusions of the EA because similar changes to canopy are not proposed in the EA.

Halosky and Hibbs. Fire Severity and Post-Fire Vegetation Recovery in Riparian Areas of the Biscuit and B&B Complex Fires, Oregon.

Overview
The conditions that determine wildfire intensitiy and mortality of trees in riparian areas is presented in this paper, with the B&B Fire as a study site. The study concludes that riparian tree density can increase bare soil in riparian areas but upland severity is strongly related to riparian burn intensity. Stream width decreased burn intensity in riparian areas. Also, steep drainages burned more intense, likely because fire burns hotter uphill.

Response
By thinning the uplands in ponderosa pine, riparian areas may be protected from intense wildfire from the uplands.

Although we made no claim in the SAFR environmental assessment on the effects of wildfire on riparian areas post thinning, the conclusions from the paper of low tree density in the uplands can reduce burn intensity in riparian areas is consistent with the objectives and intent of the SAFR project. In relation to Whychus Creek, the size of the creek would also serve to reduce the effects of wildfire, even if it is not thinned in the project.

The conclusions of the effects of the project would not change with this paper. The recovery part of the riparian vegetation is not completed for the B&B Fire in this paper. But because no large treatment in the riparian area are proposed in SAFR, this information does not change the conclusions.

Soils

Brooks J.R., F.C. Meinzer, R. Coulombe, J. Gregg; 2002. Hydraulic redistribution of soil water during summer drought in two contrasting Pacific Northwest coniferous forests. Tree Physiology 22, 1107-1117.

Overview
Brooks et al. investigate the importance of hydraulic redistribution of water by root systems of living trees. They conclude that in the Pacific Northwest forests, hydraulically redistribution water in the soil profile can constitute a significant fraction of the evapotranspiration during the summer months. They also conclude that this redistribution of water may benefit seedling establishment in these forest types.

Response
Vegetation treatments proposed in the Sisters Area Fuels Reduction (SAFR) project would not remove all of the overstory trees. Thus there would still be an overstory of trees which could function in redistribution of water in the soil profile. In addition the amounts of soil moisture which might be redistributed by live trees would be expected to be minor compared to than transpired by the trees on the site. Thus removing some of the vegetation from overstocked stands will increase the available water in the soil profile over the growing season.

US Forest Service; 2008. The potential of U.S. forest soils to sequester carbon and mitigate the green house effect ISBN: 1-5667-0583-5.

Overview
As global warming concerns increase society looks increasingly for ways to increase carbon sequestration. Research has shown that the while the ability of forest soils to sequester carbon is finite there may be some potential to increase sequestration in some soil types.

Response
During the planning of the SAFR Project the issue of increased carbon sequestration in forest soils to address global warming was considered beyond the scope of the project.

Pierce P.L., Meyer G.A., A.J. Jull; 2004. Fire-induced erosion and millennial-scale climate change in northern ponderosa pine forests. Nature Vol 432.

Overview
Pierce et al. describes the changes in ponderosa pine forest structure and function due to decades of fire suppression in the ecosystem adapted to historic frequent fire occurring about every ten years. They cite increased stand densities, fire suppression, and grazing as major contributors to the resulting stand replacing wildfires which many of these ecosystems have experienced in recent years. These authors also discuss fire induced erosion resulting from wildfire.

Response
While this specific article was not cited in the soils report the issues were considered. Planned vegetation treatments in the SAFR project are designed to address the issue of over stocked stands and plans for prescribed fire are intended to lower the risk of wildfire and the resulting negative effects of wildfire in terms of effects on soil erosion.

Belsky J.A. and Blumenthal D.M. 2008. Effects of livestock grazing on stand dynamics and soils in upland forest of the interior west. Conservation Biology Vol. 11, No.2.

Overview
Belsky et al. point out the effects of grazing and fire suppression on natural processes in ponderosa pine forest.

Response
Again, planned vegetation treatments in the SAFR project are designed to address these issues and therefore restore many of the functions cited as “missing” in these ecosystems.

Madany M.H., and N.E.West; 2008. Livestock grazing-fire regime interactions within montane forests of Zion National Park, Utah. Ecology Vol.64, No.4 pp661-667.

Overview
Madany et al. (2008) discuss the effects of historic grazing on the understory of ponderosa pine forest in the Southwest. They point out that historic grazing has had an effect on both fire return intervals and current vegetation types.

Response
The SAFR area consist of predominantly a brush understory which has resulted from fire suppression in much of the area. Vegetation and prescribed fire treatments are planned

that will both reduce the risk of fire and promote a vegetation structure which historically occurred on the site.

Wildlife

Thompson, J. 2006. Rocky to Bullwinkle: Understanding Flying Squirrels Helps us Restore Dry Forest Ecosystems. Science Findings. Issue 80.

Overview
The paper discusses flying squirrels and northern spotted owls.

Response.
The SAFR project occurs outside of the range of the spotted owl. There will be No Effect to spotted owls or their habitat associated with this project. The flying squirrel is not identified as a Threatened, Endangered, Candidate, or Sensitive species. The flying squirrel is also not identified as a Management Indicator Species. Therefore, the flying squirrel was not analyzed for the SAFR project.

Bull, E.V. 2002. The Value of Course Woody Debris to Vertebrates in the Pacific Northwest. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181.

Overview
This paper describes the importance of course woody debris to birds, mammals, amphibians, and reptiles. The paper also states that the importance of dead wood for wildlife and ecosystems has been realized, there are still some information gaps. The paper also states that there continues to be conflicts in retaining logs and lowering fuel levels to reduce the risk of wildfires. There are no recommended levels of snags or down wood identified in the paper.

Response
This paper was not utilized for the SAFR project. However, the importance of snags and down wood was addressed in the SAFR environmental assessment and wildlife report. Snags and down wood are not targeted for removal with the SAFR project. Below are mitigation measures and recommendations that were used for the SAFR project.

Mitigation Measures

- Harvest activities, both pre-commercial and commercial, will retain all existing snags greater than or equal to 10 inches dbh except where they create a safety hazard. Standing dead trees, which present a safety hazard, would be felled and left in place.
- Apply a sufficient buffer of live trees around existing snags to minimize the need to fall snags as hazard trees during logging operations.
- During prescribed fire operation, consumption of down wood at least 12 inches diameter at small end and at least 6 feet in length at rate of 40 lineal feet per acre in ponderosa pine and 140 lineal feet per acre in mixed conifer will not exceed 3

inches total (1 ½ inches per side) in order to meet Forest Plan Amendment #2 (USDA 1995).

Recommendations

- During prescribed fire operations consider lining large snags (i.e. 21 inches dbh or larger) that are at a high risk of consumption.
- Consider spring burning (when 1,000 hour fuel moistures are higher) to decrease the chances of large snag and down wood consumption.

The SAFR project meets the Forest Plan Amendment #2 (also known as the Eastside Screens) for snags and down wood.

Machmer, M. 2002. Effects of Ecosystem Restoration Treatments of Cavity-nesting Bird, Their Habitat, and Their Insectivorous Prey in Fire-maintained Forests of Southeastern British Columbia. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181.

Overview

The paper discusses the effects of prescribed fire, partial harvest, and prescribed fire with partial harvest on cavity nesting birds and their prey. Preliminary results from the study indicate that harvested treatment areas showed a decrease in nesting density and species richness in the short-term. Harvest treatment was a "shelterwood with reserves". Tree densities were dropped to 14.6 to 10.5 trees per acre ranging from 7.9 to 25.6 inches dbh ponderosa pine and Douglas-fir; 8.1 to 2.1 trees per acre ranging from 5.9 to 7.9 inches dbh. Management implications from the study suggest: wildlife tree patches should be established in all areas planned for restoration treatment, an abundance of high value dead trees should be retained as individual clumps representing a range of decay classed favoring the largest diameter snags, to minimize loss of snags during prescribed fire treatments line snags and /or use fire retardant, to enhance cavity nester forage combine partial cutting in combination with prescribed fire, and consideration for a burn only prescription to create higher densities of dead wood for cavity nester forage areas.

Response

This paper was not utilized for the SAFR project area. The treatment of "shelterwood with reserves" is not a prescription that will be utilized for the SAFR project. The prescription utilized for SAFR is a thin from below method. We anticipate at least 40 to 50 trees per acre remaining in the 8 inch dbh and above as opposed to this study where trees per acre greater than 7.9 inches dbh were reduced down to 14.6 to 10.5 trees per acre. In addition no trees larger than 21 inches dbh will be harvested. Most areas identified for thinning treatments will also have prescribed fire as suggested by the study.

Mitigation measures for the SAFR project include:

- In areas identified for thinning and mastication - Approximately 10 percent of each thinning unit will be left in clumps to provide visual screening throughout the area. This applies to all treatments including plantations except within designated defensible space.

- Harvest activities, both pre-commercial and commercial, will retain all existing snags greater than or equal to 10 inches dbh except where they create a safety hazard. Standing dead trees, which present a safety hazard, would be felled and left in place.
- Apply a sufficient buffer of live trees around existing snags to minimize the need to fall snags as hazard trees during logging operations.

Recommendations for the SAFR project include:

- During thinning activity vary spacing to mimic more natural patterns found on the landscape.
- During prescribed fire operations consider lining large snags (i.e. 21 inches dbh or larger) that are at a high risk of consumption.
- Consider spring burning (when 1,000 hour fuel moistures are higher) to decrease the chances of large snag and down wood consumption.

The mitigation measures and recommendations outlined above for the SAFR project address the management implications of this paper.

Maquire, C.C. 2002. Dead Wood and the Richness of Small Terrestrial Vertebrates in Southwestern Oregon. USDA Forest Service Gen. Tech. Rep. PSW-GTR-181.

Overview
The paper discusses dead wood as it relates to in Southwestern Oregon. The only species that was discussed in the paper that is a Threatened, Endangered, Candidate, or Sensitive species was the Oregon Spotted Frog.

Response
For the SAFR project two habitat types were utilized to discuss snags and down wood. They were Eastside Mixed Conifer and Ponderosa Pine/Douglas-fir. Southwestern Oregon habitat types differ from these two habitat types. In addition there is no suitable habitat (marshes) for the spotted frog within the SAFR project area. Snags and down wood are not targeted for removal with the SAFR project. Below are mitigation measures and recommendations that were used for the SAFR project.

Mitigation Measures

- Harvest activities, both pre-commercial and commercial, will retain all existing snags greater than or equal to 10 inches dbh except where they create a safety hazard. Standing dead trees, which present a safety hazard, would be felled and left in place.
- Apply a sufficient buffer of live trees around existing snags to minimize the need to fall snags as hazard trees during logging operations.
- During prescribed fire operation, consumption of down wood at least 12 inches diameter at small end and at least 6 feet in length at rate of 40 lineal feet per acre in ponderosa pine and 140 lineal feet per acre in mixed conifer will not exceed 3

inches total (1 ½ inches per side) in order to meet Forest Plan Amendment #2 (USDA 1995).

Recommendations

- During prescribed fire operations consider lining large snags (i.e. 21 inches dbh or larger) that are at a high risk of consumption.
- Consider spring burning (when 1,000 hour fuel moistures are higher) to decrease the chances of large snag and down wood consumption.

The SAFR project meets the Forest Plan Amendment #2 (also known as the Eastside Screens) for snags and down wood.

Andrews, L.S., J.P. Perkins, J.A. Thrailkill, N.J. Poage, and J.C. Tappeiner II. 2005. Silvicultural Approaches to Develop Northern Spotted Owl Nesting Sites, Central Coast Ranges, Oregon. WJAF 20(1).

Overview
The paper discusses the northern spotted owl.

Response.
The SAFR project occurs outside of the range of the spotted owl. There will be No Effect to spotted owls or their habitat associated with this project.

Lekhkuhl, J. F. 2004. Wildlife Adaptations and Management in Eastside Interior Forests with Mixed Severity Fire Regimes. Proceedings. Mixed Severity Fire regimes: Ecology and Management. November 17-19 2004. Spokane, Washington.

Overview
A wildlife species habitat database was used to assess the percentage of breeding species associated with early-and-late seral conditions, snags and down wood in three interior forest types with low, moderate, and high fire severity fire regimes. Analysis showed that fauna in the mixed severity East-side Conifer Forest of eastern Washington and Oregon was a mix of faunal elements from low severity ponderosa pine and high severity Montane Mixed Conifer Forests. Most species were classed as seral/Structural generalists (44%) or closed-canopy associates (40%). The fitness value of a landscape for a particular species will be both the amount and connectivity of habitat. Critical will be the restoration of old single-story forest of ponderosa pine and western larch, as well as sustaining multi-story late-seral old forest. The life history of each, e.g. mobility to habitat patchiness needs to be considered to design fuel and forest restoration management projects.

Response
The SAFR projects will provide many of the structural elements outlined in this paper. The project will convert some Multi-story late and Old Structure Forest to Single-story

Late and Old Structure Forest in the planning area. Single-story Late and Old Structure in the planning area is below the Historic Range of Variability. The project will also maintain habitat connectivity in the planning area. Key stand level habitats such as large trees, snags, and down wood will also be maintained, and in some instances enhanced, through density management in Multi-story Late and Old Structure Forests to maintain large old ponderosa pine trees in the project area. Fuels treatments should also help to prevent high severity wildfires to maintain habitats for wildlife species that prefer low intensity fire regimes.

Planning

Gisiger, T. 2001. Scale invariance in biology: coincidence or footprint of a universal mechanism. Bio. Rev.76: 161-209.

Overview
This paper provides a review of recent work on complex biological systems which exhibit no characteristic scale. The paper presents a brief introduction to the concepts of absence of characteristics scale (power-law distributions, fractals, and 1/f noise. The paper reviews typical mathematical models exhibiting such properties as edge of chaos, cellular automata and self-organized critical models.

Response
This theoretical paper is beyond the ability of this reviewer to understand in addition to determining what demonstrated relevance, if any, to the SAFR project.

Swanson, F. J., Jones, J. A., Wallin, D. O., and J. H. Cissel. 1994. Natural variability: Implications for Ecosystem Management. In: Eastside Forest Ecosystem health Assessment – Volume II: Ecosystem management principles and applications. Gen. Tech. Rep. PNW-GTR-318. Portland, Oregon. pp 89-106.

Overview
This paper describes the importance of the use of the historical variability of ecosystem conditions and the natural disturbance regimes to design ecosystem management systems. Examples include the Blue Mountain Assessment, a broad-scale assessment, and the Augusta Project, Willamette National Forest, a small-scale assessment of both the range of natural conditions and the range of natural disturbance regimes.

Response
Many of the concepts described in this paper were used to design the SAFR project, including the description of the Desired Future Condition (based on the historic conditions for pine forests found in the project area) verses the Existing Condition to frame the Need for the Project; the use of Fire Regimes/Condition Class; and the Historic Range of Variability to described and document Late and Old Structure conifer stands in the project area. The SAFR project seeks to reintroduce the role of fire to the area and restore Late and Old Structure Forests, all aspects of the natural variability of the pine dominated project area.

Nabhan, G. P., Coder, M., Smith, S. J., and Z. I. Kovacs. No date. Land use history impacts on biodiversity – Implications for management strategies (Western U. S.): Final Report. National Commission on Science for Sustainable Forestry.
Overview
This report looks at the prevailing benchmark(s) for restoration in the Southwestern United States (a presumed "pre-settlement" reference condition for ponderosa pine) and concludes that benchmark conditions do not often adequately describe the range of historic conditions found in other ponderosa pine forests in the region, let alone mixed conifer or pinyon pine forests. The authors reject the use of a single benchmark and endorse a broader reference envelope based on site-specific conditions. They conclude that climate change has been an important shaper of modern Southwest woodlands and forests.

Response
While this paper specifically deals with forests outside the SAFR planning area, some of the management implications suggested in this paper apply to the project and were incorporated into project design. These include 1) knowledge of the areas history - information contained in the Whychus Watershed Analysis was used to determine the Historic Range of Variability used to describe Late and Old Structure forests in the planning area; and 2) Use of forest and stand level objectives to provide for ecological integrity, sustainability and resilience – the SAFR project will reduce stand densities to increase the availability of site resources such as water and nutrients, improve forest health by making trees more resistant to insects and disease, and reintroduce the role of fire to maintain pine stands in their historic condition; 3) provide for high native biodiversity and landscape heterogeneity – the SAFR project will treat stands above the Upper Management Zone to provide for stand level diversity and to maintain the full compliment of tree and shrub species found on site.

Daigle,P and R. Dawson. 1996. Extension Note 07. Management Concepts for Landscape Ecology (Part 1 of 7). October 1996. British Columbia: Ministry of Forests Research Program.

Overview
This short paper provides an overview of landscape ecology principles that could be used in project planning. These concepts include using a multi-disciplinary team approach to planning including a landscape analysis and design phase and the use of spatial and time frames including the Historic Range of Variability.

Response
As with all Forest Service projects, the SAFR project used an interdisciplinary team to design and analyze the project. Information contained in the Whychus Watershed Analysis was used extensively to help define the existing condition of the project area and the desired future condition. The Historic Range of Variability was used to define the need to treat Multi-strata Late and Old Structure Forests and to determine that Single – strata Late and Old Structure Forests were below the Range of Historic Range of

Variability. The project also looked at the Fire Regimes/Condition Class associated with ponderosa pine forests to determine the ecological role of fire and need for the reintroduction of fire in the project area to bring conifer stands to the desired future condition.